

Implementing Electronic Trading at the New York Stock Exchange

A Case of Organizational Change

Project Report PAD 724
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1 Problem definition

When thinking of the New York Stock Exchange (NYSE) one may picture a loud and boisterous place, a crowd clustered around the specialists' posts, and much shouting for an eighth of a dollar of price improvement. If one were to visit the New York Stock Exchange now, it would render a surprise for most visitors. Today, the same trading floor is empty and quiet.¹ The picture of the Exchange as loud and boisterous roots in the history of the NYSE as an auction market. In this auction market a specialist who is the market maker, conducts an auction for specific stocks and allows for negotiation over the price.² This often loud and hectic process was symbolic for the New York Stock Exchange. It rooted in the beginnings of the Exchange in the 18th century when traders held auctions on Wall Street. In 1792, 24 of them signed the Buttonwood Agreement under a buttonwood tree, agreeing to give each other preference in the trading of specific securities and to charge a fixed commission.³ This agreement formed an organization which still exists today and which is often even regarded as a national symbol. Its trading process was boisterous, but as an organization it portrayed both stability and strength and the image of a conservative gentlemen's club. Most of the customers' orders were matched by a specialist who makes the market for the stocks of a specific or several corporations. According to the Exchange, providing for a fair and orderly auction process, matching orders, stepping in with their own capital to minimize imbalances and stabilizing prices is the job of the specialist.⁴ The specialists used to be a very strong force at the New York Stock Exchange that helped shape its outside image and reputation.

This reputation of the NYSE was damaged when the former CEO of the Exchange, Richard Grasso, got involved in a scandal about his outrageous pay and retirement package which was considered inappropriate for a CEO of a non-profit company. The scandal broke after Grasso tried to cash in his 140 million retirement money. Gasparino reports that Grasso's colleagues and friends asked to him to resign, only a few weeks after they had approved his pay package. "The same board of directors that had ap-

¹ Cf. Steverman, Ben: NYSE: Hooray for Market Volatility, in: Business Week Online (2007), Issued 5. Nov. 2007, p. 25.

² At the New York Stock Exchange, the market maker is called a specialist. "Specialists on the trading floor are charged with maintaining fair, orderly and continuous trading markets in specific stocks by bringing buyers and sellers together and, when circumstances warrant, adding liquidity by buying and selling stock for their own account." (NYSE Group, Inc.:Annual Report 2006, 2007a, p. 4).

³ Cf. Blume, Marshall E., Jeremy J. Siegel and Dan Rottenberg: Revolution on Wall Street: The Rise and Decline of the New York Stock Exchange, New York, London 1993, pp. 22-23.

⁴ Cf. NYSE Euronext: Types of Members, [Home > Products & Services > NYSE Equities > Trading Licenses > Overview > Types of Members], accessed 24. Oct. 2007: <http://www.nyse.com/productservices/nyseequities/1167954368183.html>.

proved his taking the money, 9/11 bonus and all, just a few weeks earlier now wanted him out.”⁵ In a 13 to 7 vote he was asked to resign.

Grasso finally was replaced by Thain, the former co-president of Goldman Sachs. He represented the large institutional customers and owners of the Exchange. With him came a major shift in the way the New York Stock Exchange does business. In 2001, as Figure 1-1 shows, the NYSE under Grasso had already enabled purely electronic trading for small orders. This meant that these small orders were matched by a computer instead of having the human intervention of the specialist. Since it concerned small orders only, the way of doing trading changed incrementally only. In 2004, however, it changed radically when the limit on the size of orders that could be handled electronically got removed. Thain also arranged a merger of the New York Stock Exchange with Archipelago, a purely electronic trading platform. Then, over the period of 2005 to 2007 the Exchange implemented the Hybrid Market. This is a form of trading that allows the customers to trade electronically. They can choose whether their order gets executed by a computer or whether their orders are routed to the specialist.

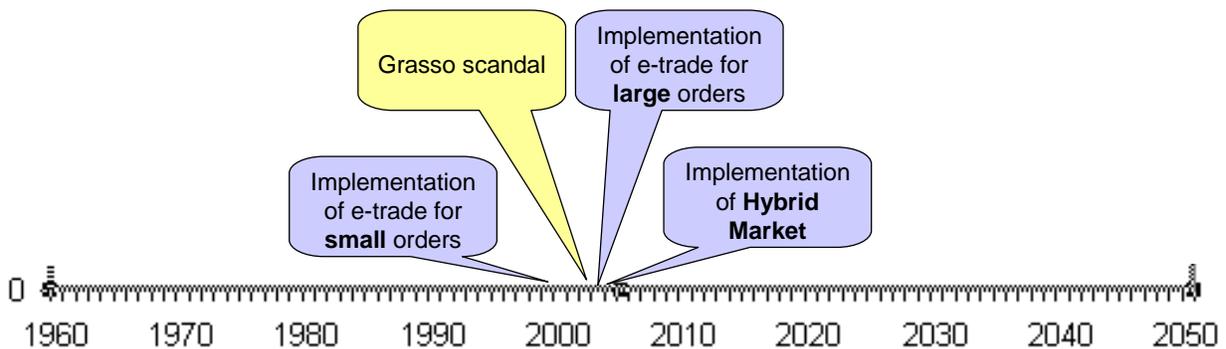


Figure 1-1: Course of events

Institutional customers make use of the electronic trading possibilities.⁶ As a consequence, the trading floor is quiet now. The area of the trading floor got cut in half.⁷ Most surprisingly, the NYSE inflicted damage on its floor brokers and specialists who until quite recently had great influence in the Exchange’s board and were the symbol for the institution.

How did this change away from the specialist system towards electronic trading come about? The reasons for this change seem obvious. Many of the NYSE’s competitors implemented electronic trading

⁵ Gasparino, Charles: King of the Club: Richard Grasso and the Survival of the New York Stock Exchange, New York 2007, p. 3. See also pp. 273-281.

⁶ Cf. McGeehan, Patrick: Next to Downsize On Wall Street? The Exchange Floor, in: New York Times (2007), Issued 23. Sep. 2007, p. 37.

⁷ Cf. McGeehan: Next to Downsize On Wall Street, 2007, p. 37.

much earlier. NASDAQ, for example, an electronic communications system and later purely electronic stock exchange and NYSE's largest competitor today, was founded in 1971. The Cincinnati exchange implemented an electronic system in 1978.⁸ Nevertheless, concerning the implementation of automated trading, it took the NYSE 25 years to follow suit; and even short before the implementation of electronic trading, there were many voices uttering that it was not likely to happen soon.

“... change at the NYSE is likely to be incremental at best -- with the interests of his seat holders remaining a matter of paramount importance. Elimination of the exchange's floor-trading system, as urged by some exchange critics, ... is not about to happen. The specialists are the exchange... [...]. Specialists and floor brokers are likely to continue to hold sway at the exchange, for the simple reason that they own it and dominate its corporate culture.”⁹

It thus seems interesting to analyze what made this change happen at all, what made it happen at this point of time, and to ask why it had been put off for so long, but not any longer. It will also be interesting to see whether the exchange could have followed a different path and implemented electronic trading earlier or maybe not at all.

In the quote above, some crucial factors which have an influence on changes at the New York Stock Exchange and its implementation of electronic trading are already mentioned. Critics urge against the floor-trading system, i.e. the specialist system, but specialists and floor brokers—those for whom involvement in trading is the primary source of income—urge for the retention of the old system. A further important aspect that is mentioned is the strong (specialist-based) corporate culture.

Yet, the specialist-based culture is not represented many specialist firms any more. In 1990, there were about 40 specialist firms, and people remembered times when there used to be about 150. By 2003, the number of specialist firms had shrunk to about 20, and now there are six firms left. The number of specialists themselves also fell steeply after the implementation of electronic trading. Whereas there were about 400 individuals working as specialists two years ago, there are just above 200 now.¹⁰ Over the last years, many specialist firms consolidated; many just left.

Thus, there are three areas of interest for the analysis of the NYSE's shift towards electronic trading. First, it will be important to know about the forces that pressured for the adoption of electronic trading.

⁸ Cf. Seligman, Joel: *The Transformation of Wall Street: A History of the Securities and Exchange Commission and Modern Corporate Finance*, rev. Ed., Boston 1995, p. 521.

⁹ Weiss, Gary: *The \$140,000,000 Man*, in: *Business Week* (2003), No. 3849, Issued 15. Sep. 2003, pp. 90-92.

¹⁰ Cf. Lucchetti, Aaron: *Niederauer's First Challenge: NYSE Floor Traders' Future*, in: *Wall Street Journal - Eastern Edition* (2007), Issued 21. Nov. 2007, p. C1.

Second, the pressures against this adaptation process are vital. Here, analyzing the impact of the specialists' culture and their cohesiveness will be important since they are the symbol of the Exchange and as their culture shaped resistance. Additionally, as mentioned above, analyzing the effect of the specialists' possibility to exit the scene helps gain a more general understanding about the possibility of stakeholders to pressure for the retention of the old system. Third, the effects of the Grasso scandal on the implementation of e-trade are important as well. The effects of the ability of the CEO to select management as well as the CEO's ability to abuse his power will be analyzed. Here, it is not only the scandal which is of interest, but the effect that the management composition and the attitude of the CEO had on the implementation of change.

2 Model structure and basic behavior

2.1 Structural Overview

In order to test the impact of these effects on the implementation of electronic trading, the system dynamics method is used. Here, a formal model reveals the structure of the underlying system. At the same time it aims at reproducing real world behavior as well as illuminating behavior in different scenarios. Figure 2-1 shows an overview of the system dynamics model, outlines its scope and boundary.

The *management's decision on the extent of electronic trade* is central. Then, depending on the *characteristics of the market*, the effects of customers' *accumulated dissatisfaction* with the NYSE's relative speed and spread (price) is considered in the pressure that this creates on the decision about e-trade. On the other hand, *customers value* the specialist system as well as do the *specialists* themselves and the other companies which mainly draw their income from trading. The pressure for the traditional system that this valuation creates is part of the analysis as well. Finally, it will be considered how the *ownership structure* influences the *management's decision about the extent of e-trade*.

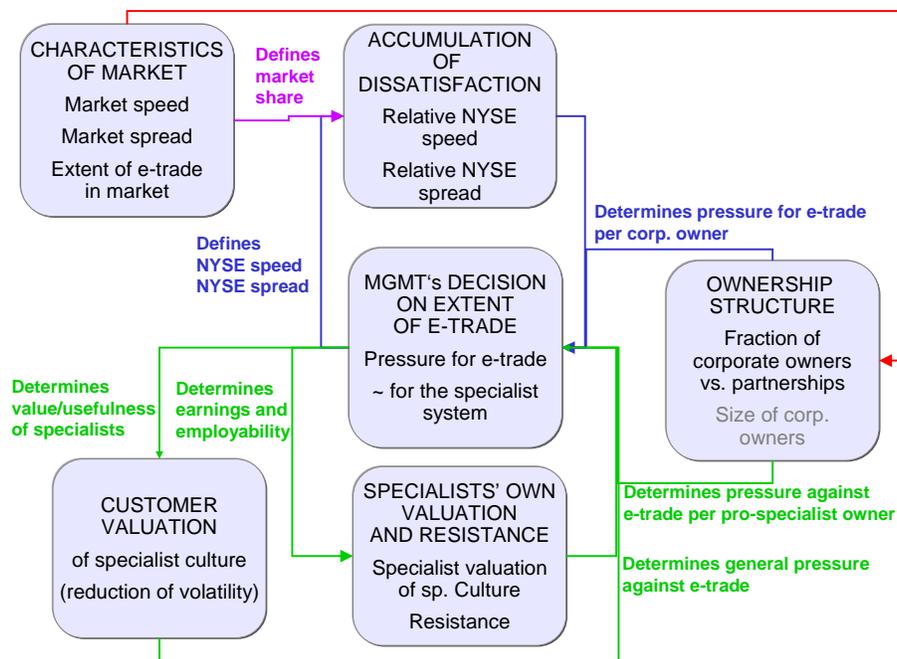


Figure 2-1: Sector diagram

In order to understand these relations in more detail, causal loop diagrams of the system dynamics model will be presented in the following.

2.2 Causal Details and Behavior

2.2.1 Adaptation View

Figure 2-2 shows an excerpt of the model, and it points at an important driver of change. Since the 1950s, more and more *capital was held by institutions*, over the last 60 years, this number increased from about 7% to more than 50%.¹¹ These *institutions* also trade stocks for the capital they hold, so they become customers of the Exchange. According to Blume et al., “[b]y the 1970s, institutional investors had replaced individual investors as the dominant force in the market.”¹² The percentage of trading that is done by institutions instead of individual investors rose from 20% in 1950 to 75% in 1975.¹³ Since these organizations trade professionally, they often make use of tiny price differences and engage in what is called *arbitrage*. Here, they also make use of computers and computer programs which issue the orders in order to automate the trading and to issue orders faster. This kind of trading is called *program trading*. Program trading then increased the number of *institutional customers* because they also have to follow suit with their insti-

¹¹ Cf. NYSE website: [Facts and Figures](#) > [Institutional Investors](#) > Holdings of corporate equities in the U.S. by type of institution (Oct. 1, 2007).

¹² Blume, Siegel and Rottenberg: *Revolution on Wall Street*, 1993, p. 108.

¹³ Cf. Blume, Siegel and Rottenberg: *Revolution on Wall Street*, 1993, p. 105.

tutional competitors so that a positive feedback loop was created. Abolafia describes a similar mechanism for the bond market where new forms of trading attracted new institutional customers and increased frequency and extent of trading.¹⁴

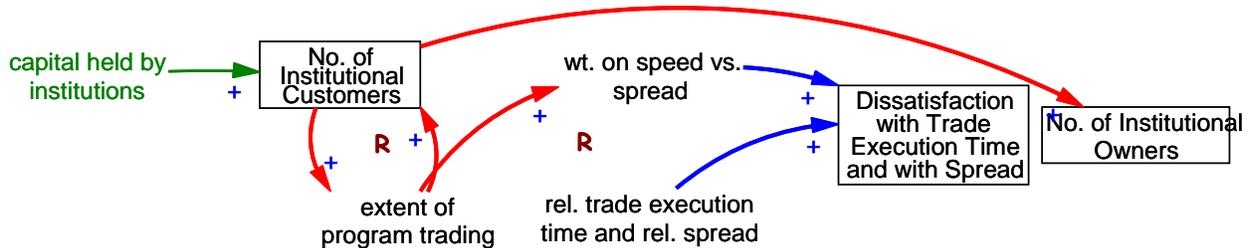


Figure 2-2: Institutional customers and program trading

It was and is crucial for these large institutional customers to gain direct access to the New York Stock Exchange’s trading floor because it gives them faster and less costly access. The number of corporate owners which represent companies whose primary source of income is not from trading started to grow.

Furthermore, as a second influence from outside, computer technology developed and paved the way for electronic trading. This led to the formation of Electronic Communication Networks (ECNs) where NYSE-listed stocks can be traded as well as to the foundation of NASDAQ, which from then on has tried to take away market share in NYSE-listed stocks.¹⁵ For example, in the first page of the “NASDAQ Facts”-webpage, NASDAQ states to be the member¹⁶ routing more order flow to the NYSE than any other member. They also maintain that their “trading systems are the faster, more efficient, transparent, better way to trade NYSE-listed securities.”¹⁷

Since program trading on the side of the customer is done by computers and since it uses minimal price differences in arbitrage, the trade execution time becomes highly important. Customers put more weight on the speed of order execution than on the spread which represents the price difference between the bid and offer. The spread is a measure for the quality of the price that the customer receives or pays, and small spreads are desired. How this creates two feedback loops can be seen in Figure 2-3. Depend-

¹⁴ Cf. Abolafia, Mitchel Y.: Making Markets: Opportunism and Restraint on Wall Street, Cambridge, MA, London 1996, pp. 5-6.
For a detailed stock and flow diagram of the above-mentioned processes please refer to Appendix I: Institutional Customers, Program Trading, and Institutional Owners.

¹⁵ Mechanisms of market share are described in chapter 2.2.4 Market Share.

¹⁶ A “member” is an entity owning at least one “seat” of the NYSE. A “seat” is an expression for the right to directly trade on the NYSE floor. They are still referred to as “seats” because in the early days of the NYSE, members sat in assigned chairs. (NYSE Glossary: “Seat”, www.nyse.com/glossary/Glossary.html) (Dec. 7, 2007).

¹⁷ NASDAQ website, NASDAQ Facts, Home > Nasdaq Corporate > Nasdaq Facts, http://www.nasdaq.com/reference/nasdaq_facts.sim (Dec. 7, 2007)

ing on the relative trade execution time and the relative spread to the market which both shrunk due to the possibilities of electronic trading, customers build up dissatisfaction with the execution time and spread. These are actually two balancing loops (B) which in this causal loop diagram are aggregated for brevity Appendix II reveals them in full detail in a full stock and flow diagram. Depending on their level of dissatisfaction, institutional customers exert pressure for the implementation of electronic trading because going electronic is a way to particularly speed trading up. When e-trade gets implemented the relative time and spread vs. the NYSE's competitors improve and dissatisfaction decreases.

At the same time, this creates a reinforcing loop (indicated by an R) pressuring for more electronic trading. If the New York Stock Exchange matches trades by a computer in less then a second, the customers have even greater incentive to use computer programs to do the trading and thus increase program trading. In the customer evaluation this puts more and more weight on the trade execution time. Since the spread is rather satisfactory because of the NYSE's high market share, but the speed is not, putting more weight on the trade execution time thus creates pressure for more e-trade.

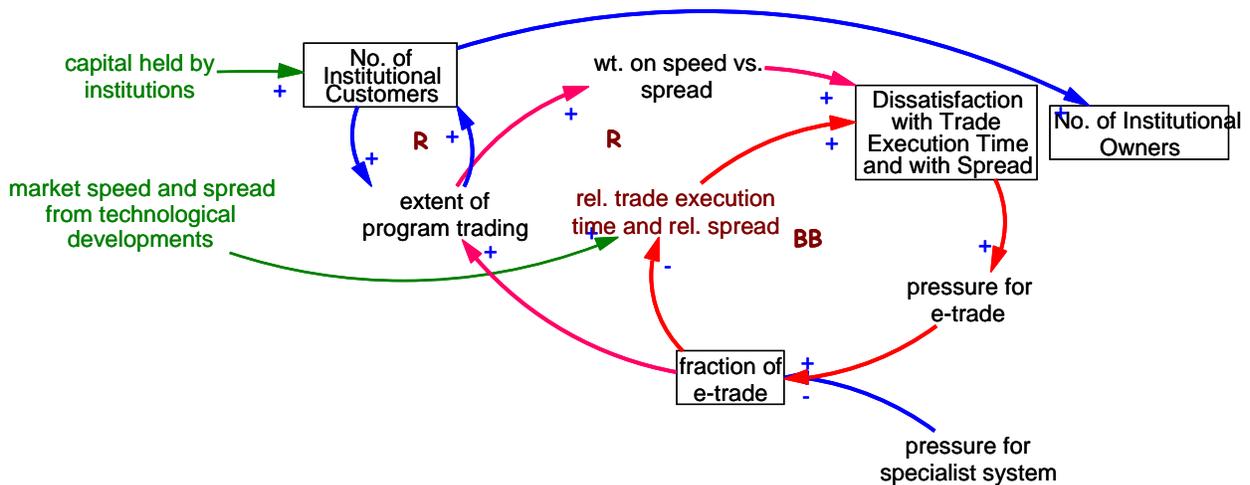


Figure 2-3: Trade execution time, spread and program trading

This model represents an adaptation view of organizational change since the NYSE can be regarded as adapting to the external forces of the market. They pressure for more electronic trading if the speed and spread are equal or worse than in the market so that it closely follows the trend in the market. Figure 2-12

shows the model behavior of this adaptation view. The fraction of e-trade at the New York Stock Exchange very closely oscillates around the fraction that is apparent in the market.¹⁸

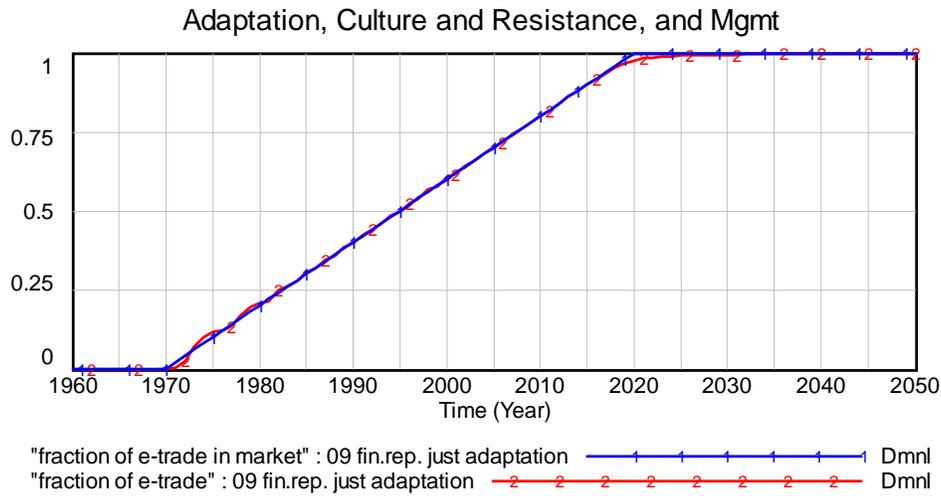


Figure 2-4: Adaptation view

Yet, this adaptation does not yet give a realistic picture of reality. As Figure 2-3 indicated already and as the following figures will show, there is not only pressure e-trade but also *pressure for the specialist system*.

2.2.2 Culture and Resistance View

There is a reinforcing feedback mechanism in which non-institutional customers pressure for the retention of the specialist system.¹⁹ Specialists participate in floor trades and provide liquidity particularly for lower-volume stocks.²⁰ The provision of liquidity plus the specialists' tasks of stabilizing prices, i.e. reducing volatility is also valued by the customers. According to NYSE Group, volatility increased only slightly since the implementation of the hybrid market because they were able to increase liquidity simultaneously.²¹ This ability of the specialist to reduce volatility is valued by those customers who do not do volatility-based program trading, and it thus creates a pressure to stick to the specialist system.

¹⁸ It has to be noticed here that the fraction of e-trade in the market follows the access to information technology. This is the variable which drives e-trade, trade execution time, and the spread in other trading platforms. In the model it increases linearly which is a simplification.

¹⁹ Appendix III reveals in more detail what pressure for the specialist system depends on.

²⁰ Cf. Ellul, Andrew, *et al.*: Order dynamics: Recent evidence from the NYSE, in: Journal of Empirical Finance, Vol. 14 (2007), No. 5, pp. 637 and 658. See also Appendix III: Customer Valuation of Specialist Culture, which reveals this mechanism in more detail.

²¹ NYSE Group, Inc.: NYSE Completes Hybrid Market Phase III Activation, NYSE Group, Inc., [News Release], accessed 11. Dec. 2007: <http://www.nyse.com/pdfs/HybridPhaseIV1.24.07.pdf>, p. 1-2.

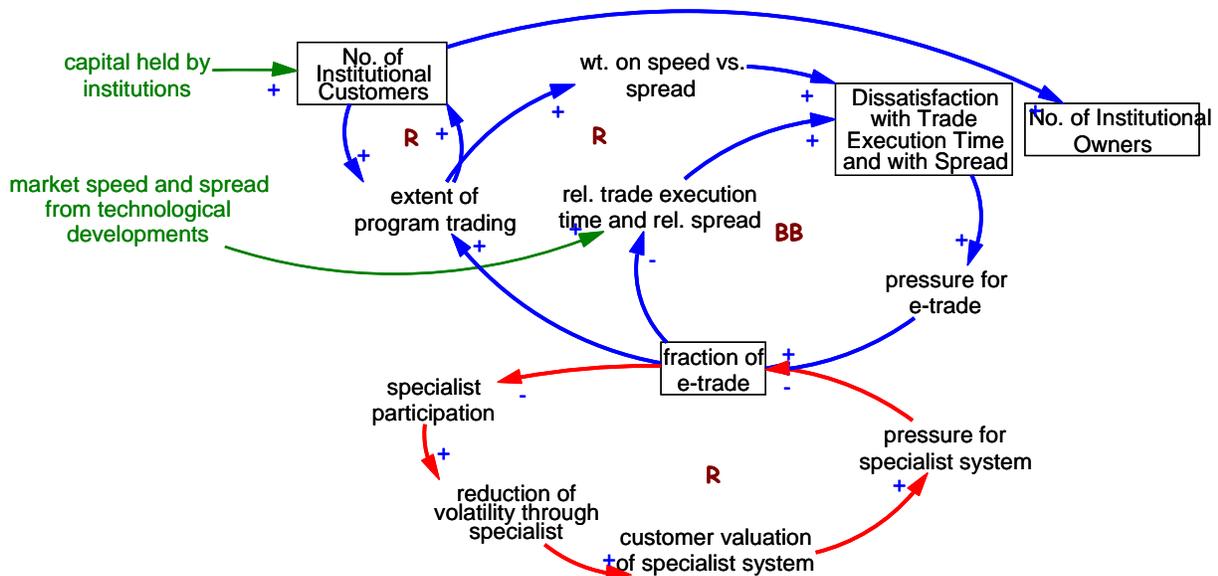


Figure 2-5: Customer valuation of specialist system

The specialists themselves plus other companies which mainly receive their revenue from trading on the floor enforce this pressure. In Figure 2-6 a reinforcing feedback loop shows how the ability specialists value their own culture depending on their ability to make profits and on their merits in reducing volatility.²² This creates a reinforcing loop, but since the specialists' valuation of themselves increases faster than it decreases, specialists in general only slowly let loose of their culture; and for a long time they still pressure for their system, even if profitability and their ability to reduce volatility has long been gone.

²² Further details can be found in Appendix IV: Specialist Valuation of Specialist Culture.

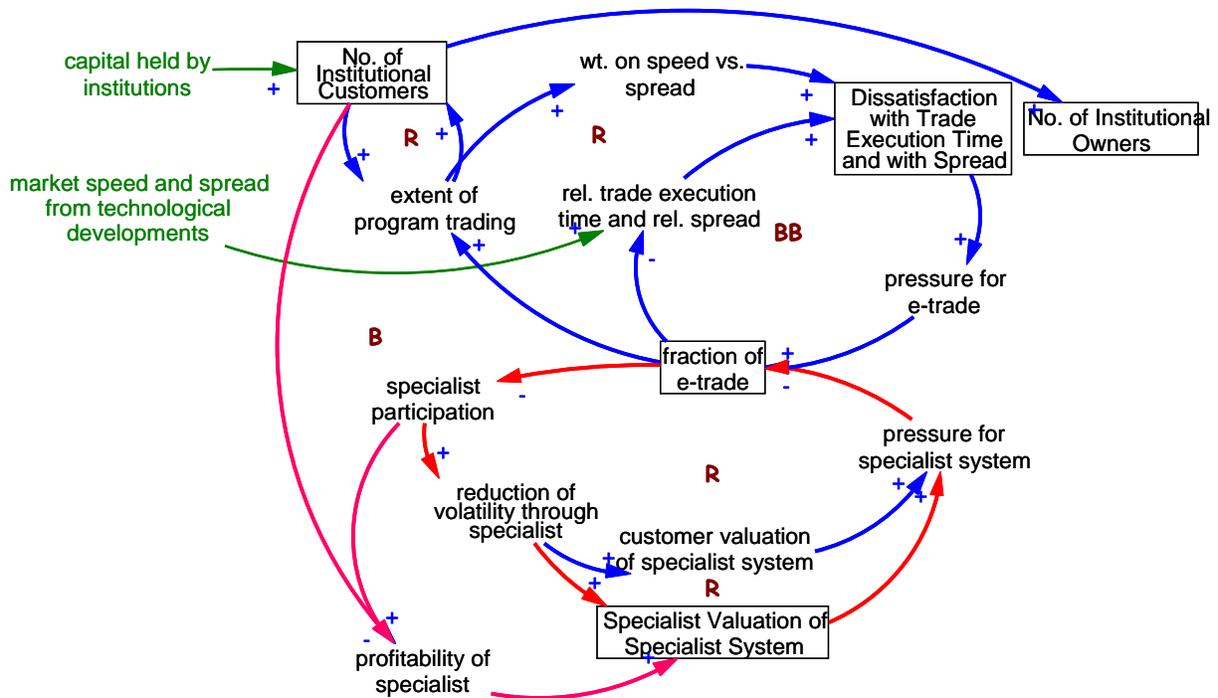


Figure 2-6: Specialist valuation of specialist system

When specialists and floor brokers noticed that a shift to electronic trading was imminent, some specialists started to protest. According to an informant, one of them still wears around 20 stickers on his suit showing his opposition to electronic trading and to the way it was implemented. Although he used to be a member of the board, his opposition is rather powerless now. Specialists make money from brokerage commissions, from the spread between the bid and ask price for their stocks and from trading for their own account.²³ It is thus not surprising that specialists and floor brokers showed resistance against the shrinking commissions due to institutional customers and against the implementation of e-trade which would additionally reduce the spread. It is not only the profitability but also the specialist' participation and employability that decreases with electronic trading, and thus both lead to resistance. Thus, based on the lower participation (employability) and profitability some resistance occurred, and its balancing loop is shown in Figure 2-7.²⁴

²³ Blume, Siegel and Rottenberg: Revolution on Wall Street, 1993, p. 40.

²⁴ Appendix V: Resistance shows a detailed stock and flow diagram of the two resistance effects, profitability and employability.

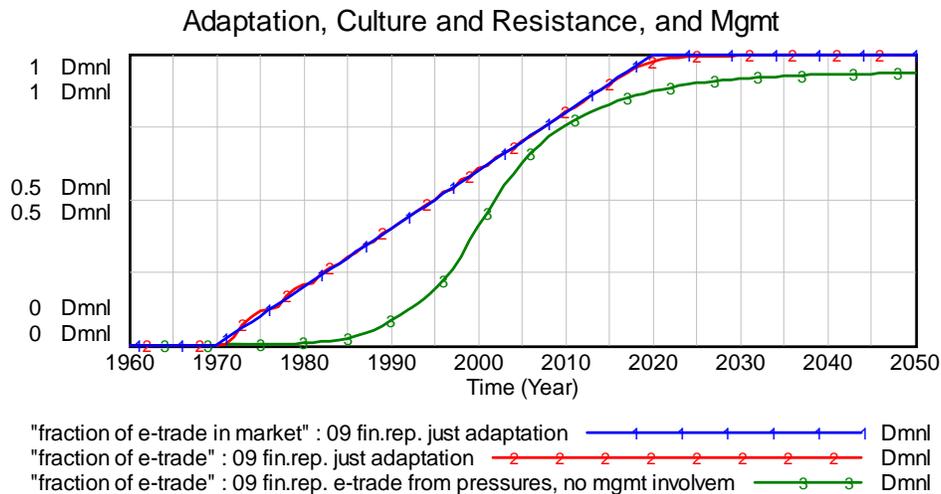


Figure 2-9: Culture and resistance

The course of events shows that the Grasso scandal as well as the important role of the New York Stock Exchange in implementing electronic trading. Before the scandal, institutional investors and owners called for the automation of trading, and small orders did get automated already, but there were not signs for a full rollout of e-trade within the next few years. Therefore, the role that management had for electronic trading is also worth consideration.

2.2.3 Management View

According to Gasparino, the NYSE's management was composed less of outside members but mainly of individuals related to the owners of the Exchange.²⁹ Management elected the CEO, and the CEO also exerted influence on who gets elected to the management board. Critics like the former chairman of the SEC, the regulatory body, described the NYSE's governance structure as a parody of corporate governance.³⁰ Whereas the Exchange's rules officially require an independent nominating committee, in reality it was a "rubber-stamp"³¹ committee agreeing to whatever the chairman suggested. In Figure 2-10 the mechanism is represented by a reinforcing feedback loop.³² Since the management elects the CEO, the CEO's valuation of the specialist system is influenced by the fraction of management favoring the specialists. This creates alignment and may protect the management system against a shrinking fraction of pro-specialist owners. Yet, as the balancing mechanism between the fraction of management favoring the specialists and the alignment variable shows, when the management over the course of many years

²⁹ Gasparino: King of the Club, 2007, pp. 209-210.

³⁰ Weiss: The \$140,000,000 Man, 2003, p. 86.

³¹ Gasparino: King of the Club, 2007, p. 209.

³² A more elaborated version of this in a stock and flow diagram can be found in Appendix VII: Management and CEO.

slowly adapts to outside pressures from owners, this may theoretically create some misalignment. It was obvious that in the Grasso period, alignment between the general management and the CEO was high and gave Grasso much leeway which also gave him strong power. After some time he started to take advantage of the alignment of the management with him for his remuneration package. Meyer S. Frucher, chairman of the Philadelphia Stock Exchange believes that Grasso was a master at using his power, which generated respect but also resentment.³³ But Morgenson regarded this only as the tip of the iceberg. "Toward the end of his career, Mr. Grasso seemed to consider himself bigger than the institution he ran, leading to a series of missteps that attracted the scrutiny of the Big Board's secretive practices, [...]."³⁴ When information about his pay package became public it led to a scandal. The support of the formerly aligned management quickly diminished, and it ended in a vote in which many of Grasso's former "buddies" asked him to resign.³⁵ Figure 2-10 shows this by a balancing feedback loop of the CEO's abuse of power and alignment with the management. Power abuse creates misalignment which then reshuffles the management composition and opens the door for outside pressures to exert influence.

The following historic example gives faith to the more general applicability of this model structure by providing a second example. A comparable course of events could be observed at the New York Stock Exchange in 1938 in the shift from low levels of self-governance to more supervision through the SEC. It can still be said that at this point of time, the specialists were ruling the Exchange. Seligman refers to the specialist-driven management as the "Old Guard", and he remarks that the majority of the Exchange's members was more "forward-looking" than them.³⁶ Yet, this majority of commission brokers were under-represented.³⁷ Thus it was a similar situation with the ruling Old Guard of specialists on the one side and a less powerful majority of the other. Pressures came from the SEC for a proportional representation of members in the Board of Governors at the NYSE and for the implementation of rules limiting the manipulation of trading.³⁸ On March 7, 1938 it became known that former NYSE president Richard Whitney had

³³ Quoted in Morgenson, Gretchen: The Fall of a Wall Street Ward Boss, in: The New York Times (2003), Issued 19. Oct. 2003, p. 1.

³⁴ Morgenson: The Fall of a Wall Street Ward Boss, 2003, p. 1.

³⁵ Cf. Gasparino: King of the Club, 2007, pp. 275-281.

³⁶ Cf. Seligman: The Transformation of Wall Street, 1995, p. 174 quoting SEC chairman William O. Douglas in a press release dated March 19, 1938, Douglas SEC Commissioner File.

³⁷ Cf. Seligman: The Transformation of Wall Street, 1995, p. 165.

³⁸ Cf. Seligman: The Transformation of Wall Street, 1995, p. 165.

misappropriated funds of the New York Stock Exchange Gratuity Fund.³⁹ In this case, too, it was the abuse of power of an important member, the former NYSE president who overbalanced the system. This eliminated the Old Guards internal strength and made the management vulnerable to outside pressures. Seligman himself puts it like this:

That Douglas under these circumstances was able to initiate a program of stock exchange reform primarily was a consequence of the deepening division among the New York Stock Exchange's members. That Douglas' reform program succeeded as completely as it did was the result of the Richard Whitney embezzlement scandal.⁴⁰

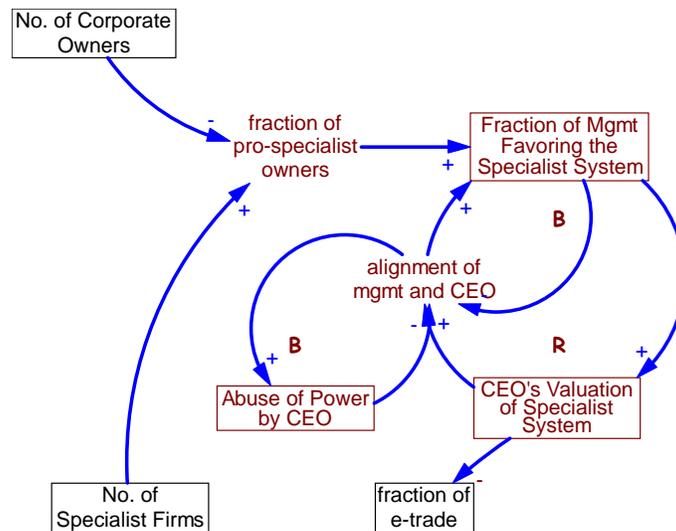


Figure 2-10: Management and CEO

The abuse of power by the CEO or another crucial figure thus has strong power to put the system out of balance and to open up windows of opportunity for outside pressures—be these rising representations of institutional owners or regulatory forces. The effects that the management and the CEO have on the implementation of electronic trading can be seen in Figure 2-11. Due to the managements and the CEO's alignment in favor of the specialist system, radical change happens only after a further time delay. Otherwise it would have been a much sooner but more incremental adaptation process.

³⁹ Cf. Seligman: The Transformation of Wall Street, 1995, pp. 167-168.

⁴⁰ Seligman: The Transformation of Wall Street, 1995, S. 160.

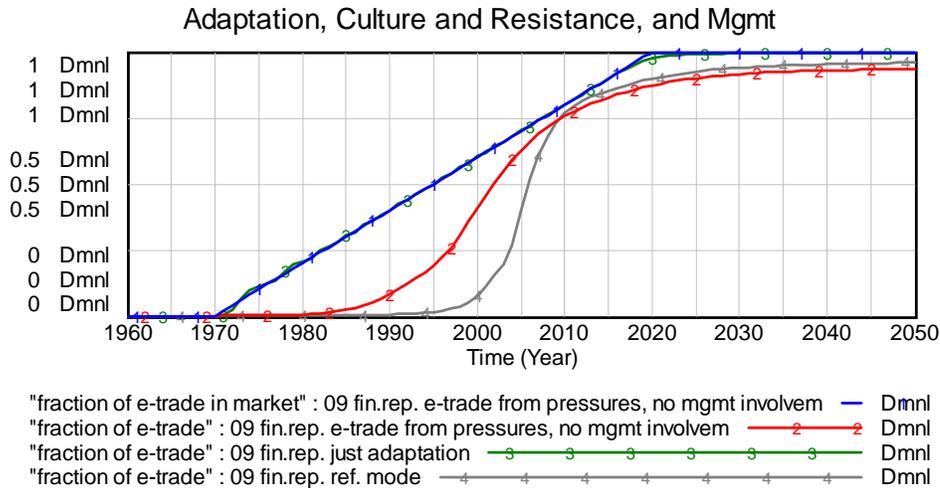


Figure 2-11: Adaptation, Culture and Resistance, and Mgmt

This last run of the model is also called the reference mode and is further explained in Figure 2-12. This run represents the basing point which reproduces the real events and behavior as closely as possible and which marks the reference point for further model analysis. It shows a very slow adaptation of electronic trading until the year 2000 when e-trade was made possible for small orders. The shift to a CEO and management team who are more affiliated with institutional customers and owners in the end of 2003 then allowed for the removal of the size limit of electronic orders in 2004. Electronic trading really took off when the Hybrid Market was launched in 2005.

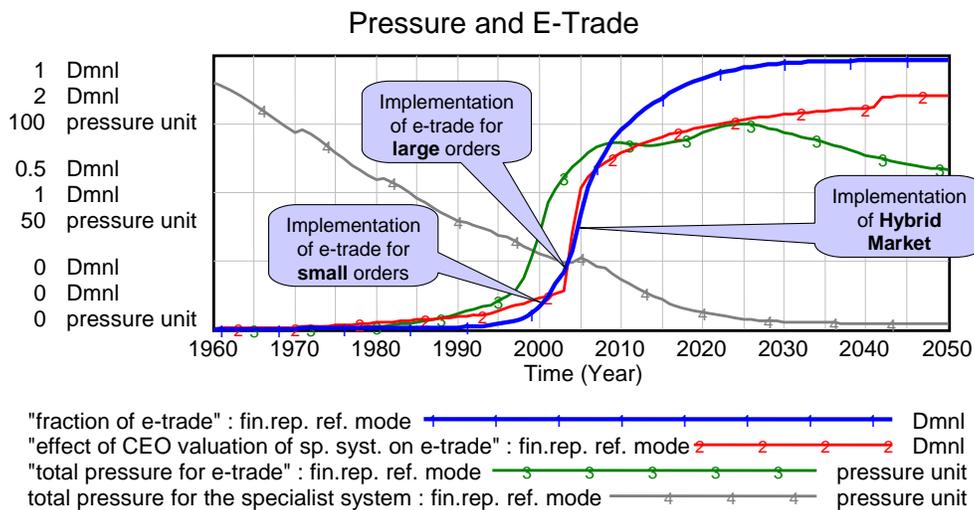


Figure 2-12: Reference Mode

At the same time Figure 2-12 reveals the different forces leading to this shift. When the pressure for e-trade starts exceeding the pressure for the specialist system, a small portion of e-trade gets implemented. The following quick implementation comes about due to the abrupt rise of the effect of the CEO's dimin-

ished valuation of the specialist system. In reality, this is the point of time when Thain replaced Grasso. Whereas the management, non-institutional owners, as well as firms which mainly receive their income from trading on the floor used to pressure for the specialist system, management and the large portion of intuitional customers and owners now support electronic trading.

2.2.4 Market Share

The extent of electronic trading then also has an effect on the Exchange's market share in the trading of NYSE-listed stocks. A bad trade execution time or spread not only leads to dissatisfaction with the New York Stock Exchange among institutional customers, it also reduces market share. Since high order flow has the effect of reducing the spread, this creates a reinforcing feedback loop which works positive for the exchange with the greatest market share.⁴¹ The spread can be reduced because, as noted earlier, it code-terminines the specialists' income. When the trading volume is high specialists can earn the same income with a low spread that they would earn with high spreads and low trading volume.



Figure 2-13: Market share

Figure 2-13 also reveals a further external aspect that shapes market share. The National Best Bid and Offer Rule (NBBO-rule) requires institutions to send orders to the exchange that currently offers the best price for their orders.⁴² Since the New York Stock Exchange traditionally had a low spread from its large market share, orders which would otherwise have been routed to the fastest exchange now have to go to the NYSE.⁴³ The National Best Bid and Offer Rule has a positive influence on the NYSE's market share in NYSE-listed stocks. Thus market share may be somewhat adjusted upward, but it is nevertheless an indicator of the Exchange's customers judgment of the current form of the NYSE's form of trading.

⁴¹ Appendix VIII: Market Share shows the stock and flow view in more detail.

⁴² Securities and Exchange Commission (SEC): Regulations NMS; Final Rule, in: Federal Register, Vol. 70 (2005), No. 124, p. 37496.

⁴³ A detailed view is provided in Appendix IX: National Best Bid and Offer Rule. The appendix further shows the differences in behavior, the base run vs. a fictional situation where the NBBO-rule does not exist.

3 Presentation and analyses of model behavior

Now, after the structure of the model as well as its behavior have been revealed, it will be important to gain some more confidence in this model. This is done with the help several tests which are applied to the model's structure and behavior. Here, one of the benefits of the system dynamics method also becomes apparent: unlike econometrical models, we are not only able to test model behavior, but model structure as well.

The stepwise development of the model structure revealed that adding new structure from the adaptation point of view via the culture and resistance view to the management view created new behavior. Figure 2-11 showed this explicitly. Concerning the boundaries of the system, it can thus be said that it was necessary to take these three views into consideration.

The model also shows sensible behavior under extreme conditions. If there are no technological developments that allowed for e-trade, in the model, no e-trade develops. If there are no institutional customers at the NYSE, no e-trade gets implemented there either. This helps to have confidence in the model because in reality electronic trading started to get implemented at the New York Stock Exchange only after both forces—institutional customers and technological possibilities for e-trade—were present.

The initial questions concerned the way the adaptation process of electronic trading is thwarted by the cohesiveness of the specialist culture, the developing resistance, and the specialist firms' possibility to exit. These relate to the forces that created inertia. Other questions included the effects of the management on the system, i.e. the CEO's ability to select the management members and the CEO's ability to abuse his power. In the following, an analysis will be presented about the effects of each of these determinants on the implementation of e-trade, pressures for and against e-trade, and the market share.

3.1 Sensitivity Analysis

3.1.1 Analysis of Culture and Resistance Aspects

The upper left graph in Figure 3-1 shows that the extent to which *e-trade* gets implemented only is mildly sensitive to variations in the *reference level of resistance*, i.e. to variations in how much resistance

is created by a certain employability or profitability gap.⁴⁴ Different strengths of resistance create more or less pressure for the specialist system (lower right). Yet, the lack in the implementation of e-trade also creates more pressure from dissatisfaction (lower left), so that the fraction of e-trade does not react very sensitive. Yet, the upper right picture reveals the effects on *market share*. The New York Stock Exchanges market share in trading of stocks listed at the NYSE reacts highly sensitive to minor shortcomings in the implementation of electronic trading so that resistance is shown to have detrimental effects.

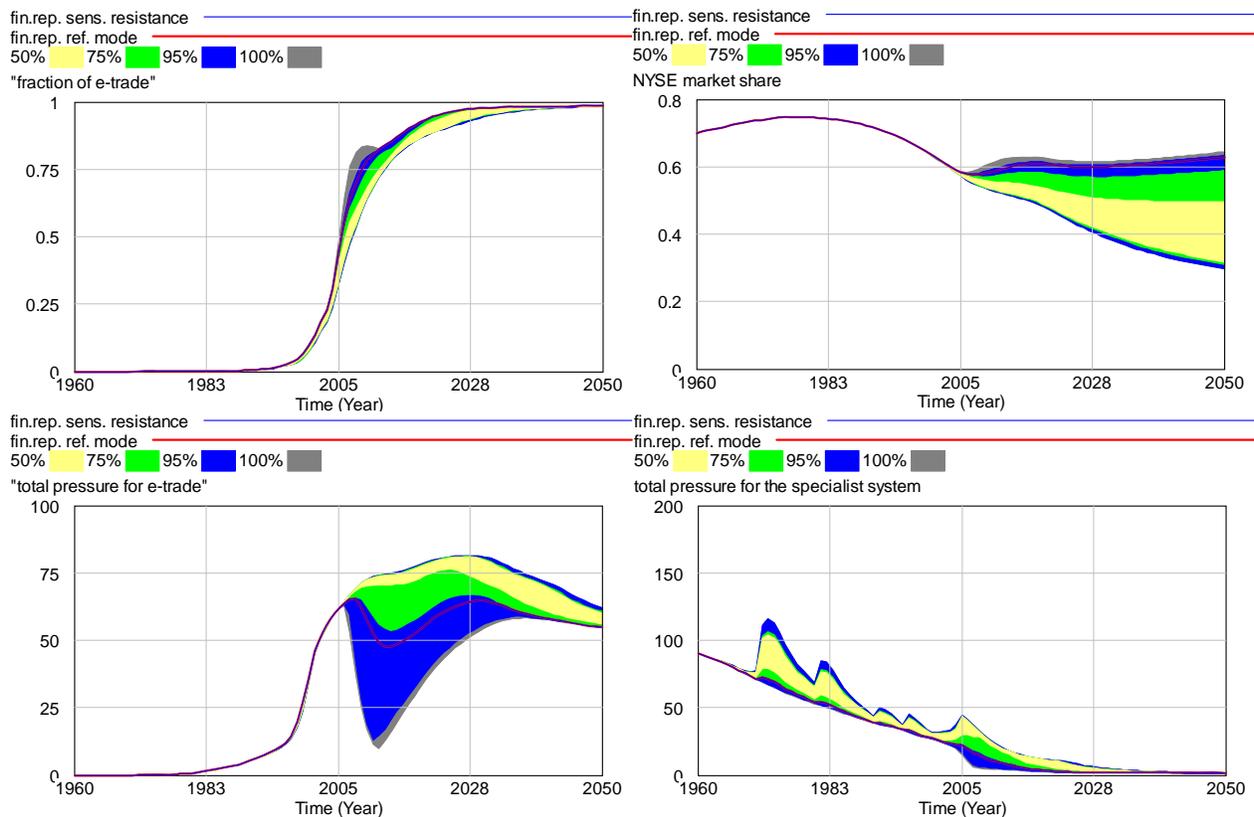


Figure 3-1: Sensitivity for resistance

When the sensitivity of the *fraction of e-trade* is checked for changes of the *degree of cohesiveness of specialist firms* all four output graphs almost look identical. Yet, Figure 3-2 suggests that when both work together—resistance and cohesiveness—the effects on the implementation of e-trade are much greater already. For the case this reveals that electronic trading would have been implemented had the cultural cohesiveness and the resistance been stronger, but it would have been implemented to a far lesser extent since the pressure for the specialist system would have been stronger.

⁴⁴ In a sensitivity analysis, the model is run 50 times while a certain parameter is changed. Here, the *reference resistance* is changed within a range of 0 to 5. In the reference mode, reference resistance is equal to 0.5. Please also not that the graphs are on different scales.

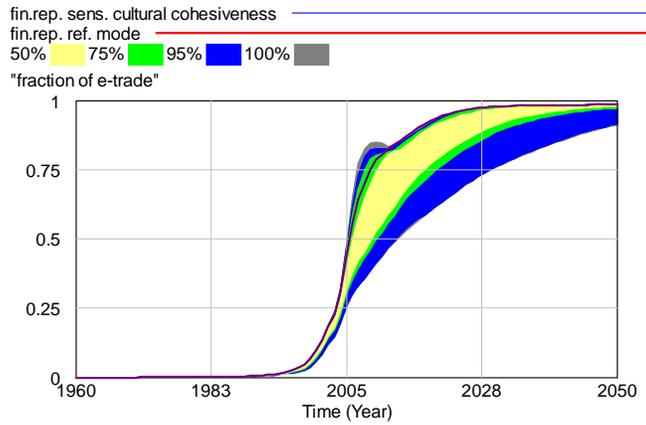


Figure 3-2: Sensitivity for resistance and cultural cohesiveness

Apart from cultural cohesiveness and resistance, the specialists' ability to exit also influenced the extent of the implementation of electronic trading. As the upper right picture of Figure 3-3 shows, the *number of specialist firms* (and other firms whose main revenue comes from trading) is highly sensitive to variations in the *reference fractional exit per year*.⁴⁵ The *total pressure for the specialist system* reacts sensitively to changing *numbers of specialist firms* (lower left) and can reduce the implementation of *e-trade* (upper left). This again creates more pressure on the institutional side as well because institutional investors become dissatisfied (lower right). The general downward trend of the total-pressure-for-the-specialist-system-graph shows that customer pressure for the specialist system has already been lost. And with increasing use of electronic trading, specialists also diminish the support for their traditional system. But in the meantime, their effects can be quite substantive.

⁴⁵ In this sensitivity analysis, the reference fractional exit per year is varies in the range of 0 and 0.1.

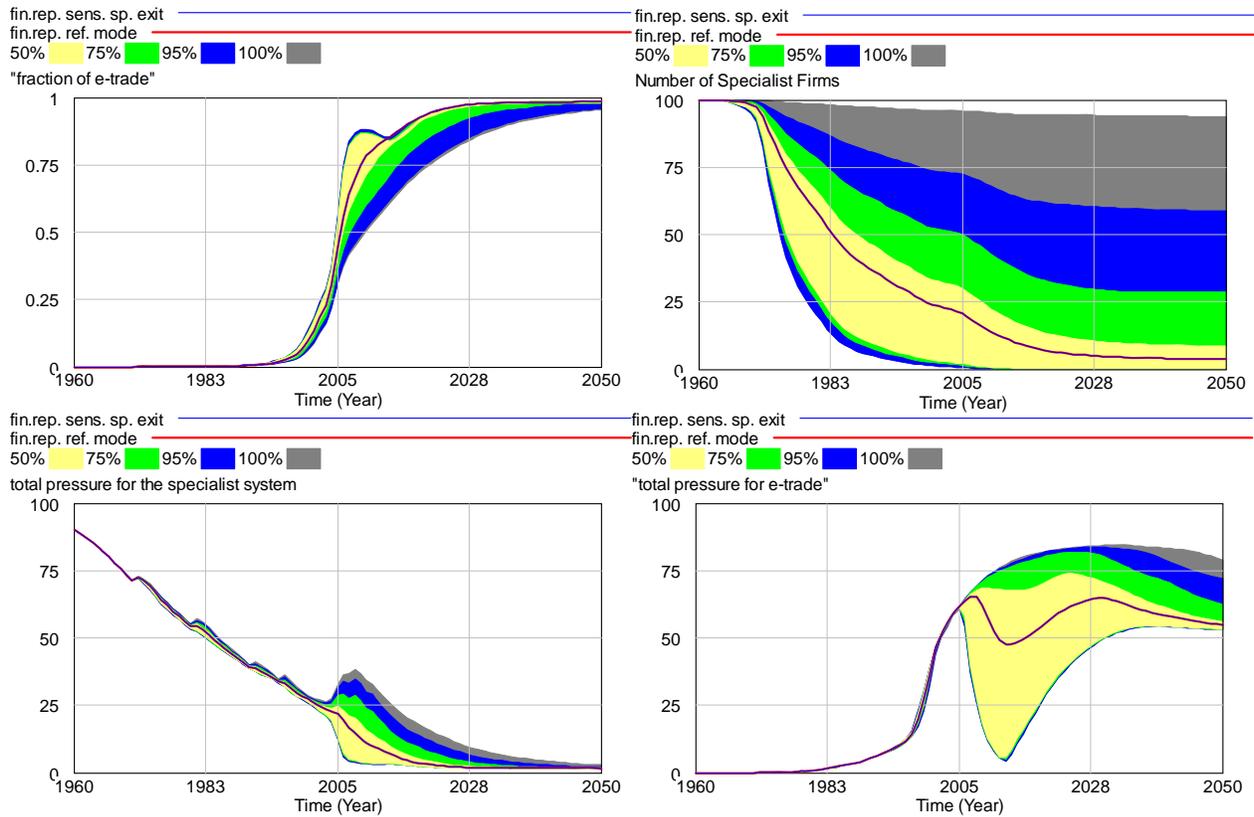


Figure 3-3: Sensitivity for specialists' ability to exit

The three sensitivity analysis show that specialists, their culture and resistance do not have much direct influence on the point of time when electronic trading gets implemented. But the analysis showed that in a situation where cultural cohesiveness and resistance are high and/or where the affected stakeholders are bound to the firm, they can reduce the extent to which electronic trading gets implemented. This then has severe effects on the market share of the New York Stock Exchange in the trading of its listed stocks.

3.1.2 Analysis of Management Aspects

In the following, it will be tested how sensitively the system reacts to changes in the CEO's ability to select management as well as his ability to abuse power. In the case of sensitivity to the CEO's ability to select management, the *reference time to change the management composition* is changed.⁴⁶ A long reference time means that the current management composition is mainly kept whereas a short reference time leads to a quick adaptation to pressures from outside. Figure 3-4 shows a highly sensitive reaction of management composition, measured by the variable *fraction of management favoring the specialist system*. As the bottom left picture shows, *e-trade* reacts very sensitively, too, first in the point of time when a shift to

⁴⁶ The changes range from a reference time of 0.1 years to 30 years. In the reference mode, the reference time to change the management composition is 5 years.

electronic trading occurs and second in the extent to which automated trading gets implemented. The effects on the *market share* (bottom right) vary from positive to detrimental, but implementation delays cause the market share to shrink rapidly.

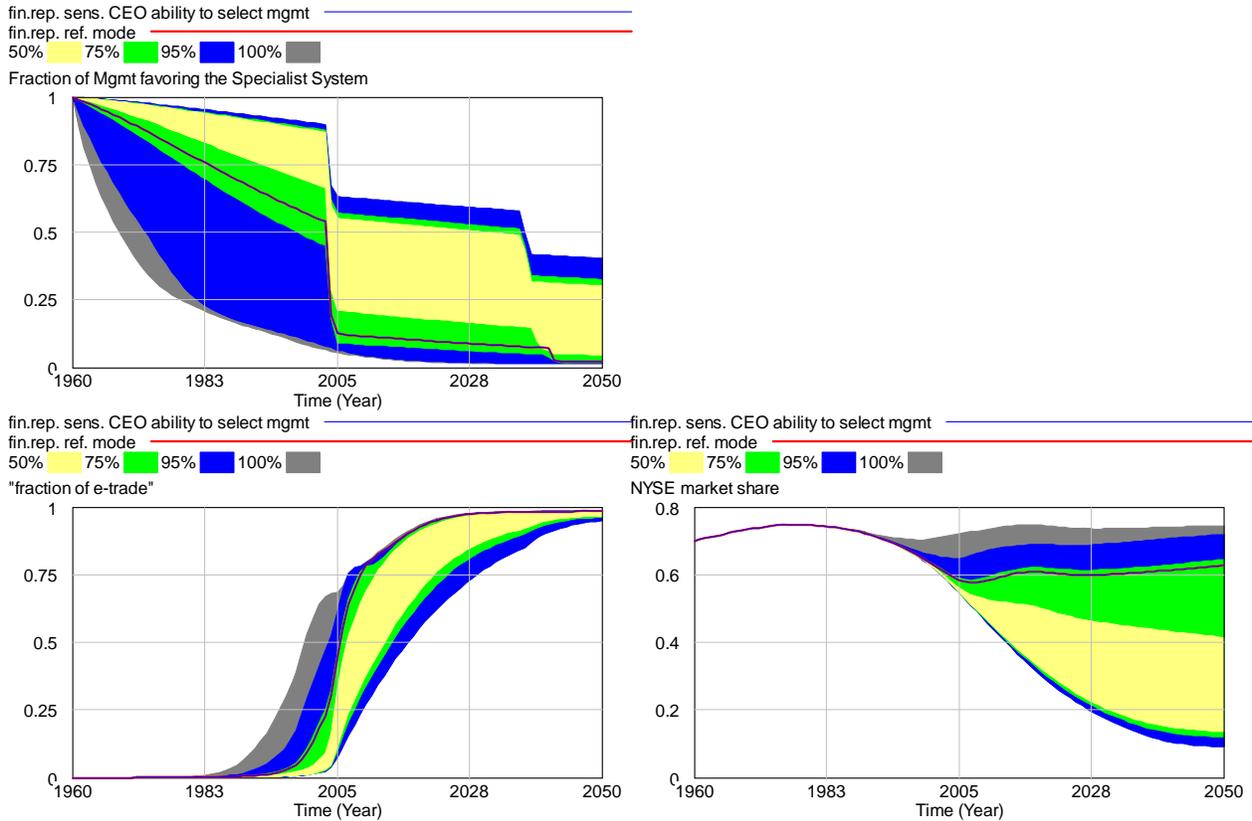


Figure 3-4: Sensitivity for the CEO's ability to select management

A similar behavior can be observed in the analysis of the CEO's ability or likelihood to abuse his power.⁴⁷ The sensitive reactions of the *fraction of management favoring the specialist system* and the consequent *fraction of e-trade* can be seen in Figure 3-5. A low *reference time to abuse power* leads to frequent misalignments between the CEO and the management, leading to more institutional owners joining management as a consequence of the internal turbulence. This leads to a quicker adaptation of electronic trading that is mostly determined by the investor pressures for e-trade and the specialist system. It is surprising that in the absence of power abuse, management alignment and the preference of the specialist culture cannot really defer e-trade past a certain point. This means that pressures from customers have become so strong that the CEO has to react to these pressures. The effect on the market share is similar to that of Figure 3-4.

⁴⁷ The reference time to abuse power is changed in the range of 0.1 and 30 years. The reference value in the reference mode is 10.

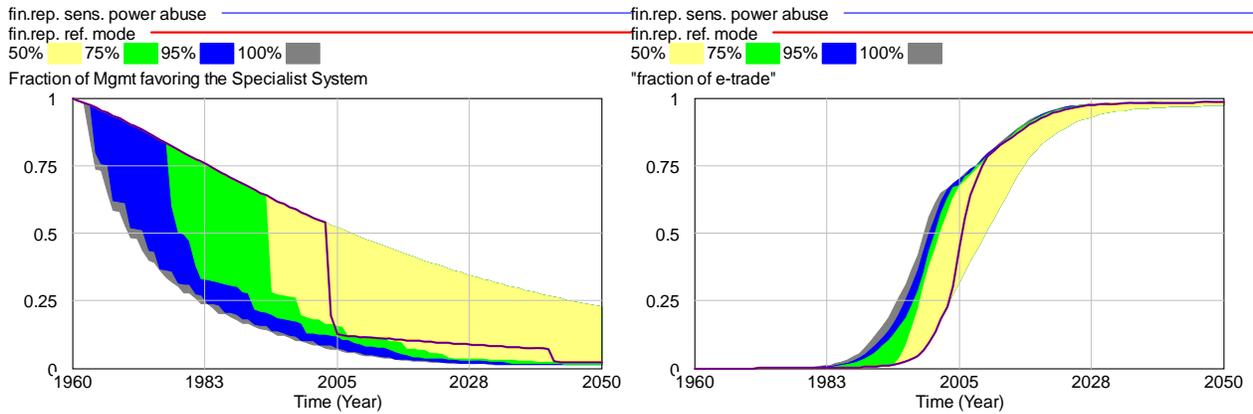


Figure 3-5: Sensitivity for the CEO's ability to abuse power

The sensitivity analyses for the CEO selecting management and abusing power supported the impact of the management and the CEO on the implementation of electronic trading. The graphs show that the implementation of e-trade could have happened much earlier had the CEO had less of an opportunity to choose who gets elected into management. The shift would also have happened faster if the Grasso scandal had happened earlier. The absence of the scandal could not have delayed electronic trading by much, but an even higher ability of the CEO to exert influence on the management composition could have. Thus, the management composition turns out to be a crucial factor when it comes to the implementation of electronic trading.

Whereas the examples so far concerned the effect of changes in a single variable on the implementation of electronic trading, it will be interesting to see what possibilities combined effects open up. Figure 3-6 shows a sensitivity analysis for a simultaneous random change of reference resistance, specialist exit, specialist cohesiveness, management selection, and power abuse.

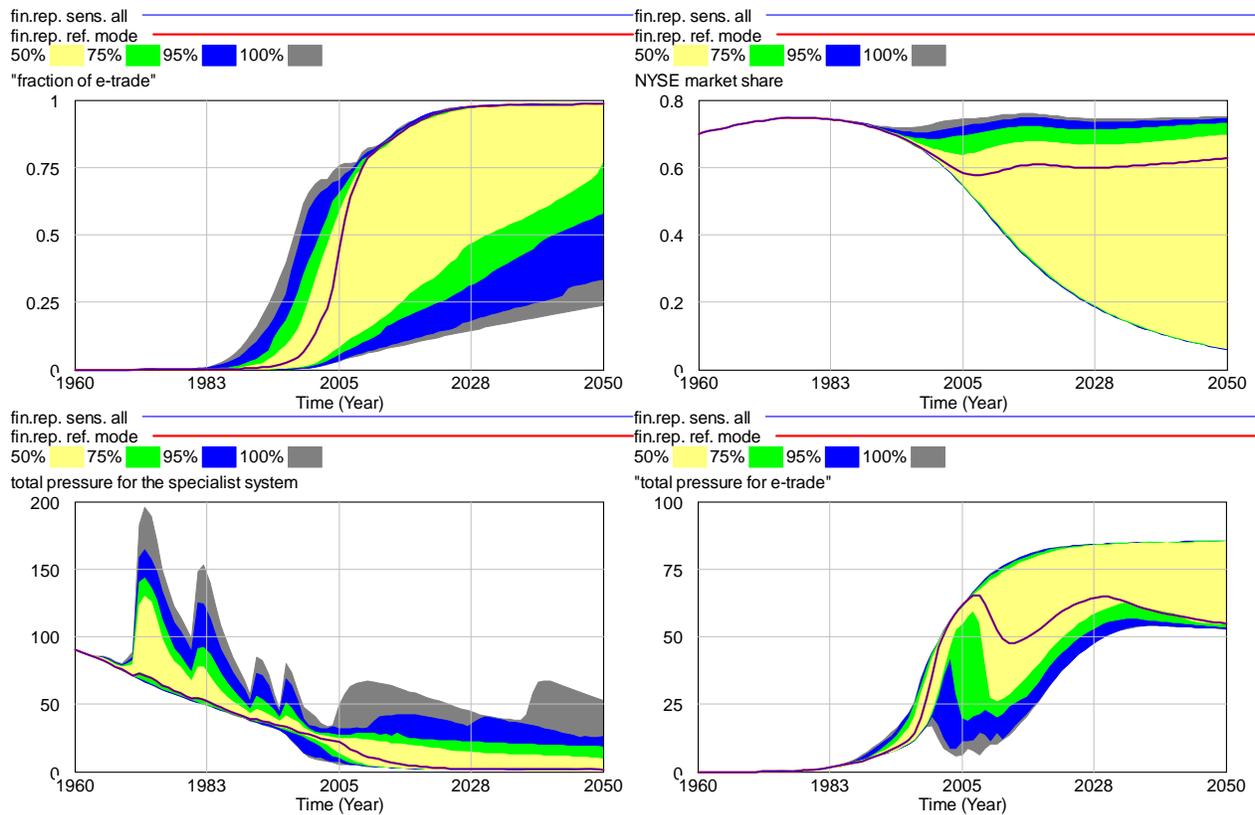


Figure 3-6: Sensitivity for all

The upper left graph of Figure 3-6 makes it obvious that the history and the future of the New York Stock Exchange could well have been different. The Exchange could not have inhibited the shift to electronic trading forever, but the extent to which it got implemented could have been different. On the other hand, automated trading could also have been implemented in the early 1990s. The different reactions in the extent of electronic trading come from the management and CEO, but also from sensitive pressures for the specialist system (bottom left) and for e-trade (bottom right). Thus, if there had still been more specialist firms, if specialists and floor brokers had shown more resistance or if management practices had been different, the change to electronic trading would have occurred in a different manner and probably at a different point of time.

4 Conclusions

4.1 Insights from the Modeling Process

The analysis reveals that the course of events in the implementation of electronic trading at the New York Stock Exchange could well have been different. It shows that specialists, floor brokers and non-institutional customers were successful at delaying the adaptation process by continuing to pressure for

the traditional system. It also shows that had the specialists been more cohesive and/or had their culture not allowed for exit, the pressure for the old system would have been fiercer.

The model analysis also demonstrates that a CEO with even more power to select the board members but who at the same time does not abuse his power could have been a strong force for a further delay in e-trade. Likewise, it was Grasso's ability to select his managers that was the reason that the shift did not yet happen in the 1990s.

The modeling process was also able to illustrate why the changes appeared to be so radical. It was a long accumulation of pressures, e.g. from dissatisfaction, that for a long time was hold up by management. Metaphorically speaking the shift in management functioned like a valve, so that once the opportunity was apparent, these pressures got released.

4.2 Relationship to Organizational Change Literature

The different scenarios have shown that, overall, the change towards electronic trading is an adaptation process of the New York Stock Exchange to its competitive environment. Since the technology provided for the possibility of e-trade and since there was a growth in institutional customers, automated trading also got implemented at the New York Stock Exchange. Without these external forces, no change in the NYSE's way of doing trading would have emerged.

Nevertheless, in the case of the New York Stock Exchange, the adaptation point of view does not give the full picture and cannot explain how—i.e. at what point of time and at what pace—the shift to electronic trading at the NYSE really happened. This limitation is apparent in much of the organizational change literature. Therefore, multiple views as suggested by Morgan are necessary.⁴⁸ Barnett and Carroll divide organizational change theory into adaptive and selective approaches. Whereas the adaptive point of view regards change as an adaptation to technological or environmental change, the selective point of view assumes that organizations neither change quickly nor easily.⁴⁹ Van de Ven and Poole call this selective point of view evolutionary theory of change in which competitive survival is the central metaphor. For them retention is a major force (including inertia and persistence) that antagonizes the variation (adap-

⁴⁸ Cf. Morgan, Gareth: *Images of organization*, Thousand Oaks, California [u.a.] 1986, pp. 12-13 and 321-322.

⁴⁹ Cf. Barnett, William P. and Glenn R. Carroll: *Modeling Internal Organizational Change*, in: *Annual Review of Sociology*, Vol. 21 (1995), No. 1, p. 218.

tation) loop.⁵⁰ This picture closely fits the idea of different pressures pushing for change vs. for the retention of the specialist system. Although the NYSE finally adapted, its corporate culture and resistance, were well able to delay this process, thus providing evidence of retention, inertia and persistence.

Yet, as said earlier, this view does not provide us with the full picture either. Kingdon indicates that there have to be windows of opportunity to make change happen.⁵¹ He states that advocates of an alternative idea “keep their proposal ready, waiting for one of two things: a problem that might float by to which they can attach their solutions, or a development in the political stream, such as a change of administration, that provides a receptive climate for their proposal.”⁵² Although Kingdon developed this theory for the public policy field, it has striking similarities with the Grasso case. An unforeseen change in the administration of the New York Stock Exchange provided the right climate for institutional customers and investors to attach their e-trade proposal and solution. Although these pressures were apparent before, they needed an opportunity window to implement their proposed idea. What also became obvious from the model analysis is that at some point of time, pressures are so great that they will even create this opportunity window.

It is important to note that the management and policy window view alone also does not explain the changes. The adaptation view, culture and resistance view plus the management view have to be applied simultaneously to make sense of the seemingly radical shift to electronic trading by the New York Stock Exchange. As Morgan points out, each new perspective adds a little different understanding, thus leading to a more complete picture.⁵³ It is their combination gives the full picture of the dynamics of how the changes unfolded.

4.3 Limitations and Future Research

This analysis is still limited by several factors concerning the model. First, technological developments are presented as a linear development. This is surely a very rough simplification of the reality and the model could be improved by a more realistic non-linear rise in the technological possibilities and uses of automated trading. Second, the factors that determine market share are limited to three: relative speed, rela-

⁵⁰ Cf. Van de Ven, Andrew H. and Marshall Poole: Explaining development and change in organizations, in: *The Academy of Management Review*, Vol. 20 (1995), No. 3, pp. 514 and 518.

⁵¹ Cf. Kingdon, John W.: *Agendas, Alternatives, and Public Policies*, 2. Ed., New York ; Munich [u.a.] 2003.

⁵² Kingdon: *Agendas, Alternatives, and Public Policies*, 2003, pp. 194-195.

⁵³ Cf. Morgan: *Images of organization*, 1997, pp. 12-13 and 321-322.

tive spread, and the NBBO-rule. It was thus possible to illustrate the effects of these factors on the market share. In reality, when management notices a decline or a low level of market share, one may assume that the management will take action to improve market share. These could be advertising, pressure for favorable regulations, or else, and these factors are outside the boundary of the model. Third, the implementation of electronic trading always also involves a capacity decision, and it would thus be advisable to actually model the capacity development of floor and e-trades. This will be a further step in the near future.

Additional future research may include a comparison to the literature on resistance to organizational change and to the writings of Piderit as well as Dent and Goldberg as they describe rational, emotional and behavioral motivations to resist change.⁵⁴ Since the shift to electronic trading has both content and process aspects of change, a closer look into the process aspects would also be beneficial.⁵⁵ Here, dialectical theory is suited to analyze the process of arriving at the implementation of NYSE's particular electronic system, the Hybrid Market. Dialectics is concerned with how an organization reaches its final states in a struggle between conflicting goals.⁵⁶ Since this shows a close fit with the exertion of pressures for e-trade or the specialist system, these additional lenses or metaphors of understanding change would be insightful.

⁵⁴ Cf. Piderit, Sandy Kristin: Rethinking Resistance and Recognizing Ambivalence: A Multidimensional View of Attitudes toward an Organizational Change, in: *The Academy of Management Review*, Vol. 25 (2000), No. 4, and Dent, Eric B. and Susan Galloway Goldberg: Challenging "Resistance to Change", in: *Journal of Applied Behavioral Science*, Vol. 35 (1999), No. 1.

⁵⁵ For a discussion of the distinction of content and processual aspects of organizational change, see Barnett and Carroll: *Modeling Internal Organizational Change*, 1995.

⁵⁶ Cf. Van de Ven and Poole: *Explaining development and change in organizations*, 1995, p. 517.

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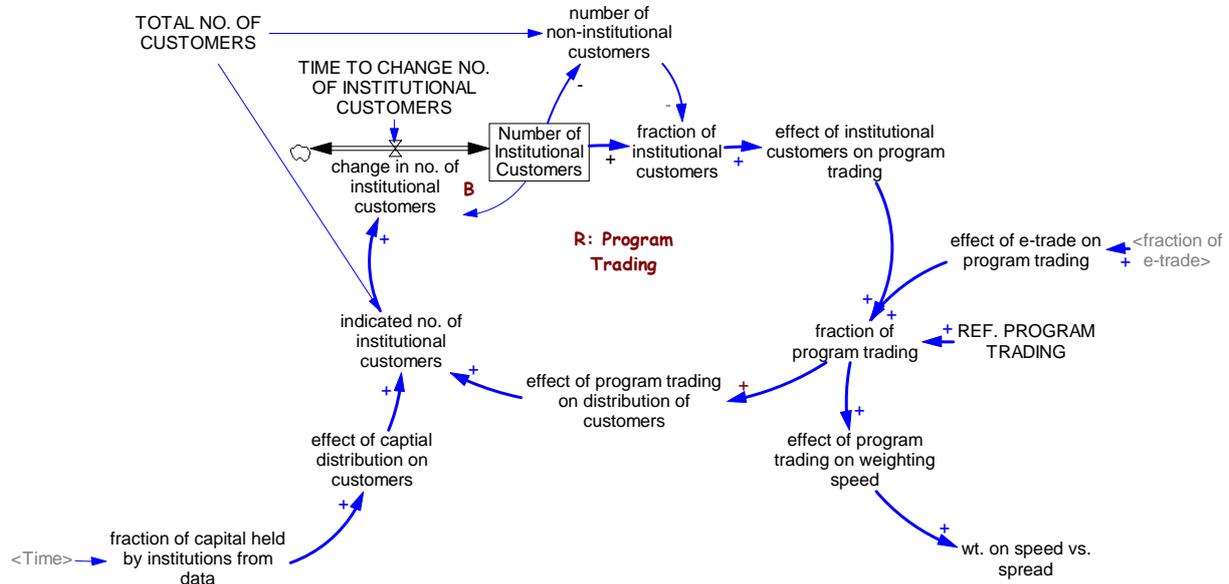
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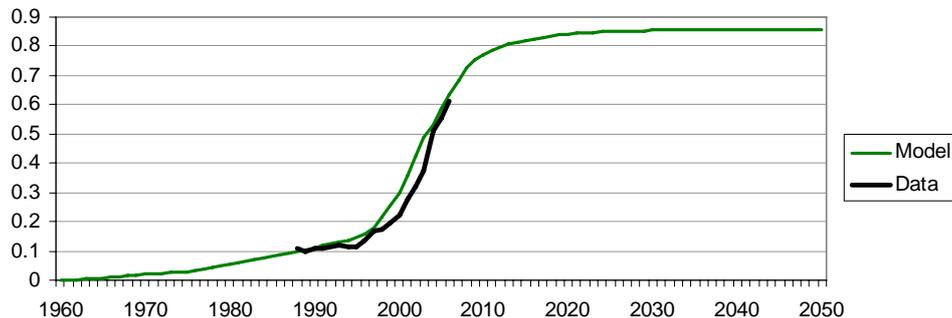
Weiss, Gary: The \$140,000,000 Man, in: Business Week, (2003), No. 3849, Issued 15. Sep. 2003, pp. 84-92.

1 Appendix I: Institutional Customers, Program Trading, and Institutional Owners

Institutional customers and program trading



Fraction of Program Trading



"change in no. of institutional customers"=
 ("indicated no. of institutional customers"-Number of Institutional Customers)/"TIME
 TO CHANGE NO. OF INSTITUTIONAL CUSTOMERS"
 Units: entity/Year

effect of captial distribution on customers= WITH LOOKUP (fraction of capital held by institutions from
 data, ((0,0)-(1,1)],(0,0),(0.1,0.05),(0.15,0.15),(0.45,0.75),(0.55,0.85),(0.66,0.9),(1,0.95))
 Units: Dmnl

"effect of e-trade on program trading"= WITH LOOKUP ("fraction of e-trade",
 ((0,1)-(1,1.9)],(0,1),(0.075,1.45),(0.225,1.75),(0.5,1.85),(1,1.88))
 Units: Dmnl

effect of institutional customers on program trading= WITH LOOKUP (fraction of institutional custom-
 ers,
 ((0,0)-(1,6)],(0.1,0),(0.4,0.3),(0.6,1),(0.7,1.5),(0.8,4),(0.9,5),(1,5.3))
 Units: Dmnl

effect of program trading on distribution of customers= WITH LOOKUP (fraction of program trading,
 ((0,1)-(1,1.1)],(0,1),(0.25,1.005),(0.5,1.012),(0.65,1.06),(0.8,1.09),(1,1.1))
 Units: Dmnl

effect of program trading on weighting speed= WITH LOOKUP (fraction of program trading,
((0,0)-
1,1)],(0,0),(0.0550459,0.0526316),(0.198777,0.311404),(0.35,0.75),(0.513761,0.877193),(0.7
5,0.95),(1,1))

Units: Dmnl

fraction of capital held by institutions from data= WITH LOOKUP (Time,(((1960,0)-
(2010,1)],(1960,0.15),(1970,0.282),(1990,0.414),(1992,0.417),(1993,0.411),(1995,0.437),(199
7,0.477),(1999,0.432),(2000,0.47),(2001,0.483))

Units: Dmnl

1970 28.20% 1950 7.20% This data is from NYSE facts and figures.

There is not data for 1960, so I assumed 15%. Holdings of
corporate equities in the U.S. by type of institution, (1. Okt.
07)

"fraction of e-trade"=

"Ratio of e-trade to floor trade"/(1+"Ratio of e-trade to floor trade")

Units: Dmnl

80% of volume was automatic on 8. Jan. 07, Nyse Group (2007)

NYSE completes Hyb. Mark. phase III activation

fraction of institutional customers=

Number of Institutional Customers/(Number of Institutional Customers+"number of non-
institutional customers")

Units: Dmnl

fraction of program trading=

"effect of e-trade on program trading"*effect of institutional customers on program trading

*"REF. PROGRAM TRADING"

Units: Dmnl

"indicated no. of institutional customers"=

effect of captial distribution on customers*effect of program trading on distribution of custom-
ers

*"TOTAL NO. OF CUSTOMERS"

Units: entity

Number of Institutional Customers= INTEG ("change in no. of institutional customers",10)

Units: entity

"number of non-institutional customers"=

"TOTAL NO. OF CUSTOMERS"-Number of Institutional Customers

Units: entity

"REF. PROGRAM TRADING"=

0.1

Units: Dmnl

According to NYSE facts and figures, in 1990 10% of NYSE trades were program trades. This is taken
as the reference.

"TIME TO CHANGE NO. OF INSTITUTIONAL CUSTOMERS"= 5

Units: Year

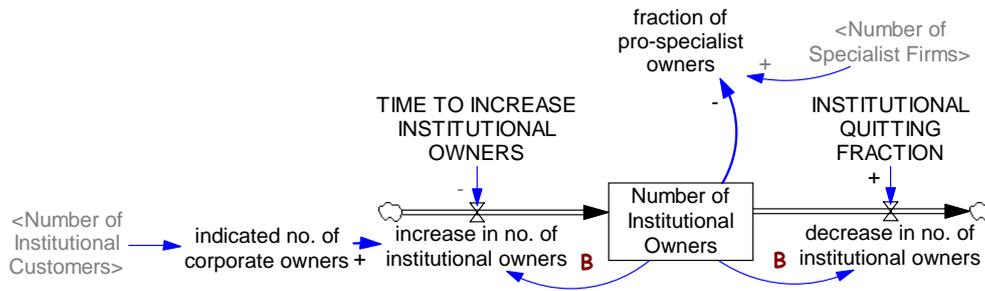
"TOTAL NO. OF CUSTOMERS"=100

Units: entity

"wt. on speed vs. spread"= effect of program trading on weighting speed

Units: Dmnl

Institutional owners



"decrease in no. of institutional owners"=
 $\text{Number of Institutional Owners} \times \text{INSTITUTIONAL QUITTING FRACTION}$
 Units: entity/Year

"fraction of pro-specialist owners"=
 $\frac{\text{Number of Specialist Firms}}{\text{Number of Specialist Firms} + \text{Number of Institutional Owners}}$
 Units: Dmnl

"increase in no. of institutional owners"=
 $\frac{(\text{"indicated no. of corporate owners"} - \text{Number of Institutional Owners})}{\text{TIME TO INCREASE INSTITUTIONAL OWNERS}}$
 Units: entity/Year

"indicated no. of corporate owners"= WITH LOOKUP (Number of Institutional Customers,
 $[(0,0) - (100,600)], (0,0), (12.5, 100), (30,200), (48,225), (55,225), (60,225), (67,225), (75,225), (100,225))$
 Units: entity

INSTITUTIONAL QUITTING FRACTION=0.01
 Units: Dmnl/Year

Number of Institutional Customers= INTEG ("change in no. of institutional customers",10)
 Units: entity

Number of Institutional Owners= INTEG (+ "increase in no. of institutional owners" - "decrease in no. of institutional owners", 78)
 Units: entity
 No of corp owners is 78 in 1960, according to Facts and Figures

Number of Specialist Firms= INTEG ("change in no. of specialist firms", 100)
 Units: entity

More than 40 specialist firms in the early 1990s, WSJ 21. Nov. 07. (also Abolafia p. 146) The initial value of 100 is an educated guess that 20% of the members of the NYSE in 1960 were specialist firms vs. 80% brokerage firms.

TIME TO INCREASE INSTITUTIONAL OWNERS= 2
 Units: Year

<http://www.nyse.com/productservices/nyseequities/1126821290345.html>
(30. Sep. 07)

execution time in market=
("fraction of e-trade in market"*"EXECUTION TIME E-TRADE"+(1-"fraction of e-trade in market")*EXECUTION TIME FLOOR TRADE)*"REF. EXECUTION TIME IN MARKET"
Units: second/trade

EXERTED PRESSURE PER DISSATISFACTION UNIT= 1
Units: pressure unit/dissatisfaction unit

"fraction of e-trade in market"= ACCESS TO INFORMATION TECHNOLOGY
Units: Dmnl

"fraction of e-trade"= "Ratio of e-trade to floor trade"/(1+"Ratio of e-trade to floor trade")
Units: Dmnl
80% of volume was automatic on 8. Jan. 07, Nyse Group (2007)
NYSE completes Hyb. Mark. phase III activation

fraction of floor trade= 1/(1+"Ratio of e-trade to floor trade")
Units: Dmnl

Number of Institutional Customers= INTEG ("change in no. of institutional customers",10)
Units: entity

NYSE trade execution time= "fraction of e-trade"*"EXECUTION TIME E-TRADE"+fraction of floor trade*EXECUTION TIME FLOOR TRADE
Units: second/trade
The NYSE is now a fast market over 99% of the time, with execution speeds in milliseconds. Reg NMS order protection rule, http://www.nyse.com/pdfs/nyse_regnms_updates_final.pdf (7. Dez. 07).

"pressure for e-trade per inst. customer"=
"total dissatisfaction per inst. customer"*EXERTED PRESSURE PER DISSATISFACTION UNIT
Units: pressure unit/entity

"Ratio of e-trade to floor trade"= INTEG ("change in ratio of e-trade", 0)
Units: Dmnl

As the NYSE awaited regulatory approval to become a publicly traded company last year, the exchange opted to shelve the fee-increase plan after criticism from brokers such as Daniel Tandy, a member of the NYSE's board of executives at the time. This year, their complaints weren't enough. <http://www.rblt.com/documents/Bloombergnews9-8-06.pdf> (8. Nov. 07) Rosenberg Securities

ratio of pressures as taken into consideration by mgmt=
ratio of pressures by customers*"effect of CEO valuation of sp. syst. on e-trade"
Units: Dmnl

ratio of pressures by customers= "total pressure for e-trade"/total pressure for the specialist system
Units: Dmnl

"REF. DISSATISFACTION PER INST. CUSTOMER"= 1
Units: dissatisfaction unit/entity

"REF. EXECUTION TIME IN MARKET"=1
Units: Dmnl

relative trade execution time= NYSE trade execution time/execution time in market

Units: Dmnl

Sustained Dissatisfaction with Execution Time= INTEG (change in sustained dissatisfaction with execution time, 0)

Units: dissatisfaction unit/entity

Sustained Dissatisfaction with Spread= INTEG (change in sustained dissatisfaction with spread, 0)

Units: dissatisfaction unit/entity

"TIME MGMT NEEDS TO CHANGE RATIO OF E-TRADE"= 5

Units: Year

time to change sustained dissatisfaction with execution time= WITH LOOKUP (ZIDZ("current dissatisfaction with execution time per inst. customer", Sustained Dissatisfaction with Execution Time), ((0,0)-(2,40)),(0,2.5),(0.25,2.5),(0.5,3),(0.875,3.75),(1,5),(1.1,7.8),(1.3,12),(1.6,14),(2,15))

Units: Year

"total dissatisfaction per inst. customer"=

"wt. on speed vs. spread"*Sustained Dissatisfaction with Execution Time+(1 -"wt. on speed vs. spread")*Sustained Dissatisfaction with Spread

Units: dissatisfaction unit/entity

"total pressure for e-trade"=

"pressure for e-trade per inst. customer"*Number of Institutional Customers

Units: pressure unit

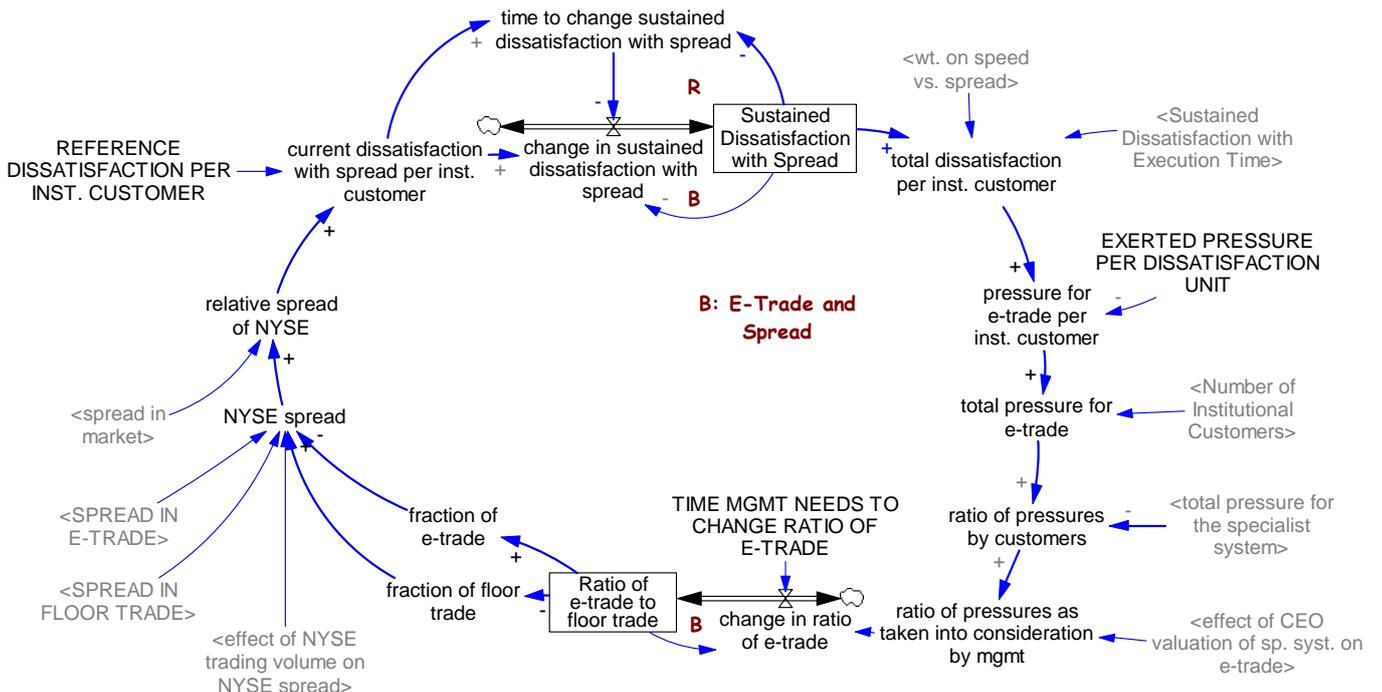
total pressure for the specialist system= pressure from customers for the specialist system+pressure from specialists for the specialist system

Units: pressure unit

"wt. on speed vs. spread"= effect of program trading on weighting speed

Units: Dmnl

E-Trade and Spread



"change in ratio of e-trade"= (ratio of pressures as taken into consideration by mgmt-"Ratio of e-trade to floor trade")/"TIME MGMT NEEDS TO CHANGE RATIO OF E-TRADE"
Units: Dmnl/Year

change in sustained dissatisfaction with spread= ("current dissatisfaction with spread per inst. customer"-Sustained Dissatisfaction with Spread)/time to change sustained dissatisfaction with spread
Units: dissatisfaction unit/entity/Year

"current dissatisfaction with spread per inst. customer"= WITH LOOKUP (relative spread of NYSE/"REF. DISSATISFACTION PER INST. CUSTOMER",((0,0)-(2,1)),(1,0),(1.01,0.2),(1.05,0.5),(1.2,0.8),(1.5,0.96),(2,1))
Units: dissatisfaction unit/entity

"effect of CEO valuation of sp. syst. on e-trade"= WITH LOOKUP (CEO's Valuation of the Specialist System, ((0,0)-(1,2)),(0,2),(0.25,1),(0.5,0.5),(0.75,0.1),(1,0))
Units: Dmnl

effect of NYSE trading volume on NYSE spread= WITH LOOKUP (NYSE trading volume/"ref. trading volume",((0,0)-(1,2)),(0,1.3),(0.1,1.27),(0.25,1.2),(0.5,1),(0.75,0.8),(0.9,0.73),(1,0.7))
Units: Dmnl

EXERTED PRESSURE PER DISSATISFACTION UNIT= 1
Units: pressure unit/dissatisfaction unit

"fraction of e-trade"= "Ratio of e-trade to floor trade"/(1+"Ratio of e-trade to floor trade")
Units: Dmnl
80% of volume was automatic on 8. Jan. 07, Nyse Group (2007) NYSE completes Hyb. Mark. phase III activation

fraction of floor trade= 1/(1+"Ratio of e-trade to floor trade")
Units: Dmnl

Number of Institutional Customers= INTEG ("change in no. of institutional customers",10)
Units: entity

NYSE spread= ("fraction of e-trade"*"SPREAD IN E-TRADE"+fraction of floor trade*SPREAD IN FLOOR TRADE)*(effect of NYSE trading volume on NYSE spread)
Units: \$/share

THE SPREAD IS THE DIFFERENCE BETWEEN BID AND ASK PRICE. and reduced volatility was the key criterion of market quality. http://www.nyse.com/pdfs/hm_booklet.pdf (30. Sep. 07) NYSE Hybrid Market Training Program. quoted spread pre hybrid 20.95, since hybrid 18.32, effective spread pre hybrid 7.50, since hybrid 8.17 bps, Nyse Group (2007) NYSE completes Hyb. Mark. phase III activation

"pressure for e-trade per inst. customer"= "total dissatisfaction per inst. customer"*EXERTED PRESSURE PER DISSATISFACTION UNIT
Units: pressure unit/entity

"Ratio of e-trade to floor trade"= INTEG ("change in ratio of e-trade", 0)
Units: Dmnl

As the NYSE awaited regulatory approval to become a publicly traded company last year, the exchange opted to shelve the fee-increase plan after criticism from brokers such as Daniel Tandy, a member of the NYSE's board of executives at the time. This year, their complaints weren't enough. <http://www.rblt.com/documents/Bloombergnews9-8-06.pdf> (8. Nov. 07) Rosenberg Securities

ratio of pressures as taken into consideration by mgmt=
ratio of pressures by customers*"effect of CEO valuation of sp. syst. on e-trade"

Units: Dmnl

ratio of pressures by customers= "total pressure for e-trade"/total pressure for the specialist system
Units: Dmnl

"REF. DISSATISFACTION PER INST. CUSTOMER"= 1
Units: dissatisfaction unit/entity

relative spread of NYSE= NYSE spread/spread in market
Units: Dmnl

"SPREAD IN E-TRADE"= 0.1

Units: \$/share

\$0.2 according to Jain (2005), S. 2969. According to the NYSE execution quality in 2003-04 the spread is around \$0.05 per share.

SPREAD IN FLOOR TRADE=

0.2

Units: \$/share

Jain (2005), S. 2969. According to the NYSE execution quality in 2003-04 the spread is around \$0.05 per share.

spread in market= ("fraction of e-trade in market"*"SPREAD IN E-TRADE"+(1-"fraction of e-trade in market")*"SPREAD IN FLOOR TRADE")*"effect of trading volume in m. on market's spread"

Units: \$/share

Sustained Dissatisfaction with Execution Time= INTEG (change in sustained dissatisfaction with execution time, 0)

Units: dissatisfaction unit/entity

Sustained Dissatisfaction with Spread= INTEG (change in sustained dissatisfaction with spread, 0)

Units: dissatisfaction unit/entity

"TIME MGMT NEEDS TO CHANGE RATIO OF E-TRADE"= 5

Units: Year

time to change sustained dissatisfaction with spread= WITH LOOKUP (ZIDZ("current dissatisfaction with spread per inst. customer", Sustained Dissatisfaction with Spread),

[(0,0)-

(10,10)],(0,2.5),(0.25,2.5),(0.5,3),(0.875,3.75),(1,5),(1.1,7.8),(1.3,17.5),(1.6,23),(2,25))

Units: Year

"total dissatisfaction per inst. customer"=

"wt. on speed vs. spread"*Sustained Dissatisfaction with Execution Time+(1-"wt. on speed vs. spread")*Sustained Dissatisfaction with Spread

Units: dissatisfaction unit/entity

"total pressure for e-trade"=

"pressure for e-trade per inst. customer"*Number of Institutional Customers

Units: pressure unit

total pressure for the specialist system=

pressure from customers for the specialist system+pressure from specialists for the specialist system

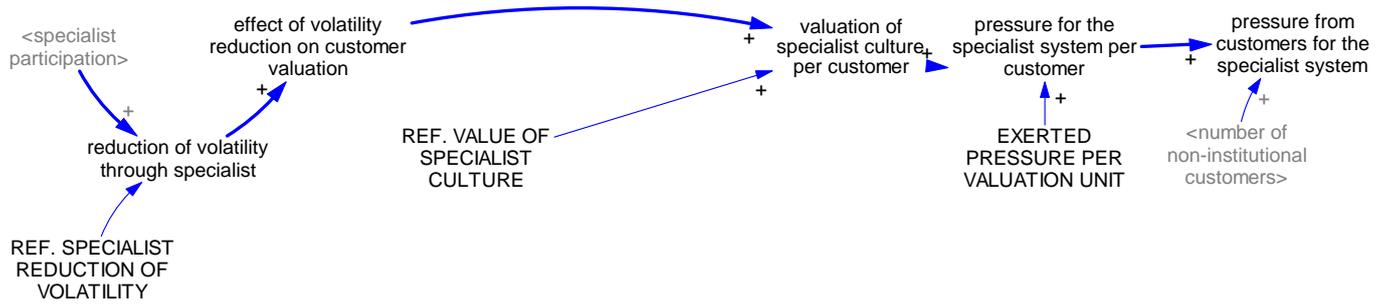
Units: pressure unit

"wt. on speed vs. spread"=

effect of program trading on weighting speed

Units: Dmnl

3 Appendix III: Customer Valuation of Specialist Culture



effect of volatility reduction on customer valuation= WITH LOOKUP (reduction of volatility through specialist,([(0,0)-(1,1)],(0,0.1),(0.25,0.25),(0.6,0.75),(0.75,0.87),(1,1)))
Units: Dmnl

EXERTED PRESSURE PER VALUATION UNIT= 1
Units: pressure unit/valuation unit

"number of non-institutional customers"=
"TOTAL NO. OF CUSTOMERS"-Number of Institutional Customers
Units: entity

pressure for the specialist system per customer=
valuation of specialist culture per customer*EXERTED PRESSURE PER VALUATION UNIT
Units: pressure unit/entity

pressure from customers for the specialist system=
pressure for the specialist system per customer*"number of non-institutional customers"
Units: pressure unit

reduction of volatility through specialist=
specialist participation/"REF. SPECIALIST REDUCTION OF VOLATILITY"
Units: reduction unit
Volatility 11.33 pre hybrid, and 12.12 since hybrid, units are 5 min/bps, Nyse Group (2007) NYSE completes Hyb. Mark. phase III activation.

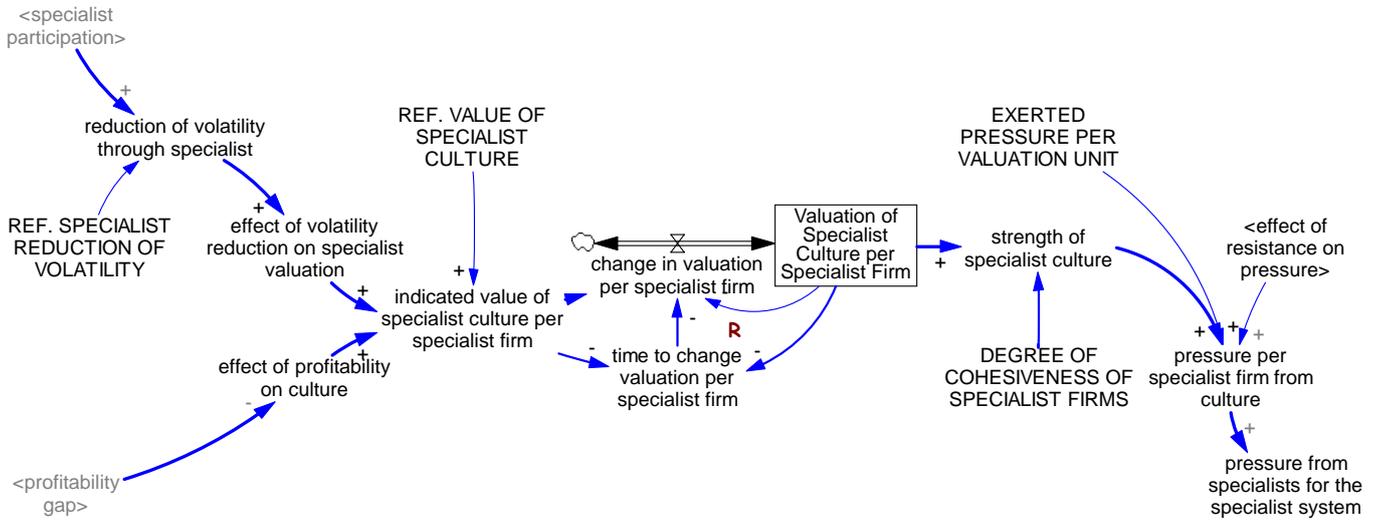
"REF. SPECIALIST REDUCTION OF VOLATILITY"= 1
Units: 1/reduction unit

"REF. VALUE OF SPECIALIST CULTURE"= 1
Units: valuation unit/entity

specialist participation=
fraction of floor trade
Units: Dmnl

valuation of specialist culture per customer=
effect of volatility reduction on customer valuation*"REF. VALUE OF SPECIALIST CULTURE"
Units: valuation unit/entity

4 Appendix IV: Specialist Valuation of Specialist Culture



"change in no. of specialist firms"=
 Number of Specialist Firms*"fract. change in no. of specialist firms"
 Units: entity/Year

change in valuation per specialist firm=
 (indicated value of specialist culture per specialist firm-Valuation of Specialist Culture per Specialist Firm)/time to change valuation per specialist firm
 Units: valuation unit/entity/Year

DEGREE OF COHESIVENESS OF SPECIALIST FIRMS= 0.6
 Units: Dmnl

effect of profitability on culture= WITH LOOKUP (profitability gap, ((-0.1,0)-(0.1,0.5)],(-0.1,0.5),(0,0.5),(0.02,0.435),(0.07,0.07),(0.1,0))
 Units: Dmnl

effect of profitability on exit fraction= WITH LOOKUP (profitability gap, ((-0.1,-1)-(0.1,0)],(-0.1,0),(0,0),(0.005,-0.02),(0.01,-0.04),(0.02,-0.07),(0.04,-0.085),(0.05,-0.09),(0.07,-0.1))
 Units: Dmnl

effect of resistance on pressure= WITH LOOKUP ("resistance against e-trade per specialist firm", ((0,0)-(2,2)],(0,0),(1,1),(2,2))
 Units: Dmnl

effect of volatility reduction on customer valuation= WITH LOOKUP (reduction of volatility through specialist,((0,0)-(1,1)],(0,0.1),(0.25,0.25),(0.6,0.75),(0.75,0.87),(1,1))
 Units: Dmnl

effect of volatility reduction on specialist valuation= WITH LOOKUP (reduction of volatility through specialist,((0,0)-(1,0.5)],(0,0.3),(0.25,0.31),(0.6,0.38),(0.75,0.44),(1,0.5))
 Units: Dmnl

EXERTED PRESSURE PER VALUATION UNIT= 1
 Units: pressure unit/valuation unit

"fract. change in no. of specialist firms"=
 effect of profitability on exit fraction*"REF. FRACT. EXIT PER YEAR"
 Units: Dmnl/Year

indicated value of specialist culture per specialist firm=
(effect of profitability on culture+effect of volatility reduction on specialist valuation)*"REF.
VALUE OF SPECIALIST CULTURE"

Units: valuation unit/entity

"number of non-institutional customers"=
"TOTAL NO. OF CUSTOMERS"-Number of Institutional Customers

Units: entity

Number of Specialist Firms= INTEG ("change in no. of specialist firms", 100)

Units: entity

More than 40 specialist firms in the early 1990s, WSJ 21. Nov. 07. (also Abolafia p. 146) The initial value of 100 is an educated guess that 20% of the members of the NYSE in 1960 were specialist firms vs. 80% brokerage firms.

pressure for the specialist system per customer=
valuation of specialist culture per customer*EXERTED PRESSURE PER VALUATION UNIT

Units: pressure unit/entity

pressure from customers for the specialist system=
pressure for the specialist system per customer*"number of non-institutional customers"

Units: pressure unit

pressure from specialists for the specialist system=
pressure per specialist firm from culture*Number of Specialist Firms

Units: pressure unit

pressure per specialist firm from culture=
strength of specialist culture*effect of resistance on pressure*EXERTED PRESSURE PER
VALUATION UNIT

Units: pressure unit/entity

"REF. FRACT. EXIT PER YEAR"= 1

Units: Dmnl/Year

"REF. VALUE OF SPECIALIST CULTURE"= 1

Units: valuation unit/entity

strength of specialist culture=
Valuation of Specialist Culture per Specialist Firm*DEGREE OF COHESIVENESS OF SPE-
CIALIST FIRMS

Units: valuation unit/entity

time to change valuation per specialist firm= WITH LOOKUP (ZIDZ(indicated value of specialist cul-
ture per specialist firm, Valuation of Specialist Culture per Specialist Firm),((0,0)-
(2,25)],(0,25),(0.35,24),(0.666667,22),(0.88,18.5),(0.98,12.5),(1,8),(1.1,6),(1.5,3),(1.75,2.5),(2,
2.5))

Units: Year

valuation of specialist culture per customer=
effect of volatility reduction on customer valuation*"REF. VALUE OF SPECIALIST CULTURE"

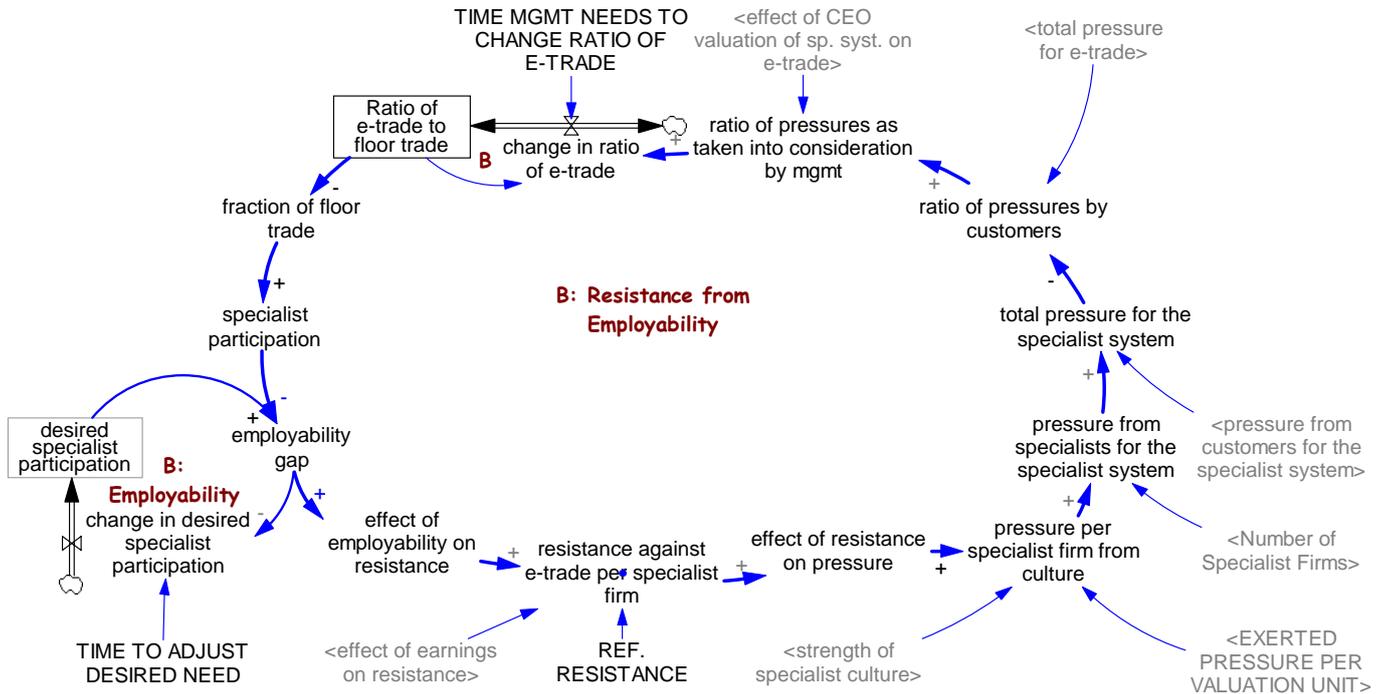
Units: valuation unit/entity

Valuation of Specialist Culture per Specialist Firm= INTEG (change in valuation per specialist firm, 1)

Units: valuation unit/entity

5 Appendix V: Resistance

Resistance from Employability Gap



change in desired specialist participation =

$$-\text{employability gap} / \text{TIME TO ADJUST DESIRED NEED}$$
 Units: Dmnl/Year

"change in ratio of e-trade" =

$$(\text{ratio of pressures as taken into consideration by mgmt} - \text{Ratio of e-trade to floor trade}) / \text{TIME MGMT NEEDS TO CHANGE RATIO OF E-TRADE}$$
 Units: Dmnl/Year

desired specialist participation = INTEG (change in desired specialist participation, "REF. DESIRED SPECIALIST PARTICIPATION")
 Units: Dmnl

"effect of CEO valuation of sp. syst. on e-trade" = WITH LOOKUP (CEO's Valuation of the Specialist System, ((0,0)-(1,2)],(0,2),(0.25,1),(0.5,0.5),(0.75,0.1),(1,0))
 Units: Dmnl

effect of earnings on resistance = WITH LOOKUP (profitability gap, ((0,0)-(0.05,1)],(0,0),(0.00625,0.04),(0.0125,0.125),(0.0185,0.25),(0.025,0.5),(0.03125,0.75),(0.0375,0.88),(0.044,0.96),(0.05,1))
 Units: Dmnl

effect of employability on resistance = WITH LOOKUP (employability gap, ((0,0)-(1,1)],(0,0),(0.0625,0.04),(0.125,0.125),(0.185,0.25),(0.25,0.5),(0.3125,0.75),(0.375,0.88),(0.44,0.96),(0.5,1))
 Units: Dmnl

effect of resistance on pressure = WITH LOOKUP ("resistance against e-trade per specialist firm", ((0,0)-(2,2)],(0,0),(1,1),(2,2))
 Units: Dmnl

employability gap =

$$\text{desired specialist participation} - \text{specialist participation}$$

Units: Dmnl

EXERTED PRESSURE PER VALUATION UNIT= 1

Units: pressure unit/valuation unit

fraction of floor trade=

$$1/(1+\text{"Ratio of e-trade to floor trade"})$$

Units: Dmnl

Number of Specialist Firms= INTEG ("change in no. of specialist firms", 100)

Units: entity

More than 40 specialist firms in the early 1990s, WSJ 21. Nov. 07. (also Abolafia p. 146) The initial value of 100 is an educated guess that 20% of the members of the NYSE in 1960 were specialist firms vs. 80% brokerage firms.

pressure from customers for the specialist system=

$$\text{pressure for the specialist system per customer} \times \text{"number of non-institutional customers"}$$

Units: pressure unit

pressure from specialists for the specialist system=

$$\text{pressure per specialist firm from culture} \times \text{Number of Specialist Firms}$$

Units: pressure unit

pressure per specialist firm from culture=

$$\text{strength of specialist culture} \times \text{effect of resistance on pressure} \times \text{EXERTED PRESSURE PER VALUATION UNIT}$$

Units: pressure unit/entity

"Ratio of e-trade to floor trade"= INTEG ("change in ratio of e-trade", 0)

Units: Dmnl

As the NYSE awaited regulatory approval to become a publicly traded company last year, the exchange opted to shelve the fee-increase plan after criticism from brokers such as Daniel Tandy, a member of the NYSE's board of executives at the time. This year, their complaints weren't enough. <http://www.rblt.com/documents/Bloombergnews9-8-06.pdf> (8. Nov. 07) Rosenberg Securities

ratio of pressures as taken into consideration by mgmt=

$$\text{ratio of pressures by customers} \times \text{"effect of CEO valuation of sp. syst. on e-trade"}$$

Units: Dmnl

ratio of pressures by customers=

$$\text{"total pressure for e-trade"}/\text{total pressure for the specialist system}$$

Units: Dmnl

"REF. DESIRED SPECIALIST PARTICIPATION"= 1

Units: Dmnl

"REF. RESISTANCE"= 0.5

Units: resistance unit/entity

"resistance against e-trade per specialist firm"=

$$(\text{effect of employability on resistance} + \text{effect of earnings on resistance}) \times \text{"REF. RESISTANCE"}$$

Units: resistance unit/entity

specialist participation=

$$\text{fraction of floor trade}$$

Units: Dmnl

strength of specialist culture=

$$\text{Valuation of Specialist Culture per Specialist Firm} \times \text{DEGREE OF COHESIVENESS OF SPECIALIST FIRMS}$$

Units: valuation unit/entity

"effect of CEO valuation of sp. syst. on e-trade"= WITH LOOKUP (CEO's Valuation of the Specialist System, ((0,0)-(1,2)],(0,2),(0.25,1),(0.5,0.5),(0.75,0.1),(1,0))

Units: Dmnl

effect of earnings on resistance= WITH LOOKUP (profitability gap,((0,0)-(0.05,1)],(0,0),(0.00625,0.04),(0.0125,0.125),(0.0185,0.25),(0.025,0.5),(0.03125,0.75),(0.0375,0.88),(0.044,0.96),(0.05,1))

Units: Dmnl

effect of employability on resistance= WITH LOOKUP (employability gap, ((0,0)-(1,1)],(0,0),(0.0625,0.04),(0.125,0.125),(0.185,0.25),(0.25,0.5),(0.3125,0.75),(0.375,0.88),(0.44,0.96),(0.5,1))

Units: Dmnl

"effect of inst. customers on commission"= WITH LOOKUP (Number of Institutional Customers, ((0,0)-(80,1)],(10,1),(25,0.85),(60,0.15),(80,0.01))

Units: Dmnl

effect of NYSE trading volume on NYSE spread= WITH LOOKUP (NYSE trading volume/"ref. trading volume",((0,0)-(1,2)],(0,1.3),(0.1,1.27),(0.25,1.2),(0.5,1),(0.75,0.8),(0.9,0.73),(1,0.7))

Units: Dmnl

effect of resistance on pressure= WITH LOOKUP ("resistance against e-trade per specialist firm", ((0,0)-(2,2)],(0,0),(1,1),(2,2))

Units: Dmnl

EXERTED PRESSURE PER VALUATION UNIT= 1

Units: pressure unit/valuation unit

"fraction of e-trade"=

"Ratio of e-trade to floor trade"/(1+"Ratio of e-trade to floor trade")

Units: Dmnl

80% of volume was automatic on 8. Jan. 07, Nyse Group (2007) NYSE completes Hyb. Mark. phase III activation

fraction of floor trade=

1/(1+"Ratio of e-trade to floor trade")

Units: Dmnl

Number of Institutional Customers= INTEG ("change in no. of institutional customers", 10)

Units: entity

Number of Specialist Firms= INTEG ("change in no. of specialist firms", 100)

Units: entity

More than 40 specialist firms in the early 1990s, WSJ 21. Nov. 07. (also Abolafia p. 146) The initial value of 100 is an educated guess that 20% of the members of the NYSE in 1960 were specialist firms vs. 80% brokerage firms.

NYSE spread=

("fraction of e-trade"*"SPREAD IN E-TRADE"+fraction of floor trade*SPREAD IN FLOOR TRADE)*(effect of NYSE trading volume on NYSE spread)

Units: \$/share

THE SPREAD IS THE DIFFERENCE BETWEEN BID AND ASK PRICE. and reduced volatility was the key criterion of market quality. http://www.nyse.com/pdfs/hm_booklet.pdf (30. Sep. 07) NYSE

Hybrid Market Training Program. quoted spread pre hybrid 20.95, since hybrid 18.32, effective spread pre hybrid 7.50, since hybrid 8.17 bps, Nyse Group (2007) NYSE completes Hyb. Mark.

phase III activation

pressure from customers for the specialist system=

pressure for the specialist system per customer*"number of non-institutional customers"
Units: pressure unit

pressure from specialists for the specialist system=
pressure per specialist firm from culture*Number of Specialist Firms
Units: pressure unit

pressure per specialist firm from culture=
strength of specialist culture*effect of resistance on pressure*EXERTED PRESSURE PER
VALUATION UNIT
Units: pressure unit/entity

profitability gap=
desired earnings-specialists' earnings per share
Units: \$/share

"Ratio of e-trade to floor trade"= INTEG ("change in ratio of e-trade",0)
Units: Dmnl

As the NYSE awaited regulatory approval to become a publicly traded company last year, the exchange opted to shelve the fee-increase plan after criticism from brokers such as Daniel Tandy, a member of the NYSE's board of executives at the time. This year, their complaints weren't enough. <http://www.rblt.com/documents/Bloombergnews9-8-06.pdf> (8. Nov. 07) Rosenberg Securities

ratio of pressures as taken into consideration by mgmt=
ratio of pressures by customers*"effect of CEO valuation of sp. syst. on e-trade"
Units: Dmnl

ratio of pressures by customers=
"total pressure for e-trade"/total pressure for the specialist system
Units: Dmnl

"REF. COMMISSION PER SHARE"= 0.05
Units: \$/share

"REF. DESIRED EARNINGS"= 0.19
Units: \$/share

"REF. RESISTANCE"= 0.5
Units: resistance unit/entity

"resistance against e-trade per specialist firm"=
(effect of employability on resistance+effect of earnings on resistance)*"REF. RESISTANCE"
Units: resistance unit/entity

specialists' earnings per share=
(NYSE spread+commission per share)
Units: \$/Year

"SPREAD IN E-TRADE"= 0.1
Units: \$/share
\$0.2 according to Jain (2005), S. 2969. According to the NYSE execution quality in 2003-04 the spread is around \$0.05 per share.

SPREAD IN FLOOR TRADE= 0.2
Units: \$/share
Jain (2005), S. 2969. According to the NYSE execution quality in 2003-04 the spread is around \$0.05 per share.

strength of specialist culture=
Valuation of Specialist Culture per Specialist Firm*DEGREE OF COHESIVENESS OF SPECIALIST FIRMS

Units: valuation unit/entity

"TIME MGMT NEEDS TO CHANGE RATIO OF E-TRADE"= 5

Units: Year

TIME TO ADJUST DESIRED EARNINGS= 10

Units: Year

"total pressure for e-trade"=

"pressure for e-trade per inst. customer"*Number of Institutional Customers

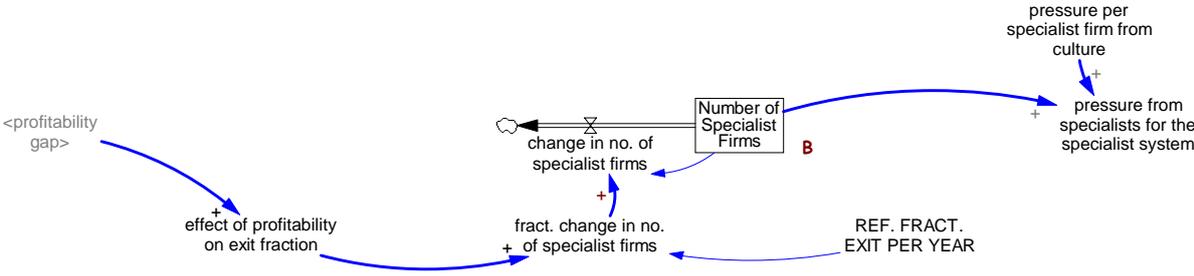
Units: pressure unit

total pressure for the specialist system=

pressure from customers for the specialist system+pressure from specialists for the specialist system

Units: pressure unit

6 Appendix VI: Specialist Firms and Firms Which Derive Income from Trading



"change in no. of specialist firms"=
 Number of Specialist Firms*"fract. change in no. of specialist firms"
 Units: entity/Year

effect of profitability on exit fraction= WITH LOOKUP (profitability gap, [(-0.1,-1)-(0.1,0)], (-0.1,0),(0,0),(0.005,-0.02),(0.01,-0.04),(0.02,-0.07),(0.04,-0.085),(0.05,-0.09),(0.07,-0.1))
 Units: Dmnl

"fract. change in no. of specialist firms"=
 effect of profitability on exit fraction*"REF. FRACT. EXIT PER YEAR"
 Units: Dmnl/Year

Number of Specialist Firms= INTEG ("change in no. of specialist firms", 100)
 Units: entity

More than 40 specialist firms in the early 1990s, WSJ 21. Nov. 07. (also Abolafia p. 146) The initial value of 100 is an educated guess that 20% of the members of the NYSE in 1960 were specialist firms vs. 80% brokerage firms.

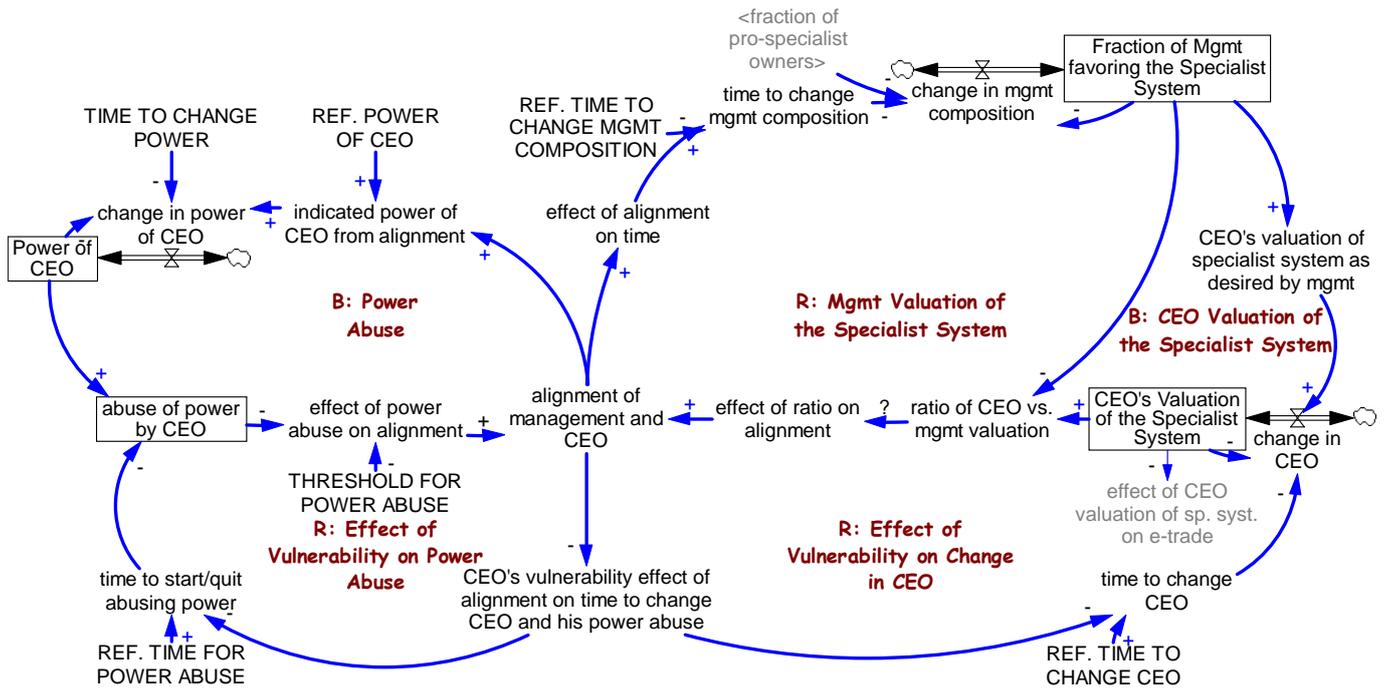
pressure from specialists for the specialist system=
 pressure per specialist firm from culture*Number of Specialist Firms
 Units: pressure unit

pressure per specialist firm from culture=
 strength of specialist culture*effect of resistance on pressure*EXERTED PRESSURE PER VALUATION UNIT
 Units: pressure unit/entity

profitability gap=
 desired earnings-specialists' earnings per share
 Units: \$/share

"REF. FRACT. EXIT PER YEAR"= 1
 Units: Dmnl/Year

7 Appendix VII: Management and CEO



abuse of power by CEO =
 $\text{SMOOTH3}(\text{Power of CEO}, \text{"time to start/quit abusing power"})$
 Units: power unit

alignment of management and CEO =
 $\text{effect of ratio on alignment} * \text{effect of power abuse on alignment}$
 Units: Dmnl

CEO's valuation of specialist system as desired by mgmt =
 $\text{Fraction of Mgmt favoring the Specialist System}$
 Units: Dmnl

CEO's Valuation of the Specialist System = $\text{INTEG}(\text{change in CEO}, 1)$
 Units: Dmnl

CEO's vulnerability effect of alignment on time to change CEO and his power abuse = $\text{WITH LOOKUP}(\text{alignment of management and CEO}, ((0,0)-(1,3)], (0,0.2), (0.1, 0.25), (0.25, 0.35), (0.5, 1), (0.8, 2.6), (1, 3))$
 Units: Dmnl

change in CEO = $(\text{CEO's valuation of specialist system as desired by mgmt} - \text{CEO's Valuation of the Specialist System}) / \text{time to change CEO}$
 Units: Dmnl/Year

change in mgmt composition = $(\text{"fraction of pro-specialist owners"} - \text{Fraction of Mgmt favoring the Specialist System}) / \text{time to change mgmt composition}$
 Units: Dmnl/Year

change in power of CEO =
 $(\text{indicated power of CEO from alignment} - \text{Power of CEO}) / \text{TIME TO CHANGE POWER}$
 Units: power unit/Year

effect of alignment on time = $\text{WITH LOOKUP}(\text{alignment of management and CEO}, ((0,0)-(1,10)], (0,0.1), (0.1, 0.15), (0.25, 0.35), (0.5, 1.5), (0.8, 5), (1, 10))$
 Units: Dmnl

"effect of CEO valuation of sp. syst. on e-trade"= WITH LOOKUP (CEO's Valuation of the Specialist System, ((0,0)-(1,2)],(0,2),(0.25,1),(0.5,0.5),(0.75,0.1),(1,0))
Units: Dmnl

effect of power abuse on alignment= WITH LOOKUP (abuse of power by CEO/THRESHOLD FOR POWER ABUSE,(((0.99,0)-(1,2)],(0.99,1),(0.992477,0.85),(0.997462,0.15),(1,0))
Units: Dmnl

effect of ratio on alignment= WITH LOOKUP ("ratio of CEO vs. mgmt valuation",(((0,0)-(20,1)],(0,0),(0.6,0.25),(0.95,0.5),(0.96,0.7),(0.97,0.85),(0.98,0.95),(0.99,0.98),(1,1),(1.2,0.98),(1.4,0.95),(1.6,0.85),(1.8,0.7),(2,0.5),(5,0.25),(20,0))
Units: Dmnl

Fraction of Mgmt favoring the Specialist System= INTEG (change in mgmt composition, 1)
Units: Dmnl

"fraction of pro-specialist owners"=
Number of Specialist Firms/(Number of Specialist Firms+Number of Institutional Owners)
Units: Dmnl

indicated power of CEO from alignment=
alignment of management and CEO*"REF. POWER OF CEO"
Units: power unit

Power of CEO= INTEG (change in power of CEO,0)
Units: power unit

"ratio of CEO vs. mgmt valuation"=
CEO's Valuation of the Specialist System/Fraction of Mgmt favoring the Specialist System
Units: Dmnl

"REF. POWER OF CEO"= 1
Units: power unit

"REF. TIME FOR POWER ABUSE"= 10
Units: Year

"REF. TIME TO CHANGE CEO"= 3
Units: Year

"REF. TIME TO CHANGE MGMT COMPOSITION"= 5
Units: Year

THRESHOLD FOR POWER ABUSE= 0.8
Units: power unit

time to change CEO= CEO's vulnerability effect of alignment on time to change CEO and his power abuse*"REF. TIME TO CHANGE CEO"
Units: Year

time to change mgmt composition=
"REF. TIME TO CHANGE MGMT COMPOSITION"*effect of alignment on time
Units: Year

TIME TO CHANGE POWER= 0.5
Units: Year

"time to start/quit abusing power"=
"REF. TIME FOR POWER ABUSE"*CEO's vulnerability effect of alignment on time to change CEO and his power abuse
Units: Year

ACCESS TO INFORMATION TECHNOLOGY

Units: Dmnl

"fraction of e-trade"=

"Ratio of e-trade to floor trade"/(1+"Ratio of e-trade to floor trade")

Units: Dmnl

80% of volume was automatic on 8. Jan. 07, Nyse Group (2007) NYSE completes Hyb. Mark.
phase III activation

fraction of floor trade=

1/(1+"Ratio of e-trade to floor trade")

Units: Dmnl

indicated market share=

(effect of spread on market share+effect of trade execution time on market share+"effect of
NBBO-rule") *"REF. MARKET SHARE"

Units: Dmnl

NYSE market share= INTEG ((change in market share),0.7)

Units: Dmnl

Every percentage point in market share equals about \$2.3 million of net income for NYSE Group, ac-
cording to estimates by analysts at New York-based JPMorgan Chase & Co.

<http://www.rblt.com/documents/Bloombergnews9-8-06.pdf> (8. Nov. 07) Rosenberg
Securities

NYSE spread=

("fraction of e-trade"*"SPREAD IN E-TRADE"+fraction of floor trade*SPREAD IN FLOOR
TRADE)*(effect of NYSE trading volume on NYSE spread)

Units: \$/share

THE SPREAD IS THE DIFFERENCE BETWEEN BID AND ASK PRICE. and reduced volatility was
the key criterion of market quality. http://www.nyse.com/pdfs/hm_booklet.pdf (30. Sep. 07)
NYSE

Hybrid Market Training Program. quoted spread pre hybrid 20.95, since hybrid 18.32,
effective spread pre hybrid 7.50, since hybrid 8.17 bps, Nyse Group (2007) NYSE completes
Hyb. Mark.
phase III activation

NYSE trading volume=

NYSE market share*TOTAL SHARES TRADED

Units: share/Year

"Ratio of e-trade to floor trade"= INTEG ("change in ratio of e-trade",0)

Units: Dmnl

As the NYSE awaited regulatory approval to become a publicly traded company last year, the ex-
change opted to shelve the fee-increase plan after criticism from brokers such as Daniel
Tandy, a member of the NYSE's board of executives at the time. This year, their complaints
weren't enough. <http://www.rblt.com/documents/Bloombergnews9-8-06.pdf> (8. Nov. 07)
Rosenberg Securities

"REF. MARKET SHARE"= 0.5

Units: Dmnl

"ref. trading volume"=

SMOOTH(TOTAL SHARES TRADED, "TIME TO ADJUST REF. TRADING VOLUME")

Units: share/Year

750 million

relative spread of NYSE=

NYSE spread/spread in market

Units: Dmnl

"SPREAD IN E-TRADE"= 0.1

Units: \$/share

\$0.2 according to Jain (2005), S. 2969. According to the NYSE execution quality in 2003-04 the spread is around \$0.05 per share.

SPREAD IN FLOOR TRADE=

0.2

Units: \$/share

Jain (2005), S. 2969. According to the NYSE execution quality in 2003-04 the spread is around \$0.05 per share.

spread in market=

("fraction of e-trade in market"*"SPREAD IN E-TRADE"+(1-"fraction of e-trade in market")*SPREAD IN FLOOR TRADE)*"effect of trading volume in m. on market's spread"

Units: \$/share

TIME FOR CHANGING MARKET SHARE= 20

Units: Year

"TIME TO ADJUST REF. TRADING VOLUME"= 2

Units: Year

TOTAL SHARES TRADED= WITH LOOKUP (Time,(((1900,0)-(2100,4e+012)],(1960,1e+009),(1970,3.5e+009),(1980,1.4e+010),(1990,4.8e+010),(1995,1e+011),(2000,2.8e+011),(2005,4.5e+011),(2007,5.5e+011),(2010,9e+011),(2015,1.8e+012),(2020,2.1e+012),(2030,2.3e+012),(2040,2.4e+012),(2050,2.45e+012)))

Units: share/Year

1 billion (1 Milliarde), 3.75e+009+RAMP(1.8e+010 ,1970, 2007). Data is referred from NYSE trading volume, Annual reported volume, turnover rate, reported trades (mils. of shares), NYSE

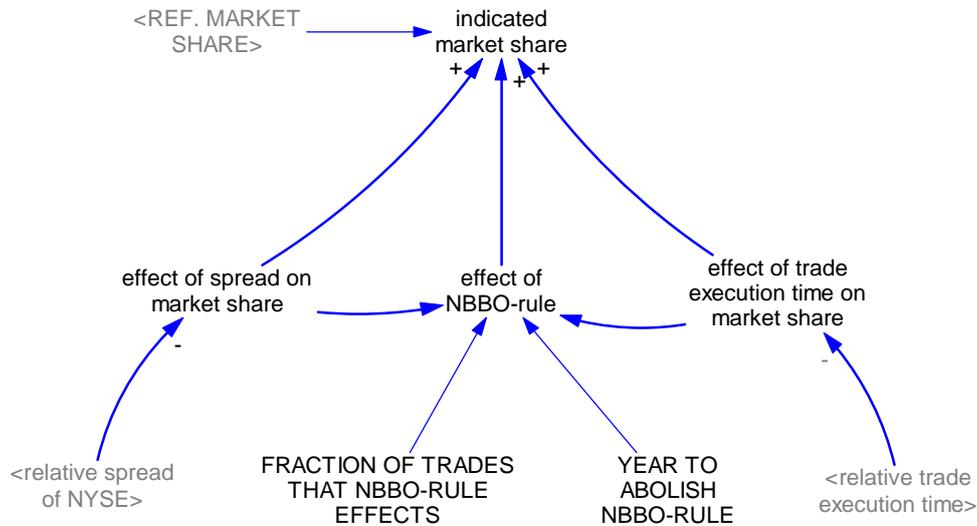
facts and figures. Data after 2007 is assumed.!!!

trading volume of the remaining market=

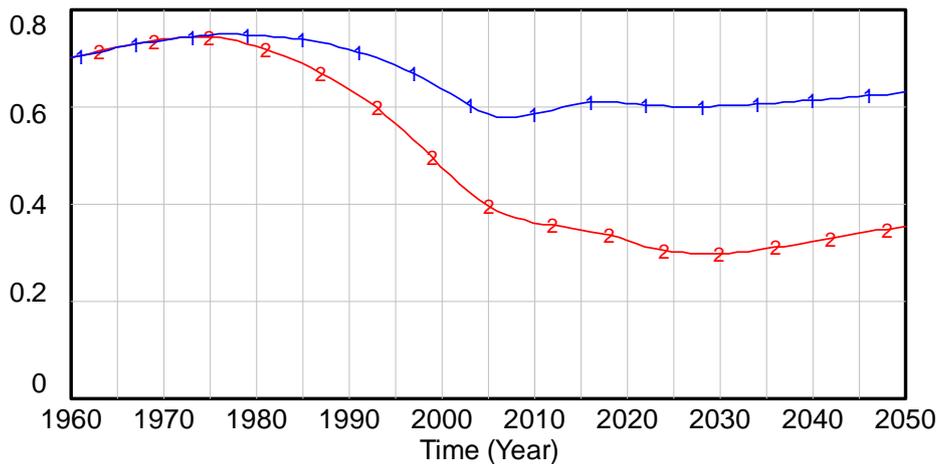
(1-NYSE market share)*TOTAL SHARES TRADED

Units: share/Year

9 Appendix IX: National Best Bid and Offer Rule



NYSE market share



NYSE market share : fin.rep. ref. mode — 1 1 1 1 1 1 Dmnl
 NYSE market share : fin.rep. no NBBO-rule - 2 2 2 2 2 2 Dmnl

"effect of NBBO-rule"=

(effect of spread on market share-effect of trade execution time on market share)
)*PULSE(1960,"YEAR TO ABOLISH NBBO-RULE"-1960)*"FRACTION OF TRADES THAT NBBO-RULE EFFECTS"

Units: Dmnl

This variable extinguishes the effect of trade execution time because it forces volume to remain at the NYSE because they have the national best bid and offer.

effect of spread on market share= WITH LOOKUP (relative spread of NYSE,(((0,0)-(2,1)),(0,1),(0.4,0.9),(0.75,0.75),(1,0.5),(1.25,0.25),(1.6,0.1),(2,0)))

Units: Dmnl

effect of trade execution time on market share= WITH LOOKUP (relative trade execution time, (((0,0)-(2,1)),(0,1),(0.4,0.95),(0.75,0.9),(1,0.8),(1.25,0.4),(1.6,0.2),(2,0)))

Units: Dmnl

"FRACTION OF TRADES THAT NBBO-RULE EFFECTS"= 0.7

Units: Dmnl

87% of the time the NYSE had the NBBO on 8. Jan. 07, Nyse Group (2007) NYSE completes Hyb. Mark. phase III activation

indicated market share=

(effect of spread on market share+effect of trade execution time on market share+"effect of NBBO-rule") *"REF. MARKET SHARE"

Units: Dmnl

"REF. MARKET SHARE"= 0.5

Units: Dmnl

relative spread of NYSE=

NYSE spread/spread in market

Units: Dmnl

relative trade execution time=

NYSE trade execution time/execution time in market

Units: Dmnl

"YEAR TO ABOLISH NBBO-RULE"= 2050

Units: Year