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AN ANALYSIS OF FACTORS CRITICAL TO THE SUCCESS OF FINANCIAL FUTURES CONTRACTS

Sarah Samuel

A Thesis
in
The Faculty
of
Commerce and Administration

Presented in Partial Fulfilment of the Requirements for the Degree of
Master of Science in Administration at
Concordia University
Montreal, Quebec, Canada

August 1994

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ISBN 0-612-05119-6

Abstract

An Analysis of Factors Critical to the Success of Financial Futures Contracts

Sarah Samuel

This paper empirically examines the factors which affect the success of financial futures contracts traded internationally. The measure of success is the trading volume that the contract can attract in the year. The theoretical model developed suggests that success of a financial futures contract depend on country, exchange, commodity and contract characteristics. Our empirical analysis was based on data obtained from 16 exchanges, from 11 countries. Data for the 65 contracts was examined for the year 1992. Four different regression models were developed. From these models, the best model, that is the double log model was chosen. The country factors which were found to be statistically significant and positively related to annual trading volume include industrial structure and exposure to price risk of the country and the degree of inflation. Exchange factors found to be positively related were partial electronic trading and the size and resource availability of the exchange. The contract factor found to be positively related included the minimum price limit and age of the contract. The contract factor found to be negatively related to annual trading volume was the average initial margin.

Acknowledgements

This research was completed under the supervision of Dr. Latha Shanker. I would like to thank her for her guidance and supervision. I am also thankful to Dr. Fassil Nebebe for his assistance and valuable comments.

Thanks to my parents who have always encouraged me in all my endeavours and without whom I would not have been able to study at Concordia. I would also like to thank Shapoor for his support, patience and love.

Finally, thanks are due to Concordia University for providing the MSc. Research grant which facilitated this research and to the various futures exchanges for the information and data they provided.

TO MY PARENTS

Table of Contents

Tables

Appendixes

Introduction

Futures contracts are standardized contracts that trade in organized exchanges. These contracts are legally enforceable commitments to buy/sell a pre specified quantity and quality of a specific underlying commodity. The contract specifies the price at which the commodity should be bought/sold and the future delivery date. A trader who buys the contract pays the current futures price, which is established through open outcry on the floor of the exchange. The trader can satisfy his/her obligation either by physically receiving the goods and paying for it, or by cancelling the obligation. In the case of financial futures contracts, delivery is either made of the underlying financial instruments or, by a cash settlement. The individual can cancel the obligation, offsetting the initial transaction by selling a similar futures contract. If the price at which the sale is made is above/below the price at which the contract was bought, then the trader receives a gain/loss. For every buyer, there is a corresponding seller. An exchange typically has a clearing organization that positions itself as an intermediary in every trade. The clearing organization requires some good faith money, that is, a margin, from each trader as a guarantee that he/she will abide by the terms of the contract. In this way, since all trades are made to a known entity, which makes provisions to eliminate any possibility of default, the traders need not worry about the credit risk of the other participants in the market.

Commodity futures contracts have been actively traded since the turn of the century. However, it was not until 1972, when the Bretton Woods system of fixed exchange rates collapsed and exchange rates of the countries started to fluctuate, that the first financial futures contracts began to appear on the exchanges.

The Chicago Mercantile Exchange (CME) was the first to launch this type of product in 1972. It was a foreign currency futures contract. Soon, other financial futures contracts such as interest rate futures and stock index futures followed. Since the advent of the first currency futures contract the number of financial futures contracts introduced and traded has greatly increased both in the U.S. and around the world. Miller (1986) reviews the past twenty years of financial innovation and bestows the accolade of "the most successful financial innovation" upon financial futures. Miller (1990) notes that the Chicago Mercantile Exchange traded more than 100 million contracts in 1989, most of which were on financial instruments and foreign currencies. Computed in nominal dollar value, these contracts equal or exceed the dollar value of shares traded on the New York Stock Exchange (NYSE). Carlton (1984) found that in North America, the number of financial futures contracts rose from nine in 1978 to 15 in 1983. By 1988 this number had risen to over 45.

While the U.S. exchanges currently dominate futures trading, their market share has been eroded by foreign futures exchanges. Miller (1990) documents that the U.S. exchanges had a market share of 100% in 1980. This figure fell to 94% in 1985 and thence to 63% in 1990. This decline has been due to the opening of new futures exchanges outside the U.S. The growth in the number of financial futures exchanges today far exceeds the growth in the number of commodity exchanges, both in the U.S. and around the world. Between 1980 and 1990 the growth rate for the number of financial futures exchanges inside and outside the U.S. was 50% and 1500% respectively. In the case of commodity futures exchanges, the rates were 10% and -10% respectively. Furthermore, the volume of contracts traded at these new exchanges has increased dramatically within a few years. For example, the London International Financial Futures Exchange (LIFFE), which opened in 1982, traded 38.6 million contracts a year in 1991. Likewise, Le Marche a Terme International de France (MATIF), which opened in 1986, traded 37.1 million contracts in 1991, and the Deutsche Terminborse (DTB), which opened in 1990, had an annual turnover of 15.4 million contracts in 1991.

Due to growing worldwide competition in the market for financial futures trading, and due to increasingly dynamic and maturing markets, futures exchanges are constantly searching for new contracts to sustain growth and competitive advantage. One might imagine that such a high volume turnover of futures contracts and the enormous growth of the financial futures exchanges implies that most of the new financial futures contracts introduced are successful. On the contrary, the number of contracts currently trading represent only a small number of those that were introduced since the exchanges opened. Despite careful analysis before the introduction of a contract by the exchange, on average, approximately two-thirds of all futures contracts never attract more than a limited amount of trading volume and open interest, and so have been discontinued. Silber (1981) performed a study on the success of futures contracts in the U.S between 1960-77. He found that only 25% of all the contracts introduced during that time period reached a trading volume of over 10,000 contracts at the end of the third year. Carlton studied contract success rate between 1921-1983 and discovered that on average 50 to 60% of contracts failed within 10 years after they were introduced. In Canada, the Toronto Futures Exchange (TFE), which opened in 1984, has since introduced six financial futures contracts of which only one, the Toronto 35 Index futures contract, which was introduced in 1989, is still trading.

Thus, the determinants of futures contract success is of significant concern to futures exchanges. All exchanges would benefit greatly from a model which could directly link identifiable characteristics to worldwide success of a new and innovative financial futures contract. With the aid of such a model the number of contracts that fail could be decreased, the cost incurred by the exchanges to introduce the contract and eventually discontinue it, would be reduced. The costs to participants of the exchange due to the failure of contracts could be minimized, and portfolio managers will thus be inclined to add futures contracts to their portfolios. This would lead not only to greater volume of trading in the contracts presently trading on the exchanges but would also increase the potential success of future contract innovations. The presence of new contracts would provide alternate markets for the public and help efficiently redistribute risk through hedging. The greater volume of trading would also create greater liquidity, thus leading to an increase in efficiency.

The purpose of this paper is to develop a model which links the global success of financial futures contracts to country, exchange, commodity and contract factors. Our approach is unique in that it is the first to study all the three types of futures contracts, that is currency, stock index, and interest rate futures contracts. Furthermore, we are also the first to analyze contracts which were introduced both inside and outside the United States. We will present a theoretical model, which will be empirically investigated using data on financial futures contracts offered on five U.S exchanges (the Chicago Mercantile Exchange, the Chicago Board of Trade, the New York Futures Exchange, the Kansas City Board of Trade and the Mid American Commodity Exchange). The foreign exchanges include the London International Financial Futures Exchange (LIFFE) of the United Kingdom, French International Futures and Options Exchange (MATIF) of France, the Singapore International Monetary Exchange Limited (SIMEX) of Singapore, Bolsa De Mercadorias & Futuros (BM&F) in Brazil, Toronto Futures Exchange (TFE) and the Montreal Stock Exchange (MSE) of Canada, Sydney Futures Exchange (SFE) in Australia, Tokyo International Financial Futures Exchange (TIFFE) in Japan, Deutsche Terminborse (DTB) in Germany, Swiss Options and Financial Futures Exchange (SOFFEX) in Switzerland and Meff Renta Fija (MEFF) in Spain. Section 1 develops the theoretical framework on which our analysis is based. Section 2 describes the data, our measure of contract success and the methodology of the empirical tests conducted. Section 3 examines the empirical models developed and interprets the results obtained, and Section 4 states the conclusions of our study.

1. Theoretical Framework

Prior studies on the determinants of trading volume have focused primarily on commodity contracts, and were contract specific. Johnson and McConnell (1989) were among the first to look at financial futures contracts. Their study was based on the GNMA-CDR contracts. The GNMA-CDR was a Government National Mortgage Association Collateralized Depository Receipt futures contract. It was a contract on a mortgage-backed security, introduced in 1975 and was the first interest rate futures contract. It was successful for the first six years, but failed thereafter. Johnson and McConnell attributed this failure to flaws in contract design. Although this case by case analysis was very informative, the results obtained were commodity specific.

Black (1986), was the first to address the issue of contract success/failure on a wide range of futures contracts. Her approach however, was different from previous studies in that it was more general, and included variables which captured both commodity and contract characteristics. Her model however has poor forecasting ability because in order to predict success of a new contract which has not yet been introduced, the values of the variable which are meant to capture the contract characteristics have to be assumed.

Our model is different in that we classify the characteristics that affect the success of financial futures contracts in the global context into country, exchange, commodity and contract characteristics. Each is described below. We hypothesize that these factors and their interactions affect the success of financial futures contracts.

1.1. Country Factors

We consider the effect of the rate of inflation, industrial structure and exposure to risk, the intensity of regulation of futures markets and the political risk of the country.

1.1.1. Inflation

Financial futures markets exist due to price uncertainty in the underlying commodity. When price uncertainty increases, the use of financial futures markets also increases. Carlton (1984) and Martell and Wolf (1987) note that there is a direct link between financial futures trading volume and the inflation rate. This is because high inflation is accompanied by high relative price variability. (See Vinning and Elwertowski (1976) and Parks (1978))

Working (1953a) states, that during times of high expected inflation, firms and individuals take part in discretionary hedging. This means that hedgers are drawn to financial futures markets in order to hedge themselves against price uncertainty of their portfolios. The presence of hedgers in the market attracts speculators as they try to profit by taking a risky position. As the incentive for traders to enter the market rises, the demand for the contracts increases, trading volume builds up and the probability of success of the contract increases.

The underlying commodities of the financial futures contracts such as stock indexes, foreign exchange and interest rate instruments are all affected by expectations of high inflation. When high inflation is expected, these expectations are reflected in the price of the underlying assets. During times of high expected inflation, the price volatility of stock prices are higher. The need to hedge against this uncertainty is greater. Expected inflation also affects interest rates and exchange rates. The uncertainty in the price of the underlying commodity can be hedged using futures contracts. Thus, the demand for financial futures would increase as inflation rises. A good example of a country with high inflation is Brazil. The Bolsa Mercentil & Futuros (BM&F), one of the largest futures exchanges in South America, recorded that there was a large growth in the number of financial futures contracts traded between 1990 and 1992. Between the years 1990 and 1992 the CPI index, valued at 100 with the base year of 1985, rose from an annual average of 2,664,750 to 158,350,667. During this period, the daily average trading volume of interest rate futures increased from 2,951 trades in 1990 to 56,975 in 1992. In the case of stock index futures, the average daily trading volume in 1990 was 10,541 trades, and by 1992 this figure had risen to 29,504. Foreign currency futures contracts daily trading volume in 1992 was 19,897, which exhibits a large increase from 2,554 contracts in 1990. This example clearly indicates how inflation affects trading volume of financial futures contracts.

1.1.2. Industrial Structure and Exposure to Risk

With reference to commodity futures, Carlton states that vertical integration in a country is a substitute for a futures market. This is true for financial futures contracts as well. For example, in the case of stock index futures, the underlying commodity, the stock index, consists of the weighted average stock price of a number of companies in the country. These companies produce products which are bought and sold in the market place. When vertical integration exists, the components which make up the final product in an integrated firm, may be bought internally at prices less than the price at which they would have to be purchased for from the open market. Thus, a vertically integrated firm is less affected by price uncertainty than a single-industry firm. When this occurs on a country-wide scale it leads to lower variability of stock index prices. Lack of vertical integration creates higher price uncertainty of the underlying commodity, and thus a greater need to hedge exists. This increases the demand for financial futures contracts.

When substitute markets exist, or when hedgers in a particular country have portfolios which are well diversified, there is less need for financial futures. This is true of financial institutions which match their assets and liabilities to lower exposure to interest rate fluctuations. Another example is the case of diversified multinationals, which have lower net exposure to foreign exchange risk. Lower exposure leads to a reduced need to hedge, which in turn leads to a decrease in demand for financial futures contracts.

1.1.3. Regulations

Most countries have a body which regulates the introduction of new contracts. The exchanges are required to meet certain specifications in order to proceed with introduction. Silber states that when the contract is approved on the basis of equal representation of all those involved, ie. hedgers, speculators and public interest, then the chances of manipulation of the terms of the contract, to suit the interests of one group, are reduced. Since traders are attracted to markets in which chances of manipulation are minimized, the contracts' probability of success will be increased.

A flip side exists to this form of regulation. Often when a new contract is developed and submitted to the regulatory body, there is a time delay before it is approved. This delay may have a critical effect on the contract's chances of survival. In many cases it is essential to take advantage of factors such as higher expected inflation, or respond to a specific need in the market. Consider the GNMA futures contract, which was introduced during a period of rising interest rates and was successful until interest rates started to decline. Hypothetically speaking, if the contract were to be approved when interest rate were declining, it would have failed immediately. A need which could be satisfied by the GNMA had existed when interest rates were rising, however, under conditions of declining interests rates the need no longer existed. In those countries in which the regulatory bodies are both fast and efficient the chances of success of a new contract are higher.

If traders are able to use futures markets to get around some of the laws which apply to the cash market then there will be a higher demand for futures contracts. An example of this is taxation. In some countries, the various taxation rules which govern for futures trading create incentives for some types of investors to use futures positions instead of positions in the cash securities. Therefore, countries in which regulation of futures markets are less stringent than of cash markets attract traders for tax avoidance reasons rather than for hedging and speculation. Carlton, provides an example of this. In 1983, gains from futures markets in the U.S were taxed at a maximum of 32%, while short-term capital gains from investment in a cash security were taxed at 50%. Thus an individual in the high tax bracket would be more inclined to trade in futures markets, since s/he will face a lower maximum limit on taxation.

1.1.4 Political Risk

When there is high political risk in a country then there is a lower likelihood of new foreign investment within that country. Political risk is usually followed by economic instability. Due to uncertainties investors are less likely to invest in such areas of the world. Even the domestic traders are likely to traded in foreign markets. Thus if political uncertainty and unrest exist then there is a lower chance of the contracts succeeding. Thus we hypothesize that the greater the political risk the lower the volume of trading for the financial futures contracts in that country.

1.2. Exchange Factors

Exchange factors include the structure of the exchange, existence of substitute markets, support available for new contracts, specialization of the exchange, presence of duplicate contracts, size and resources available at the exchange, the confidence of the public in the exchange and, lastly, the trading system used on the exchange. These variables, unlike the country factors, can be influenced by the exchange. Ensuring that the right conditions are present in an exchange can ensure contract success.

1.2.1. Structure

Chambers (1990) noted that all exchanges are non-profit entities. This means that although they are allowed to make a profit, all profits are retained within the exchange. Thus the managers of the exchange have no incentive to increase profits or make sure that all the contracts are potential successes. In their view, as long as aggregate income is equal or slightly greater than aggregate costs, all is well. This process of aggregating costs and revenues leads to cross-subsidization between the products that will clearly be successful and those that are potential failures.

In addition, the decision to introduce certain types of contracts are made primarily by standing member committees. The individuals who make up these committees are also the ones who use the services of the exchange. Thus a conflict of interest may exist, since members may only approve those contracts which will benefit them personally.

In order for an exchange to introduce contracts which would be potential successes, the better structure is a for-profit one. By distributing at least part of the profit based on contract success (i.e. a certain trading volume figure, at various intervals of the contract's life), the manager is given an incentive to actively encourage introduction of only the best contracts. He/She will be more likely to follow up on the contract once it has been introduced, so that success is guaranteed. The number of failing contracts could thus be reduced.

Another structural change which would positively influence contract success is one in which the standing member committees in the exchange have equal representation from all types of traders. In this way the new contract which is approved by the committee has the confidence of all the different types of traders.

1.2.2. Substitute Markets

Sandor (1973) stated that the breakdown of forward markets increases the probability of success in futures contracts. When alternates to a futures contract on a particular underlying commodity exists, such as a forward market or a futures contract on a close substitute of the underlying commodity, and if this substitute market is well established and active, then it is harder for the exchange to introduce the new futures contract.

Markets that are active already possess the liquidity which the new contracts lack. This initial lack of liquidity is a major stumbling block for all financial futures contracts. Lack of initial liquidity leads to higher costs of trading. This high cost deters both the hedger and the speculator. Although it may be true that the forward market and the cross hedge in futures markets are not perfect substitutes for the new futures contract, and that a hedger is able to obtain a more effective hedge by using the new contract, the trader could reject the contract. This would be true if the trader finds that the benefit of the older, more liquid contract far exceeds the cost of the newer and more appropriate hedging instrument.

Garbade (1982) however, disagrees with this and shows that the existence of a forward market does not completely deter futures contract trading. He reports that the GNMA futures contract succeeded for six years despite the presence of an active and established forward market.

The existence of other financial derivatives such as options and swaps markets also reduce the demand for futures markets. Both these derivatives are instruments which redistribute risk, and can thus reduce the potential market share of financial futures markets.

1.2.3. Support for the new contract

If the new contract is introduced on an exchange in which the specialist floor traders, hedgers and speculators support the contract, then the probability of success is higher than if no support is present. Silber suggests that if the account executives of major brokerage firms are in favour of the contract, then the chances of success are greater. This is because these executives help to attract speculative capital from public investors.

In section 1.2.1 on exchange structure, we noted that it was the member standing committees which approved the introduction of new contract, and that equal representation was important to contract success. Seevers (1981) states that most of these committee members are floor traders. Thus although the contract may have the support of the floor traders, it may not have the support of the other types of traders. If and when equal representation on member standing committees occurs, there will be support from all the various types of traders and the contract will stand a better chance of survival.

1.2.4. Specialization

Floor traders tend to prefer contracts which are similar. This is because these traders need to have an extensive knowledge of the commodities they trade. Thus by approving contracts on similar commodities, they have to spend less time acquiring this knowledge. In section 1.2.2 we stated that if substitute markets exist then the probability of success of a new contract is smaller. If however the exchange has succeeded in introducing contracts in a specific area such as in the case of foreign exchange futures and has built a reputation in the area, then that exchange will be viewed as a specialist in that area. When this happens, the exchange has an advantage over other exchanges when it wants to introduce another contract in its area of specialization. The liquidity in the other contracts can help raise the initial liquidity of the new contract since the type of trader needed for the new contract already transacts in the same exchange. Thus the probability of success of the new contract is higher.

1.2.5. Duplicate Contracts

If a futures exchange is the first to offer a financial futures contract on a particular underlying commodity, and if this contract has become a success, then that exchange has a natural monopoly over the futures contract on that commodity. Any other exchange which wants to introduce a duplicate contracts will find it hard to succeed. This is because the same hedging opportunity already exists in a more liquid market at a lower cost. For both the hedger and the speculator it is more efficient to have all trading on a particular futures contract in one exchange.

An exception however is in the case of duplicate contracts on the Singapore International Monetary Exchange (SIMEX) and the Chicago Mercantile Exchange (CME). These contracts enjoy a higher degree of liquidity in both markets. This phenomenon occurs because the CME and the SIMEX have created a unique link which allows the exchanges to offer interchangeable futures and options contracts that can be offset on each others exchange. This link also allows both the exchanges to have access to a full day and night trading cycle, further increasing the volume traded on each contract.

1.2.6. Size and Resource Availability of the Exchange

Both hedgers and speculators prefer active markets. Silber noted that during the 1960-1977 period, the success rate of larger exchanges in introducing futures contracts was greater than that of smaller exchanges. He attributed this fact to the resource availability of the exchanges. Carlton recorded that for the 1921-1983 period the larger exchanges (largest by volume in 1983) in the U.S did better at introducing new contracts than the smaller ones.

Exchanges have three general types of costs which they incur in order to introduce and maintain a new contract. There are:

1. Development costs, which are costs of dealing with the initial market surveillance for identifying customers needs, including the investigation and approval of the underlying commodity and the analysis of the contract design terms.
2. Establishment costs, which are the costs involved in satisfying all regulations, provision of a trading floor, electronic quotation board, skilled labour, management and coordination of marketing and educational efforts.
3. Maintenance costs include the recording, monitoring, modifying and redesigning

of all existing contracts.

These costs take up a considerable amount of resources. As stated by Silber and Chambers, these activities are essential for the ensured success of a financial futures contract. Larger exchanges have more resources available to perform these functions more extensively and effectively than smaller ones, and therefore have a higher probability of success in introducing new contracts.

1.2.7. Confidence of the Public

Confidence of the public in the exchange, the futures market and the particular financial futures contract is essential for the success of the futures contracts. To gain this confidence all prices must be freely determined, that is, no force either government, cartel or monopoly should be able to control the supply of the underlying commodity. To ensure the confidence of the public in the exchange, rules and regulations must be set, which should be implemented and monitored regularly. To gain the trust of the public in the futures market, the exchange needs to ensure the credibility of the clearing house, and present this information to the public. By raising the confidence in the futures market the exchange can increase the potential pool of users in the futures market.

1.2.8. Trading System

The two types of systems are the floor trading system and the computerized trading system. New futures exchanges tend to use only the computerized trading systems, while the older exchanges use either floor trading or both floor and electronic trading systems. For example the Tokyo International Financial Futures exchange, the Deutsche Terminborse and Swiss Options and Financial Futures Exchange, to name a few, do not have a trading floor, all trading is computerized. Exchanges such as the Chicago Mercantile Exchange and the Sydney Futures Exchange have both the electronic and floor trading systems. Twenty four hour trading is possible at these exchanges. On the other hand as in the case of the London International Financial Futures Exchange electronic trading is present, but only for a few hours. In the case of the Bolsa de Mercadorias & Futuros of Brazil, and the Toronto Futures Exchange and the Montreal Futures exchange of Canada, for example no electronic trading exits.

The initial investment of the computerized system is large, however in the long run computer trading lowers maintenance costs of the exchange thus lowering transaction costs. The longer trading hours that span different time zones attract foreign investors and compete directly with foreign markets, providing increased liquidity, efficiency and greater access to markets worldwide. The computers also have a greater capacity because they can keep automatic record and they are easier to police.

The ratio of international to domestic members in futures exchanges varies from exchange to exchange. The growing number of foreign futures exchanges are reducing U.S exchanges' market share in futures contracts trading. Miller (1990) notes that the major threat to U.S exchanges from overseas markets is a technological one, since decentralized electronic screen trading can remove the advantage of the natural monopoly existent in U.S futures exchanges today. Thus, in order to be able to compete, exchanges should invest widely in technological research and development. With this advantage, exchanges can lure traders from other exchanges, and increase demand for the contracts.

1.3. Commodity Factors

This section describes how futures and price volatility, cash market size and the high correlation of a cross hedge affects the probability of success of a contract. These variables should be considered by the exchange before choosing the underlying commodity on which the contract is based.

1.3.1. Cash and Futures Price Volatility

Past literature has frequently cited cash price variability as an important factor contributing to contract success. (See Telser, Cornell, Wolf, Carlton, Working, Sandor and Black.)

Organized futures markets exist to facilitate transfer of risk. The risk arises due to uncertainty about the price of the underlying commodity. Large and frequent changes in the cash price tend to stimulate hedging and speculation more so than smaller changes in the cash price. Hedgers in these markets where large changes in cash price exist have greater incentive to seek protection. Speculators are attracted to these markets because of the possibility of large profits.

The larger the futures price volatility of the commodity on which the futures contract is based, the greater the probability of success of the new financial futures contracts.

1.3.2. Cash Market

According to Black, two main aspects of a broad cash market, the supply and the demand, affect the demand for futures. On the supply side, the larger the number of firms distributing the underlying product, the larger the number of suppliers in the cash market and thus the lower the possibility of price manipulation. Reduced possibility of manipulation is an attractive factor to both the hedger and the speculator. On the demand side, when there are a large number of participants in the underlying commodity then there is a larger pool of potential hedgers and speculators.

In the case of financial futures contracts a broad cash market on both the supply and the demand side are important factors to consider when choosing the underlying commodity. In the case of foreign currency futures the demand for the various underlying currencies exist because of foreign trade. The larger the amount of foreign trade the greater the need for the various currencies and the more the need to hedge. Thus the larger the number of potential hedgers the greater the demand for financial futures contracts. Likewise, the larger the value of the cash market the greater the need for the participants to hedge.

The presence of an active large cash market allows for an orderly meeting of the supply and demand forces providing a forum for continuous trading, and thus encouraging the introduction of new futures contracts.

Consequently an active and liquid cash market stimulates futures contract success. Exchanges would find it easier to introduce a new financial futures contracts if they already have a well established and active cash market.

1.3.3. Cross Hedge Correlation

The ideal hedge exists when the underlying commodity of the futures contract is the same as the cash position of the hedger. In many cases however, especially for stock indexes, cross hedging occurs. This is because a futures contract with an underlying commodity which perfectly matches the cash position, does not always exist.

The effectiveness of the cross hedge is greater when the price of the asset to be hedged is highly correlated with the price of the futures contract being used.

When a new contract which provides a more effective hedge is introduced, the hedger would conduct a cost/benefit analysis. He/She would examine the tradeoff between the added risk reduction that the new contract provides and the cost of trading this contract in a non-liquid market, against that of the older, more liquid contract. Often the hedger may choose the contract which provides the less effective hedge due to the benefit of its added liquidity. If this happens the new contract will fail. Evidence of this is provided by Working, and Black.

Therefore, exchanges intending to introduce a new financial futures contract in a particular area need to examine the efficiency of the cross hedge present. The correlation between the futures contract and the cash market is a measure of efficiency. If this value of correlation is high, then the contract is a better hedge than if the value is low. Thus, higher correlation of the cross hedge to the cash market values indicate that the probability of success of the new financial futures contract is slim.

1.4. Contract Factors

The contract characteristics include the size of the contract, the delivery options embedded in the contract, the margins, minimum price limits, position limits, the maximum price limits and the age of the contract.

1.4.1. Size of the Contract

Sometimes even trivial changes in contract specifications, such as small changes in contract size, make substantial differences in the trading volume. For example, the silver contract that was introduced in 1969 by the CBOT, was similar to the one already trading on the COMEX, except that the size of the contract was 5,000 ounces instead of

10,000. This small change was appealing to hedgers and the contract was an instant success. Another example in which the size of the contract highly influenced the success of a contract was in the case of the four different gold contracts which were simultaneously introduced in 1975. The contracts had different sizes, but the 100 ounce contract on the COMEX and the CME attracted a larger number of traders than the 3 kg and 1 kg contracts of the CBOT and MidAmerica Commodity exchanges. Silber conjectures that traders preferred the round number of 100 ounces to the other numbers. He concludes that even slight changes in design could reflect the preferences of potential participants and can thus attract greater trading volume.

One explanation for the importance of contract size, is that different sizes pose different transaction costs to traders. When a number of small hedgers exist in a particular market, then it is more cost effective for them to use a small size contract.

We hypothesize that if small differences in contract size, (that is, differences in the cost of trading) for commodity futures contracts could cause some contracts to be more successful than others, then the same would be true for financial futures contracts.

1.4.2. Delivery Options

Exchanges try to broaden the appeal of futures contracts by including a variety of delivery options so that the traders have flexibility in making delivery. However, when a contract has two or more varieties which could be delivered on a hedged position, then at least one of the varieties bears some extra unhedgeable risk.

Garbade and Silber (1983) stated that a trader with a choice of delivery between a higher grade and a lower grade variety, will choose the cheapest, which is the lower grade.

In the case of foreign currency and stock index futures the delivery option does not apply. This is because in the case of foreign currency contracts there is only one deliverable commodity and in the case of stock index futures the deliverable commodity is cash. However, in the case of interest rate futures this specification can have an impact on the trading volume. An example of this is the case of the GNMA-CDR futures contract.

The GNMA-CDR was introduced by the CBOT in 1975 to act as a hedging instrument for current coupon mortgages and current coupon mortgage-backed securities. Johnson and McConnell stated that the main hedgers of this instrument were mortgage bankers, who were exposed to interest rate risk on mortgages written at the current market interest rate at the time that the loans were made to the secondary market.

When interest rates were rising, the variety which was delivered, (the cheapest) was the current coupon bonds. This was the variety which was hedged by the mortgage bankers. When interest rates dropped, the bonds with higher interest rates were cheaper.

Thus, these were the type that were delivered, while it was the current coupon bond with the lower interest rate which needed to be hedged. Since the futures contract was no longer an effective hedge the demand for the contract reduced and the contract failed. Thus the delivery option in the GNMA-CDR futures contract was the main reason for the failure.

1.4.3. Margins

Various studies have been conducted on margin changes and their effects on demand for the contract. Goldberg and Fishe (1986) conducted a study on margin changes for all contracts traded on the CBOT between 1972 and 1978. Their results show that although the magnitude of the change is small, open interest is significantly affected by margin changes. For contracts with distant expiration days however, margin changes have no effect. The results for trading volume were inconclusive. Hartzmark (1986) studied the same issue and concluded that margin changes result in significant changes in the composition of traders in the market, but that the direction and magnitude of these changes were unpredictable. We hypothesize that the initial and maintenance margins specific to the different contracts affect the trading volume of the contract since the cost to the traders differ depending on the margin. As we had stated previously the lower the cost, the higher the liquidity and thus the more successful the contract.

1.4.4. Minimum Price Limit

The minimum price limit is the minimum amount by which the price of a contract may fluctuate during trading. All changes occur as multiples of this number. Brown, Laux and Schachter (1992) investigated the presence of an optimal tick size. They suggest that as the volatility and volume of the market increases, traders want to avoid time consuming bargaining over a small tick size. They conclude that tick size does affect the operational efficiency of the market. Thus traders in the futures markets are sensitive to costs of trading. If the tick size can in some way reduce this cost, it could help increase the liquidity of the contract.

1.4.5. Position Limits

Position limits exist for some contracts. This limit is the maximum number of contracts which can be traded by an investor on a particular futures contract. We expect that if no limit exists or if the position limit is high then, the greater the contract's trading volume. This is because lower limits place constraints on investors.

1.4.6. Maximum Price Limits

The maximum price limit is the maximum allowable increase in price admissible during a given period of time. For example, in the case of currency futures contracts traded on the CME, there is an initial limit. This is applicable only for the first 15 minutes of trading. If the price increases above the limit before the first 15 minutes of trading then the price is not allowed to increase above the set limit, until the time limit expires. On the other hand, the maximum price limit affects the value of the maximum loss that a trader could suffer over a day. We hypothesize that the constraints on price fluctuation imposed by price limits could reduce the volume of trading. The lower this price limit, the lower the loss and the greater the volume of trading.

1.4.7. Exchange Fees

These fees govern the ease of entry into the exchange and the cost of trading to the hedger and speculators. We hypothesize that the lower the cost of trading, the higher the volume of trading. Thus exchanges which cost less to participate in would increase trading volume on all contracts.

1.4.8 Age of the contract

We hypothesize that the longer a contract has been trading on an exchange the greater the amount of trading. The first few years after introduction are the years in which the contract is most likely to fail. The longer a contract continues to trade the greater the liquidity and thus the higher the chances of success.

2. Data and Methodology

2.1. The data

This section describes the data used in the empirical research. Data on country factors was obtained from the International Financial Statistics of the International Monetary Fund and from the Euromoney classification of country risk rankings[1]. The Futures Industry Institute (FIA) was contacted for exchange, contract and commodity factors for the financial futures contracts trading on all world exchanges. Data requested was from the date the contract started trading until December 1992. However, complete data was available for only a few exchanges. To obtain additional information on exchange and contract factors a survey was sent to the individual exchanges. *Appendix 1A and 1B* shows a sample survey which was sent to LIFFE of U.K. Other surveys sent to the various exchanges were similar to that of *Appendix 1*, the only differences being the names of the contracts.

Since it was not possible to obtain information on all factors for the entire trading period of each contract, the data set was limited to the year 1992. *Table 1* shows the countries and the exchanges at which the contracts were introduced, the financial futures contracts used in the analysis, the type of contract and the date of introduction. The data in *Table 1* shows that currency, stock index and interest rate futures contracts traded on

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[1] "Nowhere To Lend To", *Euromoney*, September 1992, pp. 65-72.

16 different world futures exchanges from 11 countries were analyzed. The U.S exchanges include the Chicago Mercantile Exchange (CME), the Chicago Board of Trade (CBT), the New York Futures Exchange (NYFE), the Kansas City Board of Trade (KBOT) and the MidAmerica Commodity Exchange (MIDEX). The foreign exchanges include the London International Financial Futures Exchange (LIFFE) of the United Kingdom, French International Futures and Options Exchange (MATIF) of France, the Singapore International Monetary Exchange Limited (SIMEX) of Singapore, Bolsa De Mercadorias & Futuros (BM&F) in Brazil, Toronto Futures Exchange (TFE) and the Montreal Stock Exchange (MSE) of Canada, Sydney Futures Exchange (SFE) in Australia, Tokyo International Financial Futures Exchange (TIFFE) in Japan, Deutsche Terminborse (DTB) in Germany, Swiss Options and Financial Futures Exchange (SOFFEX) in Switzerland and Meff Renta Fija (MEFF) in Spain.

These futures contracts and exchanges were included in the study, because complete data on all factors affecting contract success could only be obtained for these contracts. Contracts and exchanges for which complete data were unavailable were eliminated.

2.2. Measure of contract success

This section describes the measure used to quantify contract success. Measures of success used in past studies included either the length of time traded and/or amount of annual trading volume. Sandor (1973) qualified a successful contract as being one which reached a trading volume of 1,000 contracts a day, while Silber (1981) defined it as one which reached a trading volume of over 10,000 contracts in the first three years of trading.

This study does not define success or failure based on an arbitrary number, as used in the studies mentioned above, nor does it base success on a dichotomous variable. Rather, a continuous variable is used, which is similar to the measure used by Black. Black used average daily trading volume and average annual trading volume as a measure of success. The time frame used was between the date the contract was introduced, till the end of the third year of trading or whenever the volume of the contract dropped to zero. Her explanation for using this three year period, was that, it was a way to compare contracts which had already achieved success, during a similar stage in their life.

In this analysis, annual trading volume is used to measure success. The time frame used in the analysis is the year 1992. As explained earlier the study was limited to the year 1992 because it was only for this year that we were able to obtain data on the exchange and contract factors affecting contract success. The study does not compare the contracts in a "similar stage in their life" as Black does. Rather, an independent variable, age, is included to account for the effect of longevity upon volume of trading.

2.3. Factors affecting contract success

2.3.1. Country Factors

Section 2.3.1. expands on the following country factors which affect contract success. These factors include the rate of inflation, industrial structure, regulation and the political risk. Since some factors are quantifiable and measurable across all countries and others are not, only those factors which could be measured were used in the statistical analysis.

a. Inflation

The inflation rate INFR, was measured using the quarterly consumer price index in 1992 for the different countries.

where

$$INFR = \left(\frac{P_2 - P_1}{P_1}\right) * 100$$

where

P_1 = Consumer Price Index, 1st quarter of 1992 for the country of interest

P_2 = Consumer Price Index, 4th quarter of 1992 for the country of interest

The greater the inflation rate (INFR), the greater the trading volume, as explained in Section 1.1.1.

b. Industrial Structure and Exposure to Price Risk

The degree of vertical Integration was used to measure the effect of the industrial structure. The proxy measure for capturing the degree of vertical integration was VIN where

$$VIN = \frac{Mean\ of\ GDP}{Standard\ Deviation\ of\ GDP}$$

This variable captures the cyclical nature of the gross domestic product (GDP) of the country. The GDP of a country may fluctuate due to many factors. However, some part of the fluctuations of the gross domestic product could be due to the degree of vertical integration within the country. Thus, we would expect that the higher the degree of vertical integration, the lower the uncertainty in the gross domestic product of the country. We used yearly GDP figures over the 10 year period prior to 1992 to calculate VIN. Thus the time period used was from 1982 to 1991.

c. Political Risk

The political risk (PR) of the country was measured by using the latest country risk rankings published by Euromoney (September 1992 pp. 65 - 72). The country risk rankings comprised of varies categories, some of which include economic performance, political risk and debt indicators. The weight given to the political risk category was 20%. Thus value for the political risk index was between 0 and 20, where a score of 20 indicated a near minimal amount of political risk. Euromoney obtained these rankings after polling political risk analysts, risk insurance brokers and bank credit officers. Each of these groups were asked to give each country a score of between 0 and 10. The higher the score the smaller the risk. Countries were scored compared to each other and with the rating of previous years.

For the purpose of this analysis the value for political risk was converted to a value between 0 and 1. Zero indicates that the country has high political risk and one denotes low risk. The larger the value of the political risk index, the larger the trading volume.

2.3.2. Exchange Factors

The exchange factors in our analysis include number of members on the exchange as a measure of size, total assets as a measure of resource availability, and number of contracts traded on the exchange as a proxy to measure the confidence of the public on the exchange. To describe the trading system three variables were used, these were full electronic trading, partial electronic trading and existence of floor trading. Data on exchange fees were available for most of the exchanges for 1992 but were not directly comparable across exchanges. Section 3.3 provides a discussion on the exchanges fees.

a. Size and Resource Availability of the Exchange

The number of members on each exchange (NOM) is used to measure the size of the exchange. These values were obtained from the survey results. It is expected that the greater the number of members of the exchange, the larger the trading volume.

The total assets of the exchange (TA) was used as a variable to measure the resource availability of the exchanges. The larger the exchange, the larger the resources available to innovate, introduce and maintain contracts and thus, the larger the trading volume. Total asset values which were collected from the various exchanges were obtained in national currencies of the countries in which the exchanges were situated. These figures were converted into U.S $ values by using annual average exchange rates for 1992. This made it possible to compare the various exchanges in regard to size.

b. Confidence of the Public on the Exchange

The total number of different contracts currently trading on the exchange (NOTC) is used as a proxy to measure the confidence of the public in the exchange. The greater the total number of different contracts traded on the exchange, the greater the confidence in the exchange and thus the larger the trading volume.

c. Electronic Trading

Two dummy variables PET and FET are used to measure the different types of electronic trading which exist on the exchange and one dummy variable EFTR is used to identify the existence of a trading floor on the exchange.

If partial electronic trading, is present on a contract then the dummy variable PET has the value one. This indicates that outside the normal floor trading hours, electronic trading exists for some time. We have set this time period as being less than or equal to four hours. If the electronic trading is either more than four hours or if electronic trading is non existent on the exchange the variable will show a value of zero. For example, in the case of the three month Euromark interest rate futures contract traded on the London International Financial Futures Exchange (LIFFE), electronic trading is between 16.29 pm and 17.59 pm London time. Since electronic trading is less than 4 hours the partial electronic figure will have a value of one.

In the case of the variable FET used to measure full electronic trading, if the number of hours exceed four, then the variable is given a value of one. If either partial or no electronic trading is present on the contract the value would be zero. For example, the British Pound currency futures contract traded on the Chicago Mercantile exchange would have a value for FET of one. This is because the contract trades on GLOBEX, an electronic trading system, for a period greater than four hours. Zeros in both dummy variables indicate the absence of any electronic trading.

The third variable used to measure the type of trading used by the various exchanges is EFTR, which measures the existence of floor trading on the exchange. Some exchanges such as the Meff Renta Fija of Spain do not have a trading floor. All trading is done through the electronic trading system. Thus all the contracts on this exchange would show a value for FET of one. On the other hand the older exchanges such as the Chicago Mercantile Exchange, which have a trading floor but also have electronic trading on some contracts for a period greater than four hours would have a value for FET of one. To differentiate between the contracts traded on these two exchanges and to measure the effect of floor trading on the trading volume a new variable EFTR was added. If floor trading exists then EFTR has a value of one and if no floor trading is present then EFTR has a value of zero.

2.3.3. Commodity Factors

Cash market size and cash/futures price volatility are two factors which capture the commodity characteristics which influence contract success. The size of the cash market was also omitted from the analysis due to the difficulty in quantifying this variable for the different types of contracts that we have used in our the analysis.

a. Futures Price Volatility

Previous researchers have found that for U.S contracts these commodity factors have a significant effect on contract success. For example, Black found that both the cash market size and the cash price variability positively affect the success of interest rate and stock index contracts. Cornell studied the relation between volume of trading in commodity futures and the price variability for futures contracts and found a positive and significant relationship. Martell and Wolf conducted a study on metal futures and also found a positive and significant relationship between futures price variability and trading volume. We were unable to obtain data on cash prices for all the contracts in our data set although we contacted all the exchanges and the FIA for the same. Thus, we could not calculate cash price volatility. However, we used futures price volatility as a proxy for cash price volatility. Futures settlement prices for each contract was obtained for all delivery months in 1992. The settlement prices for only those contracts closest to delivery were considered. The reason being that contracts closer to the delivery date would have a higher volume of trading. The volatility measure of futures prices was calculated as follows

where

$$VOLAT = \frac{\textit{Mean of Settlement Price}}{\textit{Standard Deviation of Settlement Price}}$$

2.3.4. Contract Factors

Contract factors which affect trading volume include, the size of the contract, delivery options, margins, minimum price limits, position limits, maximum price limits and age of the contract. Due to the difficulty in measuring the delivery options for stock index futures and bond futures across various exchanges in the different countries, this variable was not included in the statistical analysis.

a. Contract Size

Since the sizes of the various contract are based on a variety of different currencies, the size of the contract was converted to U.S$. For each contract the annual average size was computed by dividing the size of the contract in the national currency by the average daily exchange rate of national currency per U.S $ over 1992.[2] In the case of stock index contracts, the size of the contract is dependent on the underlying index value. For example, the CAC 40 futures contract size is equal to FF 200 * CAC 40 Index. To find the average size of the contract over the year we need the average CAC 40 Index value. The average of the high and low values for the cash price in 1992 was used as a proxy for the value of the CAC 40 index . If the market is made up of small traders who prefer small contract sizes, then the larger the contract size, the lower the trading volume. If the market consists mainly of large traders, then the larger the contract size the higher the annual trading volume.

b. Margins

Margins set on different exchanges vary considerably. In the case of U.S exchanges and the SIMEX of Singapore, margins were divided into initial margin, maintenance margins and spread margins for the different types of traders eg. hedger, speculator and member. In the case of the LIFFE in the U.K, margins are divided into initial, spread and span margins. For MATIF of France, margins are divided into initial delivery month, initial non-delivery month and straddle margins. In the case of the BOLSA in Brazil the margins are divided into common, hedge and spread margins. These margins vary depending on how close the contract is to delivery. For example, the one day US$ interest rate futures contract on the BM&F has different margin rates

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[2] In the case of the British Pound, Australian Dollar and the ECU, US$ per national currency exchange rates were available. Therefore the size of the contract was multiplied by these rates.

depending on first, second, third and other nearest contracts to delivery.

Since data on the initial margin for hedgers was most commonly provided by most of the exchanges, we used this as the measure of margin in our study. In addition some adjustments had to be made for specific exchanges. For example, in the case of MATIF where the margin was different for delivery and non delivery months, the average of the two was used as a proxy for the initial margin for hedgers. In the case of the BOLSA where the hedge margins varied according to delivery month, the average value of margin for of all delivery months was used as a proxy.

The average initial margins for hedgers was thus calculated for the entire year. The margins set by the various exchanges were denominated in either U.S dollars or in the local currency. These figures were converted to U.S $, so that they could be comparable. Since margins increase costs for the trader, the larger the margins the lower the trading volume.

c. Minimum Price Limits

In the case of minimum limits (MIP), the values were quoted in either U.S $ or in the national currency of the country in which the exchange was located. These values were converted to U.S Dollars using the annual average exchange rates. As argued by Laux and Schachter we expect that very low minimum limits only add to additional costs of trading. We expect that if the minimum limits at present are not high enough then we can expect that a higher limit would increase trading volume.

d. Maximum Price Limits

The maximum price limits (MAP) set by the different exchanges were also as diverse in nature as that of the margins. For example, the currency futures contracts traded on the CME had a maximum limit (in U.S dollars) set for only the first fifteen minutes after the start of trading. Thus the limit applies from only 7.20 am to 7.35 am. The same exchange (CME) has very different limits for the S&P 500 index futures contract. In this case there are a series of limits which apply at different times during the trading day. For example, there is an initial limit as well as several intermediate and expanded limits. These limits are coordinated with the trading halts of the underlying stocks. The CAC 40 index future traded on the MATIF has a basic limit (in French Francs) which covers the entire trading period. The Dutch Top 5 Index traded on the Financial Futures Market Amsterdam in the Netherlands has a limit which covers the entire trading period, but is applicable for only 30 minutes in the day. The BOLSA in Brazil has a different system. The limits take the form of a percentage of the size of the contract. Even though these limits are applicable for the entire trading period, they only apply to contracts with specific delivery months. For example, the Bovespa Index futures contract has a maximum limit of 5% of the size of the contract on the third delivery month. Some contracts do not have any price limits, like the Deutsche Mark traded on the LIFFE.

In order to compare these limits across the various exchanges, the following changes were made. Where there was only one limit, regardless the length of the period over which it held, it was considered as the value of the maximum price limit (MAP). When various limits existed, the limit which held for the longest period in the day was considered as the maximum price limit. In the case where only certain delivery months had limits, this value was taken to represent all delivery months. After this was done, the limits were converted to U.S $. Then, a new variable MAXPR was constructed. where

$$\begin{aligned} MAXPR &= \frac{1}{MAP} && \textit{if there was a maximum price limit for the contract} \\ MAXPR &= 0 && \textit{if there was no maximum price limit for the contract} \end{aligned}$$

MAXPR takes on values between zero and one. The, higher the MAP, the lower the MAXPR. When there is no maximum price limit then the value of MAXPR is zero. We expect that the lower the MAXPR the greater the trading volume

e. Age of the contract

The age of the contract (AGE) was measured by calculating the number of years between the introduction date and 31st December 1992. The longer the contract has been trading the greater its volume of trading.

2.4. Methodology

The data consisting of country, exchange, commodity and contract factors which have been described in section 2.3 were used to develop models that explain financial futures contract success.

The variable names and definitions used in the models which follow are given below.

VARIABLE	DEFINITION
ATV	Annual Trading Volume
PR	Political Risk Index
INFR	Inflation Rate
VIN	Measure of Vertical Integration
SIZE	Size of the contract in U.S. Dollars
AIM	Average Initial Margin in U.S. Dollars
MIP	Minimum Price Limit in U.S Dollars
MAXPR	Converted value for the maximum price limit
AGE	Age of the contract in years
NOTC	Number of futures contracts traded on the exchange
NOM	Number of members on the exchange
PET	Partial Electronic Trading at the exchange
FET	Full Electronic Trading at the exchange
EFTR	Existence of Floor Trading
TA	Total Assets of the Exchange
VOLAT	Volatility of futures prices

2.4.1 Regression Diagnostics

The data was initially analyzed using descriptive statistics. These statistics, shown in *Table 2*, indicate the minimum, maximum, mean and standard deviations of the variables. The figures show that each variable has a wide range of values, and while some variables are measured in tens, others are measured in millions. For example, the value for total assets is measured in millions of U.S dollars while the value for the minimum price limit is in tens of U.S dollars.

Regression diagnostics was performed to test for outliers using standardized residuals, Cook's distance and Leverage values (not shown). There was only one observation which appeared to be an outlier. However, since this data point was a slight outlier and due to concerns about the sample size the observation was not removed from the analysis.

Table 3 shows the correlation matrix between the variables in the data. This matrix indicates the strength of the linear relationship between the dependent and all the independent variables used in our analysis. A correlation coefficient of +1 indicates two variables which are perfectly positively correlated and a value of -1 indicates perfect negative correlation. The matrix can be used to select the final independent variables in a model, since it aids in identifying variables which exhibit multicollinearity. If any of the independent variables are more highly correlated with each other than with the dependent variable, then multicollinearity exists. The correlation matrix shows that multicollinearity exists between many of the variables. The pairs of variables which appear to be the most strongly correlated are PR and INFR, NOM and NOTC, AIM and NOM and NOM and AGE.

2.4.2 Regression Analysis

The relationship between the variables was analyzed for the year 1992, using cross sectional Ordinary Least Squares (OLS) regression analysis. The data are made up of 65 contracts, from 11 countries.

Least Squares regression analysis tries to find the best fitting plane between the actual data points and the fitted line, by minimizing the sum of the squared residuals. The Gauss-Markov theorem states that if certain criteria are met then the OLS estimates are best linear unbiased estimates. These criteria or assumptions are that the error terms of the multiple regression equation are independent, that they have a mean of zero, constant variance, and that there is no autocorrelation. If these assumptions are not met then the estimates of the regression model will not be best linear unbiased estimates. Although normality of the error terms is not a requirement of OLS, it is required so as to make inferences. Since we are dealing with cross sectional data the assumption of autocorrelation is not necessary.

Four different models are developed in our analysis and each model is tested for these assumptions, and steps have been taken to ensure that the assumptions hold. A three step procedure was used in each case. First the assumption of normality was tested using histograms of the residuals and normal probability plots (not shown). Then the Kolmogorov-Smirnov (K-S) test (see example given by Scheaffer and McClave, 1982) was performed to test the hypothesis that normality exists. In this test the standardized residuals of the regression model are arranged in ascending order, then the empirical distribution is compared to a hypothesized theoretical distribution which is normally distributed. This comparison is made over the entire range of values and the distance between the distributions is calculated. If the results showed a K-S Z value greater than one, then the normality assumption does not hold in that particular model.

The second step in testing for the assumptions was to test for heteroscedasticity. To test this a plot of the squared standardized residuals on the predicted dependent values was examined. If the plot has a pattern then the assumption of constancy of variance of the error terms does not hold. To investigate heteroscedasticity further the Anscombe and Tukey test (see example given by John Fox, 1984) was conducted on each of the models. In this test the squared value of the standardized residuals are regressed against the predicted dependent variable of the model, as shown below. If the value for β_1 is significant then heteroscedasticity exists.

$$(\text{RESIDUALS})^2 = \beta_0 + \beta_1 \text{ PRED Y} + e_i \qquad (1)$$

where

β_0 and β_1 are the coefficients of the regression and e_i is the error term of the regression.

The last step in the procedure used to test the assumptions of OLS was to test for multicollinearity among the independent variables. The correlation matrix shown in *Table 3* already shows the pairs of variables which are highly related to each other.

However, to examine how a particular independent variable is related to all the other variables in the regression model a test as described by Greene, (1990, pp. 277) was conducted. This test involves regressing each of the independent variables in turn upon all the other independent variables. Fourteen different regression equations were obtained. The presence of multicollinearity is indicated if the R^2 of any of these regressions is higher than the R^2 of the model. Another measure of multicollinearity is to measure the variance inflation factor (VIF), where VIF is defined as $1/(1- R^2)$. VIF values greater than ten indicate variables which exhibit severe multicollinearity. *Table 4*, shows the R^2 values and the VIF values of all the equations. The variables with high VIF values were PR, NOM and EFTR. Another symptom of multicollinearity is when the estimated regression coefficients of a variable has a large standard error.

In each of the models the variables which indicated multicollinearity were removed and the reduced model was tested for normality and heteroscedasticity.

3. Model Estimation and Interpretation of Results

3.1 Model Estimation

3.1.1 Model 1

The following linear model was estimated initially.

$$\begin{aligned} ATV \quad = \quad & \beta_0 + \beta_1 PR + \beta_2 INFR + \beta_3 VIN + \beta_4 SIZE + \beta_5 AIM + \beta_6 MIP + \\ & \beta_7 MAXPR + \beta_8 AGE + \beta_9 NOTC + \beta_{10} NOM + \beta_{11} PET + \beta_{12} FET + \\ & \beta_{13} EFTR + \beta_{14} TA + \beta_{15} VOLAT + e_i \end{aligned} \tag{2}$$

where

$\beta_0 \ldots \beta_{15}$ are the coefficients of the regression and e_i is the error term of the regression. The β value indicates the change in ATV for a unit change in the independent variable, keeping all other variables constant.

The results of the least squared regression equation (2) for the year 1992 are provided in *Table 5*. These initial results show a low F-value of 0.966, suggesting a lack of overall significance of the model. The R-squared value, which indicates the strength of linear association between the dependent variable and the independent variables is very small, only 0.228. The variables found to be significant at the 10% level were EFTR and FET.

The test for normality indicated a K-Z value of 1.992, shown in *Table 5*. Since the value is greater than the critical, non-normality exists. The plot of the squared residuals of model (2) showed that as the predicted values of the dependent variable increase the values of the squared residuals decrease linearly. The Ascombe and Tukey test indicated a presence of heteroscedasticity since β_1 is significant at the 5% significance level, see *Table 5*.

The regression coefficients estimated in model (2), show that the variable MAXPR has a very high standard error, indicating that it is a variable which contributes to multicollinearity. Remedial measures were taken, MAXPR, PR, NOM and EFTR were removed from the full model (2) to produced the following reduced model (3).

$$\begin{aligned} \text{ATV} = {} & \beta_0 + \beta_1\text{INFR} + \beta_2\text{VIN} + \beta_3\text{SIZE} + \beta_4\text{AIM} + \beta_5\text{MIP} + \beta_6\text{AGE} + \\ & \beta_7\text{NOTC} + \beta_8\text{PET} + \beta_9\text{FET} + \beta_{10}\text{TA} + \beta_{11}\text{VOLAT} + e_i \end{aligned} \tag{3}$$

where

$\beta_0 \ldots \beta_{11}$ are the coefficients of the regression and e_i is the error term of the regression.

This reduced model (3) was tested for normality and heteroscedasticity once again. The results showed that non-normality and heteroscedasticity still exist, see *Table 6*. The variance inflation factor values for the reduced model are shown in *Table 7*. The results indicate that the correlations between all the other variables have been reduced.

3.1.2 Model 2

In order to correct for the presence of non-normality and heteroscedasticity in the initial regression model (2) and the subsequent reduced model (3), the Box Cox family of transformations were performed on the data. (See Nester, Wasserman and Kutner, 1990, pp. 149). The Box-Cox transformation, is a procedure in which a power transformation of the dependent variable is used to correct for non-normality and unequal error variances in the distribution of error terms. The normal probability plots show that the distribution of the error terms is positively skewed. To correct for this the $\log_{10}(Y)$ transformation was conducted on the dependent variable, annual trading volume as follows.

$$\begin{aligned} \text{lgATV} \quad = \quad & \beta_0 + \beta_1\text{PR} + \beta_2\text{INFR} + \beta_3\text{VIN} + \beta_4\text{SIZE} + \beta_5\text{AIM} + \beta_6\text{MIP} + \\ & \beta_7\text{MAXPR} + \beta_8\text{AGE} + \beta_9\text{NOTC} + \beta_{10}\text{NOM} + \beta_{11}\text{PET} + \\ & \beta_{12}\text{FET} + \beta_{13}\text{EFTR} + \beta_{14}\text{TA} + \beta_{15}\text{VOLAT} + e_i \end{aligned} \tag{4}$$

where

$\beta_0 \ldots \beta_{15}$ are the coefficients of the regression and e_i is the error term of the regression. The β value indicates the percentage change in ATV for a unit change in the independent variable, keeping all other variables constant.

Table 8 shows the results of the above regression. The results indicate overall significance of the regression model at a 10% significance level. An R^2 value of 0.338, indicates that 33% of the variation in the dependent variable is due to the independent variables in the model. The variables VIN, AGE and NOM are significant at the 5% level and the variables NOTC and TA are significant at the 10% level.

When the tests for normality and heteroscedasticity were conducted using the Kolmogrov - Smirnov and the Anscombe and Tukey methods respectively, the results showed normality but heteroscedasticity was still present.

Next the variables PR, NOM, EFTR and MAXPR suspected of causing multicollinearity were removed from the model. The reduced model (5) which follows was tested for normality and heteroscedasticity.

$$\begin{aligned} \mathrm{lgATV} \quad = \quad & \beta_0 + \beta_1\mathrm{INFR} + \beta_2\mathrm{VIN} + \beta_3\mathrm{SIZE} + \beta_4\mathrm{AIM} + \beta_5\mathrm{MIP} + \beta_6\mathrm{AGE} \\ & + \beta_7\mathrm{NOTC} + \beta_8\mathrm{PET} + \beta_9\mathrm{FET} + \beta_{10}\mathrm{TA} + \beta_{11}\mathrm{VOLAT} + e_t \end{aligned} \tag{5}$$

where

$\beta_0 \ldots \beta_{11}$ are the coefficients of the regression and e_t is the error term of the regression.

Table 9 shows the results of this reduced model. The R^2 value is 0.254, VIN is significant at the 5% level and AGE is significant at the 10 % level. The results also indicate normality and homoscedasticity, however, the F-value of 1.644, shows that the overall model is not significant even at a 10% significance level.

3.1.3. Model 3

The full model 2, that is equation (4), described in the previous section is used to derive a new model which solves for heteroscedasticity. The technique used to do this is weighted least squares (WLS) regression analysis. In this technique different weights are applied to the model and then the transformed model is regressed using ordinary least squares regression. The method of weighting which we have used is the iterative weighted least squares procedure (in a manner similar to Greene, 1990 pp. 407-408). See *Appendix 2*. The weighted model follows

$$\begin{aligned} \mathrm{wlgATV} \quad = \quad & \beta_0 + \beta_1\mathrm{wPR} + \beta_2\mathrm{wINFR} + \beta_3\mathrm{wVIN} + \beta_4\mathrm{wSIZE} + \beta_5\mathrm{wAIM} + \\ & \beta_6\mathrm{wMIP} + \beta_7\mathrm{wMAXPR} + \beta_8\mathrm{wAGE} + \beta_9\mathrm{wNOTC} + \beta_{10}\mathrm{wNOM} \\ & + \beta_{11}\mathrm{wPET} + \beta_{12}\mathrm{wFET} + \beta_{13}\mathrm{wEFTR} + \beta_{14}\mathrm{wTA} + \\ & \beta_{15}\mathrm{wVOLAT} + e_i \end{aligned} \tag{6}$$

where

w is the weight used in this iterative least squares regression model, see *Appendix 2A* for a more detailed description. $\beta_0 \ldots \beta_{15}$ are the coefficients of the regression and e_i is the error term of the regression.

The results of this weighted regression model are presented in *Table 10.* The results indicate that the model is significant. The variables which are significant at a 5% level include VIN, AGE, NOM, NOTC and TA, while the variables significant at the 10% level are INFR and EFTR. When the assumptions of normality and homoscedasticity were tested the results indicated that non-normality is present. Next the variables MAXPR, PR, NOM and NOTC which cause multicollinearity were removed and the iterative weighted least squares analysis was performed once again. The following regression model was analyzed.

$$\begin{aligned} w'lgATV \quad = \quad & \beta_0 + \beta_1 w'INFR + \beta_2 w'VIN + \beta_3 w'SIZE + \beta_4 w'AIM + \\ & \beta_5 w'MIP + \beta_6 w'AGE + \beta_7 w'NOTC + \beta_8 w'PET + \beta_9 w'FET + \\ & \beta_{10}\, w'TA + \beta_{11}\, w'VOLAT + e_i \end{aligned} \tag{7}$$

where

w' is the weight used in this iterative least squares regression model, see *Appendix 2B* for a more detailed description. $\beta_0 \ldots \beta_{11}$ are the coefficients of the regression and e_i is the error term of the regression.

The results are shown in *Table 11*, and this weighted reduced model shows normality and homoscedasticity. However, the model which was not weighted but had the same variables, that is the reduced model 2 (equation 5) also showed normality and heteroscedasticity. Therefore the weighting of the variables in fact serves no purpose.

3.1.4. Model 4

The next step in our analysis was to investigate a model which transformed both the dependent and independent variables. The following regression model was developed.

$$\mathrm{lgATV} = \beta_0 + \beta_1\mathrm{lgPR} + \beta_2\mathrm{lgINFR} + \beta_3\mathrm{lgVIN} + \beta_4\mathrm{lgSIZE} + \beta_5\mathrm{lgAIM} + \beta_6\mathrm{lgMIP} + \beta_7\mathrm{lgMAXPR} + \beta_8\mathrm{lgAGE} + \beta_9\mathrm{lgNOTC} + \beta_{10}\mathrm{lgNOM} + \beta_{11}\mathrm{PET} + \beta_{12}\mathrm{FET} + \beta_{13}\mathrm{EFTR} + \beta_{14}\mathrm{lgTA} + \beta_{15}\mathrm{lgVOLAT} + e_i \tag{8}$$

where

$\beta_0 \ldots \beta_{15}$ are the coefficients of the regression and e_i is the error term of the regression. The β value indicates the percentage change in ATV for one percent change in the independent variable, keeping all other variables constant.

The results shown in *Table 12* indicate that the overall model is significant and that the independent variables reduce the variation in the dependent variable by 53.8%. The variables which are significant at the 5% level include lgINFR, lgVIN, lgAGE and lgTA, while the variables significant at the 10% level are lgSIZE and PET. The test results for normality and homoscedasticity indicate that the assumptions are met.

The next step taken was to eliminate the variables suspected of causing multicollinearity and then testing the new model for the assumptions. The results for the model which follows are given in *Table 13*.

$$\mathrm{lgATV} = \beta_0 + \beta_1\mathrm{lgINFR} + \beta_2\mathrm{lgVIN} + \beta_3\mathrm{lgSIZE} + \beta_4\mathrm{lgAIM} + \beta_5\mathrm{lgMIP} + \beta_6\mathrm{lgAGE} + \beta_7\mathrm{lgNOTC} + \beta_8\mathrm{PET} + \beta_9\mathrm{FET} + \beta_{10}\mathrm{lgTA} + \beta_{11}\,\mathrm{lgVOLAT} + e_i \tag{9}$$

where

$\beta_0 \ldots \beta_{11}$ are the coefficients of the regression and e_i is the error term of the regression.

The variables significant in this model include lgINFR, lgVIN, lgMIP, lgAGE, lgNOTC and PET at the 5% level and lgAIM and lgTA at the 10% level.

3.2 Interpretation of Results

Of the four models developed in our analysis, the model which best describes financial futures contract success is the Reduced Model 4, equation (9). Model 1 (full and reduced) shows non-normality and heteroscedasticity. Model 2 (the full model) shows heteroscedasticity. The reduced Model 2, that is equation (5), removes the problem of heteroscedasticity but shows that the overall model is not significant.

Model 3 (full and reduced) uses the iterative weighted least squares method. In the case of the full model 3, non-normality exists. The assumptions for the reduced model hold regardless of the weighting process and thus the regression of the reduced model 3 is unnecessary. Furthermore, this model was not used as the final model due to the fact that this model has been transformed by the use of various weights and so the regression coefficients are difficult to interpret.

The full Model 4 has both normality and homoscedasticity, is significant as an overall regression model and is easier to interpret. The reduced Model 4 which eliminates the variables causing severe multicollinearity, is an improvement on the full model since the new estimated regression coefficient results produced are more precise than those of the full model.

The results of the final model, that is equation 11 is shown in *Table 13*. Since this model is a log-linear model the coefficients are elasticities. The coefficients can be interpreted as the percentage change in the dependent variable, for one percent change in the independent variable, keeping all the other independent variables constant.

The variable INFR, that is inflation, is the variable which shows the highest significance. As hypothesized the relationship is positively related to annual trading volume. The results indicate that for a 1% change in inflation in the year the annual trading volume increased by 1.245%.

The variable used to measure vertical integration is also statistically significant and positively related to annual trading volume. We expected that low volatility in the GDP (the proxy for VIN) would indicate that there was higher vertical integration in the country. Thus countries with high vertical integration would have lower annual trading volume, and countries with lower vertical integration which exhibit higher volatility in the GDP will have higher annual trading volume. The results indicate that the greater the fluctuation of the GDP (the proxy for VIN) the greater the annual trading volume. This relationship is as hypothesized. The results indicate that for 1% change in VIN, that is volatility of GDP, there is a 3.089% change in the annual trading volume. This variable causes the strongest impact on the annual trading volume.

The size of the contract is not significant. We had hypothesized that if the market consisted mainly of small traders then the larger the size of the contract the lower the annual trading volume. Likewise, if the market consisted mainly of large traders then the larger the size of the contract the higher the annual trading volume. The results show that the market consists of both large and small traders and that size is not a variable which affects annual trading volume.

The average initial margin is statistically significant and negatively related to annual trading volume as was expected. The results indicate that for a 1% increase in the average initial margin the annual trading volume would decrease by 0.685%.

In the case of the minimum price limit, we find that this variable is statistically significant and positively related to annual trading volume. This result indicates that at present the minimum limits are lower than what is desirable to the trader, and that the trader prefers higher limits.

The age of the contract is also found to be statistically significant and positively related to annual trading volume as hypothesized. The longer a contracts trades on an exchange the greater the monopoly it creates. There is added confidence in the survival of the contract the longer it continues to trade.

The exchange factors which are significantly related to annual trading volume include the number of contracts on the exchange, the presence of partial electronic trading and the value of total assets of the exchange. In the case of number of contracts present on the exchange, the results show that as the number of contracts traded on an exchange increases the volume traded on a particular contract decrease. This result is opposite to what we expected. We hypothesized that NOTC would proxy for the confidence of the public on the exchange and that higher numbers of contracts traded on an exchange would reflect the success of the exchange.

Of the two variables PET and FET which measured the effect of electronic trading in this model, the results show that PET is statistically significant and positively related to annual trading volume.

The size and resources availability of the exchange, which was measured by the total assets of the exchange is statistically significant and positively related to annual trading volume, as hypothesized.

The variable VOLAT is found to be not significant. We had expected that higher volatility in the cash price would cause higher trading volume. We used futures price volatility as a proxy for cash price volatility, and perhaps this could be the reason that the variable was found to be insignificant.

Of the eleven variables entered in the reduced regression model (4), eight were found to be statistically significant. Of these eight, the relationship between seven of the variables and the annual trading volume were found to be as hypothesized.

3.3 Discussion on Exchange Fees

As mentioned earlier we hypothesize that the lower the cost of trading, the higher the volume of trading. We tried to compare the exchange fees and transaction costs of the various exchanges in our study. However, we realised that the fees varied from contract to contract and exchange to exchange.

Each of the exchanges we contacted had a unique way of charging of exchange fees to traders. Fees depended on either/or the underlying contract, the type of trader, the type of transaction or the quantity traded. For example the Toronto Futures

Exchange (TFE), the Sydney Futures Exchange (SFE) and the London International Financial Futures Exchange (LIFFE) approached pricing of exchange fees similarly. They quoted fees depending on the underlying contract and type of transaction. However, for LIFFE pricing was based on a round trip transaction, while at the TFE and the SFE this depended on either a buy or sell transaction. The MEFF of Spain and MATIF of France quoted prices based basically on volume and the underlying contract. The fee structure at the BM&F of Brazil is quoted as a percentage per transaction charged by member type. At SIMEX of Singapore, CBOT and CME, fees are quoted by member type. This membership structure varies for all the three exchanges. FUTOP of Denmark on the other hand uses a combination of a basic charge and a quantity charge, to calculate fees per transaction.

From this summary of the fee structure it is clear that one of the ways exchanges differentiate themselves is through their fee structure. It is very difficult to compare the exchanges based on their fee structure. One cannot say that one structure is better than another, rather it is a unique differentiating aspect of each exchange.

4. Conclusion

Over the past decade, the emergence of new futures exchanges around the world and the loss of market share for U.S futures exchanges, has led to increased global competition in financial futures markets. In order to sustain growth and competitive advantage exchanges are constantly introducing new financial futures contracts. However only one-third of these contracts have succeeded in the past. Futures exchanges around the world would benefit from a model which could predict the factors which affect worldwide success of new and innovative financial futures contracts.

The purpose of this paper has been to develop a model linking the global success of financial futures contracts to country, exchange, commodity and contract characteristics. This paper is unique in that it is the first one to study all the three types of financial futures contracts, i.e currency, stock index and interest rate contracts. It is also the first to address the factors affecting the success of financial futures contracts in an international context. Furthermore, although it is an extension of Black's paper on contract success it is unique in that it includes country, exchange, commodity and contract factors within the model.

Given that there are two types of traders, hedgers and speculators, attracting demand for the new contract implies appealing to these traders. Hedgers want to be able to reduce the risks inherent in their portfolios due to underlying commodity price uncertainty, while speculators are attracted to the possibility of potential profits. Both however, will only enter markets which have the lowest cost. With these criteria in mind various variables were considered. Our theoretical model divides the variables into four separate categories, that is, country, exchange, commodity and contract characteristics. Country characteristics include the rate of inflation, industrial structure and exposure to risk, intensity of regulation of futures markets and political risk. Exchange factors are the structure of the exchange, existence of substitute markets, support for new contracts, specialization of the exchange, the existence of duplicate contracts, size and resource availability of the exchange, the confidence of the public in the exchange and degree to which electronic trading was utilised on the exchange. The commodity factors include cash price volatility, the cash market size, and the cross hedge correlation. Contract factors affecting success are size of the contract, delivery options embedded in the contract, the margins, minimum and maximum price limits, the position limits and age of the contract.

Due to the fact that not all these variables are quantitative only a few of the above factors were tested in our empirical research. These factors include the inflation rate, vertical integration, political risk, the size resource availability of the exchange, confidence of the public in the exchange, the trading system, cash price volatility, size of the contract, average annual initial margins, maximum and minimum price limits, and the age of the contract.

The data included 65 contracts from 16 exchanges in 11 countries. A cross-sectional analysis on data in 1992 was conducted using Ordinary Least Squares (OLS). Four regression models were developed. The best model, the double log model was chosen based on ease of interpretation of the regression coefficients and on the fact that it satisfied the assumptions of the OLS model.

The empirical investigation conducted on the final model shows of the eleven variables included in the model, eight are found to be statistically significant. Seven of these variables are as hypothesized. The factors which are positively related to annual trading volume in order of impact on annual trading volume include industrial structure and exposure to price risk, inflation, age, partial electronic trading, minimum price limit and size and resource availability of the exchange. As hypothesized, the factor which is negatively related to annual trading volume is the average initial price limit.

Suggestions for further research would include increasing the data set to include more contracts than the 65 used in our analysis. Since our analysis measured the variables for the year 1992 and was cross sectional in nature, further research could try to include data over a longer time period. With a larger data set the variables which were removed due to multicollinearity could be included in the regression models.

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6. Tables

Table 1

Financial Futures contracts used in the study

COUNTRY	EXCHANGE	CONTRACT NAME	INTRODUCTION
NAME	NAME		DATE
UNITED STATES	CME	BRITISH POUND FUTURE	May-72
UNITED STATES	CME	CANADIAN $ FUTURE	May-72
UNITED STATES	CME	DEUTSCHE MARK FUTURE	May-72
UNITED STATES	CME	JAPANESE YEN FUTURE	May-72
UNITED STATES	CME	SWISS FRANC FUTURE	May-72
UNITED STATES	CME	AUSTRALIAN $ FUTURE	May-72
UNITED STATES	CME	T-BILL FUTURE	Jan-76
UNITED STATES	CME	EURO $ FUTURE	Dec-81
UNITED STATES	CME	S&P 500 FUTURE	Apr-82
UNITED STATES	CBOT	5 YR NOTE FUTURE	Jun-79
UNITED STATES	CBOT	10 YR NOTE FUTURE	May-82
UNITED STATES	CBOT	MAJOR MARKET INDEX FUTURE	Jan-86
UNITED STATES	CBOT	T-BOND FUTURE	Sep-77
UNITED STATES	CBOT	MUNICIPAL BOND FUTURE	Jun-85
UNITED STATES	NYFE	NYSE COMPOSITE INDEX FUTURE	May-72
UNITED STATES	KBOT	VALUE LINE FUTURE	Feb-82
UNITED STATES	MIDEX	US $ INDEX FUTURE	Oct-92
UNITED STATES	MIDEX	T-BOND FUTURE	Sep-81
UNITED KINGDOM	LIFFE	GERMAN BUND FUTURE	Sep-88
UNITED KINGDOM	LIFFE	US T-BOND FUTURE	Jun-84

Table 1 (continued)

Financial Futures contracts used in the study

UNITED KINGDOM	LIFFE	ECU FUTURE	Oct-89
UNITED KINGDOM	LIFFE	EURO $ FUTURE	Sep-82
UNITED KINGDOM	LIFFE	LONG GILT FUTURE	Nov-82
UNITED KINGDOM	LIFFE	SHORT STERLING FUTURE	Nov-82
UNITED KINGDOM	LIFFE	EURO SWISS FUTURE	Feb-91
UNITED KINGDOM	LIFFE	EURO MARK FUTURE	Apr-89
UNITED KINGDOM	LIFFE	EURO LIRA FUTURE	May-92
UNITED KINGDOM	LIFFE	ITALIAN BOND FUTURE	Sep-91
UNITED KINGDOM	LIFFE	FTSE- INDEX FUTURE	May-84
UNITED KINGDOM	LIFFE	JAP BOND FUTURE	Apr-91
FRANCE	MATIF	CAC 40 INDEX FUTURE	Jun-88
FRANCE	MATIF	NOTIONAL BOND FUTURE	Jun-86
FRANCE	MATIF	PIBOR FUTURE	Jun-88
FRANCE	MATIF	ECU FUTURE	Oct-90
BRAZIL	BOLSA	1 DAY INTERBANK DEPOSIT FUTURE	Jun-91
BRAZIL	BOLSA	US $ COMMERCIAL FUTURE	Apr-90
BRAZIL	BOLSA	US $ FLOATING FUTURE	Aug-91
BRAZIL	BOLSA	BOSVESPA INDEX FUTURE	Feb-86
SINGAPORE	SIMEX	BRITISH POUND FUTURE	Jul-86
SINGAPORE	SIMEX	DEUTSCHE MARK FUTURE	Sep-84
SINGAPORE	SIMEX	EURO [illegible] FUTURE	Sep-84
SINGAPORE	SIMEX	EURO MARK FUTURE	Sep-90
SINGAPORE	SIMEX	EURO YEN FUTURE	Oct-89

Table 1 (continued)

Financial Futures contracts used in the study

SINGAPORE	SIMEX	JAPANESE YEN FUTURE	Nov-84
SINGAPORE	SIMEX	NIKKEI INDEX FUTURE	Sep-86
CANADA	TORONTO	TORONTO 35 INDEX FUTURE	May-87
CANADA	MONTREAL	1 MONTH CDN BANKERS ACCEPTANCE FUTURE	Apr-92
CANADA	MONTREAL	3 MONTH CDN BANKERS ACCEPTANCE FUTURE	Apr-88
CANADA	MONTREAL	10 yr GOVT. BOND FUTURE	Sep-89
AUSTRALIA	SYDNEY	ALL ORDINARIES SHARE PRICE INDEX FUTURE	Feb-83
AUSTRALIA	SYDNEY	3 yr AUSTRALIAN T-BOND FUTURE	May-88
AUSTRALIA	SYDNEY	10 yr AUSTRALIAN T-BOND FUTURE	Dec-84
AUSTRALIA	SYDNEY	90 DAY BANK ACCEPTED BILL FUTURE	Oct-79
AUSTRALIA	SYDNEY	50 LEADERS SHARE PRICE INDEX FUTURE	Jan-92
JAPAN	TIFFE	1 yr EUROYEN FUTURE	Jun-92
JAPAN	TIFFE	3 MONTH EUROYEN FUTURE	Jun-89
JAPAN	TIFFE	US$/ JAPANESE YEN FUTURE	Jun-91
GERMANY	DTB	DAX INDEX FUTURE	Nov-90
GERMANY	DTB	BOBL FUTURE	Oct-91
GERMANY	DTB	BUND FUTURE	Nov-90
SWISS	SOFFEX	5 yr SWISS FRANC FUTURE	Oct-91
SWISS	SOFFEX	SWISS GOVT. BOND INDEX FUTURE	May-92
SWISS	SOFFEX	SWISS MARKET INDEX FUTURE	Nov-90
SPAIN	MEFF	MIBOR 90 DAY FUTURE	Oct-90
SPAIN	MEFF	3 yr NOTIONAL SPANISH BOND FUTURE	Mar-90
SPAIN	MEFF	10 yr NOTIONAL SPANISH BOND FUTURE	Jun-05

Table 2

Descriptive Statistics

	ATV	PR	INFR	VIN	SIZE
Mean	5708736.615	92.154	35.979	10.067	333511.985
Standard Deviation	12000255.465	14.221	133.839	2.053	444242.963
Minimum	203.000	39.000	0.262	5.163	564.943
Maximum	70003894.000	100.000	554.594	13.009	2482005.460
Count	65	65	65	65	65

	AIM	MIP	MAXPR	AGE	NOM
Mean	21592.185	19.141	0.001	7.031	732.385
Standard Deviation	94841.404	14.484	0.004	5.981	903.807
Minimum	148.236	1.000	0.000	0.167	59.000
Maximum	689043.080	78.958	0.020	20.667	2724.000
Count	65	65	65	65	65

	NOTC	PET	FET	EFTR	TA
Mean	11.892	0.185	0.369	0.800	1110119708.495
Standard Deviation	8.172	0.391	0.486	0.403	1909050531.365
Minimum	1.000	0.000	0.000	0.000	1016419.293
Maximum	26.000	1.000	1.000	1.000	5678829000.000
Count	65	65	65	65	65

Table 3

Correlation Matrix

	ATV	PR	INFR	VIN	SIZE	AIM	MIP	MAXPR	AGE
ATV	1.000								
PR	0.032	1.000							
INFR	0.017	-0.964	1.000						
VIN	0.159	0.131	0.035	1.000					
SIZE	0.058	0.076	-0.090	-0.173	1.000				
AIM	-0.004	-0.761	0.789	0.030	-0.136	1.000			
MIP	0.098	0.123	-0.049	-0.039	0.138	0.182	1.000		
MAXPR	-0.073	-0.607	0.567	-0.012	-0.185	0.396	-0.248	1.000	
AGE	0.230	0.177	-0.133	0.115	-0.130	-0.060	-0.059	-0.127	1.000
NOM	0.272	-0.051	0.137	0.212	-0.115	0.112	-0.039	0.036	0.758
NOTC	0.311	0.021	0.069	0.134	-0.060	0.054	0.104	-0.052	0.647
PET	0.005	0.103	-0.123	0.055	-0.045	-0.100	-0.101	-0.134	-0.048
FET	0.178	0.262	-0.194	0.171	-0.199	-0.161	0.064	0.004	0.245
EFTR	0.147	-0.140	0.127	0.002	0.168	0.104	-0.111	-0.088	0.445
TA	0.201	0.186	-0.128	0.164	-0.013	-0.096	-0.062	-0.102	0.714
VOLAT	0.107	0.210	-0.206	-0.206	0.542	-0.176	0.439	-0.114	-0.067

Table 3 (continued)

Correlation Matrix

	NOM	NOTC	PET	FET	EFTR	TA	VOLAT
ATV							
PR							
INFR							
VIN							
SIZE							
AIM							
MIP							
MAXPR							
AGE							
NOM	1.000						
NOTC	0.813	1.000					
PET	-0.243	-0.047	1.000				
FET	0.353	0.148	-0.364	1.000			
EFTR	0.343	0.482	0.238	-0.654	1.000		
TA	0.844	0.535	-0.235	0.392	0.214	1.000	
VOLAT	-0.071	-0.051	-0.005	0.054	-0.063	0.051	1.000

Table 4
Test for Multicollinearity

Full Model

Variable	*R-squared*	*VIF*
PR	0.9735	37.7358
INFR	0.9702	33.5121
VIN	0.5497	2.2205
SIZE	0.4526	1.8267
AIM	0.7072	3.4158
MIP	0.5382	2.1655
MAXPR	0.5084	2.0342
AGE	0.7756	4.4567
NOM	0.9465	18.6916
NOTC	0.8569	6.9896
PET	0.3126	1.4547
FET	0.8810	8.4012
EFTR	0.9034	10.3488
TA	0.8619	7.2427
VOLAT	0.5532	2.2381

Table 5

Model 1: Full Model
Dependent variable: ATV

Regression Statistics	
Multiple R	0.478
R Square	0 228
Adjusted R Square	-0 008
Standard Error	12048662.966
Observations	65

Analysis of Variance					
	df	*SSE*	*MSE*	*F*	*Sig F*
Regression	15	2.10305E+15	1.40203E+14	0 966	0 503
Residual	49	7 11334E+15	1 4517E+14		
Total	64	9.21639E+15			

Variables in the Equation				
	Coeff.	*Std Error*	*t Statistic*	*P-value*
Intercept	-16088245 561	56142799.136	-0 287	0 775
PR	-110612.793	650615.151	-0 170	0 866
INFR	7691.453	65143.028	0.118	0 906
VIN	624563.880	1093345.218	0.571	0 570
SIZE	0.009	4.582	0 002	0 998
AIM	-8.177	29.349	-0 279	0 781
MIP	65900.974	153022.577	0 431	0 668
MAXPR	-213943658.475	542379756.152	-0 394	0.695
AGE	-379223.004	531579 039	-0.713	0.478
NOTC	-4007.001	7204.549	-0.556	0.580
NOM	207790.049	487236.999	0.426	0.671
PET	2181315.104	4645691.022	0.470	0.640
FET	20652970.326	8975546.953	** 2.301	0.025
EFTR	23022684.219	12019057.802	* 1.916	0.060
TA	0.000	0.002	0.129	0 898
VOLAT	12486 719	25028.583	0 499	0 620

** Significant at 5%

* Significant at 10%

Normality Testing		
	K-Z value	Critical
Kolmogrov Smirnov	1.992	1.000

Heteroscedasticity Testing		
	Beta	Critical
Anscombe & Tukey	4.433	2.000

Table 6

Model 1: Reduced Model
Dependent variable: ATV

Regression Statistics	
Multiple R	0.398
R Square	0.158
Adjusted R Square	-0.016
Standard Error	12097942.692
Observations	65

Analysis of Variance

	df	*SSE*	*MSE*	*F*	*Sig. F*
Regression	11	1.4593E+15	1.32664E+14	0.906	0.541
Residual	53	7.75709E+15	1.4636E+14		
Total	64	9.21639E+15			

Variables in the Equation

	Coeff.	*Std Error*	*t Statistic*	*P-value*
Intercept	-11425577.127	8653933.320	-1.320	0.191
INFR	10644.269	20686.710	0.515	0.609
VIN	724706.443	787210.971	0.921	0.361
SIZE	2.461	4.363	0.564	0.575
AIM	-7.176	29.176	-0.246	0.807
MIP	32382.886	136974.770	0.236	0.814
AGE	184254.218	424726.906	0.434	0.666
NOTC	358245.267	263246.672	1.361	0.178
PET	2519320.837	4515167.096	0.558	0.579
FET	4314739.018	3898062.549	1.107	0.272
TA	0.000	0.001	-0.273	0.786
VOLAT	12353.405	24078.802	0.513	0.610

* Significant at the 10% level
** Significant at the 5% level

Normality Testing

	K-Z value	Critical
Kolmogrov Smirnov	2.073	1.000

Heteroscedasticity Testing

	Beta	Critical
Anscombe & Tukey	3.175	2.000

Table 7
Test for Multicollinearity

Reduced Model

Variable	*R-squared*	*VIF*
INFR	0.7017	3.3520
VIN	0.1242	1.1418
SIZE	0.3912	1.6424
AIM	0.7013	3.3481
MIP	0.4190	1.7211
AGE	0.6456	2.8220
NOTC	0.5059	2.0238
PET	0.2663	1.3629
FET	0.3637	1.5717
TA	0.6183	2.6196
VOLAT	0.5133	2.0546

Table 8

Model 2: Full Model
Dependent variable: lgATV

Regression Statistics	
Multiple R	0.582
R Square	0.338
Adjusted R Square	0.136
Standard Error	1.053
Observations	65

Analysis of Variance					
	df	*SSE*	*MSE*	*F*	*Sig F*
Regression	15	27.746	1.850	1.670	0.090
Residual	49	54.288	1.108		
Total	64	82.033			

Variables in the Equation				
	Coeff.	*Std Error*	*t Statistic*	*P-value*
Intercept	6.515	4.905	1.328	0.189
PR	-0.039	0.057	-0.691	0.492
INFR	0.000	0.006	0.056	0.955
VIN	0.220	0.096	** 2.305	0.024
SIZE	0.000	0.000	-0.273	0.785
AIM	0.000	0.000	-0.127	0.899
MIP	-0.005	0.013	-0.384	0.702
MAXPR	-43.098	47.382	-0.910	0.366
AGE	0.094	0.046	** 2.033	0.046
NOM	-0.001	0.001	** -2.315	0.024
NOTC	0.083	0.043	* 1.953	0.055
PET	0.360	0.406	0.888	0.378
FET	0.353	0.784	0.451	0.654
EFTR	-0.371	1.050	-0.353	0.725
TA	0.000	0.000	* 1.677	0.098
VOLAT	0.002	0.002	1.136	0.260

* Significant at the 10% level
** Significant at the 5% level

Normality Testing		
	K-Z value	Critical
Kolmogrov Smirnov	0.475	1.000

Heteroscedasticity Testing		
	Beta	Critical
Anscombe & Tukey	-2.325	2.000

Table 9

Model 2: Reduced Model
Dependent variable: lgATV

Regression Statistics	
Multiple R	0.504
R Square	0.254
Adjusted R Square	0.100
Standard Error	1.074
Observations	65

Analysis of Variance					
	df	*SSE*	*MSE*	*F*	*Sig. F*
Regression	11	20.867	1.897	1.644	0.113
Residual	53	61.166	1.154		
Total	64	82.033			

Variables in the Equation				
	Coeff.	*Std Error*	*t Statistic*	*P-value*
Intercept	3.551	0.768	** 4.622	0.000
INFR	0.002	0.002	1.010	0.316
VIN	0.150	0.070	** 2.151	0.035
SIZE	0.000	0.000	0.106	0.916
AIM	0.000	0.000	-0.188	0.851
MIP	0.002	0.012	0.167	0.868
AGE	0.065	0.038	* 1.726	0.089
NOTC	0.000	0.023	-0.010	0.992
PET	0.609	0.401	1.520	0.133
FET	0.342	0.346	0.988	0.327
TA	0.000	0.000	-0.283	0.778
VOLAT	0.002	0.002	0.754	0.454
FET	0.353	0.784	0.451	0.654

* Significant at the 10% level
** Significant at the 5% level

Normality Testing		
	K-Z value	Critical
Kolmogrov Smirnov	0.632	1.000

Heteroscedasticity Testing		
	Beta	Critical
Anscombe & Tukey	-1.262	2.000

Table 10

Model 3: Full Model
Dependent variable: wlgATV

Regression Statistics	
Multiple R	0.999
R Square	0.997
Adjusted R Square	0.996
Standard Error	3.370
Observations	65

Analysis of Variance					
	df	*SSE*	*MSE*	*F*	*Sig. F*
Regression	15	206151.170	13743.411	1210.110	0.000
Residual	50	567.858	11.35716		
Total	64				

Variables in the Equation				
	Coeff.	*Std Error*	*t Statistic*	*P-value*
wlgPR	0.007	0.023	0.290	0.773
wlgINFR	0.010	0.005	*2.05	0.046
wlgVIN	0.509	0.191	** 2.672	0.010
wlgSIZE	0.000	0.000	-0.362	0.719
wlgAIM	0.000	0.000	-0.156	0.876
wlgMIP	-0.003	0.036	-0.076	0.934
wlgMAXPR	-94.597	86.739	-1.091	0.281
wlgAGE	0.016	0.046	** 3.519	0.001
wlgNOM	-0.005	0.001	** -7.304	0.000
wlgNOTC	0.316	0.042	** 7.471	0.000
wPET	-0.876	0.735	-1.193	0.238
wFET	-1.278	0.979	-1.306	0.198
wEFTR	-2.923	1.648	* -1.773	0.082
wlgTA	0.000	0.000	** 6.845	0.000
wlgVOLAT	0.007	0.004	1.545	0.129

* Significant at the 10% level
** Significant at the 5% level

Normality Testing		
	K-Z value	Critical
Kolmogrov Smimov	1.256	1.200

Heteroscedasticity Testing		
	Beta	Critical
Anscombe & Tukey	-0.120	2.000

Table 11

Model 3: Reduced Model
Dependent variable: wlgATV

Regression Statistics	
Multiple R	0.987
R Square	0.973
Adjusted R Square	0.968
Standard Error	2.466
Observations	65

Analysis of Variance					
	df	*SSE*	*MSE*	*F*	*Sig. F*
Regression	11	11958.982	1087.180	178.716	0.000
Residual	54	328.497	6.08328		
Total	64				

Variables in the Equation				
	Coeff.	*Std Error*	*t Statistic*	*P-value*
wlgINFR	0.001	0.003	0.486	0.627
wlgVIN	0.443	0.042	10.421	0.000
wlgSIZE	0.000	0.000	2.358	0.022
wlgAIM	0.000	0.000	-0.132	0.895
wlgMIP	0.012	0.018	0.669	0.507
wlgAGE	0.182	0.044	4.113	0.000
wlgNOTC	-0.029	0.025	-1.180	0.243
wPET	0.823	0.394	2.089	0.041
wFET	0.263	0.475	0.554	0.582
wlgTA	0.000	0.000	-0.818	0.417
wlgVOLAT	-0.002	0.003	-0.634	0.529

* Significant at the 10% level
** Significant at the 5% level

Normality Testing		
	K-Z value	Critical
Kolmogrov Smirnov	0.751	1.000

Heteroscedasticity Testing		
	Beta	Critical
Anscombe & Tukey	0.177	2.000

Table 12

Model 4: Full Model
Dependent variable: lgATV

Regression Statistics	
Multiple R	0.734
R Square	0.538
Adjusted R Square	0.397
Standard Error	0.879
Observations	65

Analysis of Variance					
	df	*SSE*	*MSE*	*F*	*Sig F*
Regression	15.000	44.157	2.944	3.808	0.000
Residual	49.000	37.877	0.773		
Total	64.000	82.033			

Variables in the Equation				
	Coeff.	*Std Error*	*t Statistic*	*P-value*
Intercept	3.573	8.450	0.423	0.674
lgPR	-0.558	4.023	-0.139	0.890
lgINFR	1.227	0.577	** 2.125	0.037
lgVIN	2.923	1.440	** 2.030	0.047
lgSIZE	-0.617	0.348	* -1.775	0.081
lgAIM	-0.251	0.518	-0.484	0.630
lgMIP	0.260	0.532	0.490	0.626
lgMAXPR	-153.730	111.221	-1.382	0.172
lgAGE	1.330	0.337	** 3.951	0.000
lgNOM	-0.829	0.602	-1.377	0.173
lgNOTC	-0.236	0.783	-0.302	0.764
PET	0.804	0.420	* 1.917	0.060
FET	0.314	0.630	0.499	0.620
EFTR	0.080	0.831	0.097	0.923
lgTA	0.432	0.209	** 2.063	0.043
lgVOLAT	0.866	0.557	1.556	0.125

* Significant at the 10% level

** Significant at the 5% level

Normality Testing		
	K-Z value	Critical
Kolmogrov Smirnov	0.830	1.000

Heteroscedasticity Testing		
	Beta	Critical
Anscombe & Tukey	-1.268	2.000

Table 13

Model 4: Reduced Model
Dependent variable: lgATV

Regression Statistics	
Multiple R	0.706
R Square	0.499
Adjusted R Square	0.395
Standard Error	0.881
Observations	65

Analysis of Variance					
	df	*SSE*	*MSE*	*F*	*Sig. F*
Regression	11	40.900	3.718	4.791	0.000
Residual	53	41.134	0.776		
Total	64	82.033			

Variables in the Equation				
	Coeff.	*Std Error*	*t Statistic*	*P-value*
Intercept	1.855	2.321	0.799	0.427
lgINFR	1.245	0.317	** 3.932	0.000
lgVIN	3.089	1.161	** 2.661	0.010
lgSIZE	-0.416	0.298	-1.397	0.167
lgAIM	-0.685	0.383	* -1.791	0.078
lgMIP	0.831	0.405	** 2.053	0.044
lgAGE	1.198	0.273	** 4.391	0.000
lgNOTC	-1.144	0.506	** -2.262	0.027
PET	0.961	0.353	** 2.725	0.008
FET	0.135	0.306	0.442	0.660
lgTA	0.415	0.209	* 1.990	0.051
lgVOLAT	0.365	0.458	0.796	0.429

* Significant at the 10% level
** Significant at the 5% level

Normality Testing		
	K-Z value	Critical
Kolmogrov Smirnov	0.545	1.000

Heteroscedasticity Testing		
	Beta	Critical
Anscombe & Tukey	-1.588	2.000

7. Appendices

Appendix 1A

London International Financial Futures and Options Exchange
London, England
Chief Executive Officer
fax: 071-588-3624

Dear Mr. D. Hodson,

I am a student at Concordia University in Montreal, pursuing a Master of Science in Administration (Finance), working under the supervision of Dr. Latha Shanker. For my thesis topic I am analyzing factors which are critical to the success of financial futures contracts introduced in exchanges around the world.

I would be extremely grateful if you could respond to the questionnaire that follows, or send it to the appropriate person who would be able to do so. The questionnaire deals with financial futures contracts traded on your exchange in 1992. Your participation is integral to this research. Your responses to the questionnaire which follows will be combined with those from other participating exchanges to perform extensive statistical analysis. Please give a complete answer to every question as it is critical for the success of this research.

This research is the first of its kind performed on the international level, the results would help exchanges like yours to introduce and maintain new financial futures contracts. If you wish to receive a summary of the results of this research, you can do so by asking for it when the questionnaire is returned. Please be assured that we will ensure your anonymity, all data on individual exchanges will be confidential.

I would appreciate if this questionnaire could be sent by **fax** to the number stated above, as soon as possible. Thank you for your time.

Sincerely

SARAH SAMUEL
MSc. Student
Concordia University

Attachments

Appendix 1B

1. What was the total asset value of the exchange in *1992* ? (please state currency unit)

____

2. What was the total equity value of the exchange in *1992* ? (please state currency unit)

____

3. What was the total membership at the exchange in *1992* (in all classes) ?

____

4. What were the exchange fees in *1992* for all classes ? (in local currency)

Hedgers _______________________________________

Speculators ____________________________________

Other ____

5. State the hours (in local time) between which each contract is traded on an electronic trading system in *1992* ?

CONTRACT NAME	FLOOR TRADING HOURS (local time)	ELECTRONIC TRADING HOURS (local time)
German Bund Future		
U.S T-Bond Future		
ECU Future		
Euro Dollar Future		
Long Gilt Future		
Short Sterling Future		

Please feel free to attach any documentation you believe will help explain the answers to the questions asked above.

CONTINUED ON NEXT PAGE

CONTRACT NAME	FLOOR TRADING HOURS (local time)	ELECTRONIC TRADING HOURS (local time)
Euro Swiss Future		
Euro Mark Future		
Euro Lira Future		
Italian Bond Future		
FT-SE Index Future		

6. In your opinion do you consider the regulatory body in your country to be efficient ? Please tick the correct answer.

efficient____________________

somewhat efficient__________

not efficient________________

7. When was the final proposal for introduction of the new contract submitted to the regulatory body for approval, and when was the it finally approved ?

CONTRACT NAME	SUBMISSION OF FINAL PROPOSAL	APPROVAL OF FINAL PROPOSAL
German Bund Future		
U.S T-Bond Future		
ECU Future		
Euro Dollar Future		
Long Gilt Future		
Short Sterling Future		
Euro Swiss Future		

Please feel free to attach any documentation you believe will help explain the answers to the questions asked above.

CONTINUED ON NEXT PAGE

CONTRACT NAME	SUBMISSION OF FINAL PROPOSAL	APPROVAL OF FINAL PROPOSAL
Euro Mark Future		
Euro Lira Future		
Italian Bond Future		
FT-SE Index Future		

8. What is the maximum allowable number of contracts which can be traded by the different members (position limits), at your exchange in *1992* ?

Hedger ______________________________

Speculator ______________________________

____

____

____

9. What were the initial margin changes for hedgers and speculators in *1992* for all contract months ? (please specify currency unit).

CONTRACT NAME	DATE	INITIAL MARGIN
German Bund Future	Jan-	
U.S T-Bond Future	Jan-	

Please feel free to attach any documentation you believe will help explain the answers to the questions asked above.

CONTINUED ON NEXT PAGE

CONTRACT NAME	DATE	INITIAL MARGIN
ECU Future	Jan-	
Euro Dollar Future	Jan-	
Long Gilt Future	Jan-	
Short Sterling Future	Jan-	
Euro Swiss Future	Jan-	
Euro Mark Future	Jan-	
Euro Lira Future	Jan-	
Italian Bond Future	Jan-	

Please feel free to attach any documentation you believe will help explain the answers to the questions asked above.

CONTINUED ON NEXT PAGE

CONTRACT NAME	DATE	INITIAL MARGIN
FT-SE Index Future	Jan-	

10. What was the maximum price limit for each contract and during what time in the day did the limit hold in *1992* ? (please specify currency unit).

CONTRACT NAME	MAXIMUM PRICE LIMIT	TIME
German Bund Future		
U.S T-Bond Future		
ECU Future		
Euro Dollar Future		
Long Gilt Future		
Short Sterling Future		
Euro Swiss Future		
Euro Mark Future		
Euro Lira Future		
Italian Bond Future		
FT-SE Index Future		

11. What was the total volume of contracts traded in *1992* (trading volume) ?

CONTRACT NAME	TRADING VOLUME
German Bund Future	
U.S T-Bond Future	

Please feel free to attach any documentation you believe will help explain the answers to the questions asked above.

CONTINUED ON NEXT PAGE

CONTRACT NAME	TRADING VOLUME
ECU Future	
Euro Dollar Future	
Long Gilt Future	
Short Sterling Future	
Euro Swiss Future	
Euro Mark Future	
Euro Lira Future	
Italian Bond Future	
FT-SE Index Future	

12. Would you like to receive a summary of our results.

Yes____________ No____________

Appendix 2A

Iterative Weighted Least Squares Regression on the Full Model 3

The first stage of this transformation is to use the squared residuals of equation (4) and regress it on the independent variables.

$$e_i^2 = \alpha_0 + \alpha_1 PR + \alpha_2 INFR + \alpha_3 VIN + \alpha_4 SIZE + \alpha_5 AIM + \alpha_6 MIP + \alpha_7 MAXPR + \alpha_8 AGE + \alpha_9 NOTC + \alpha_{10} NOM + \alpha_{11} PET + \alpha_{12} FET + \alpha_{13} EFTR + \alpha_{14} TA + \alpha_{15} VOLAT + v_i$$

The second stage involves obtaining the predicted value of this transformed regression equation and using it as the weight in a model where the squared error terms of equation (4) are regressed on the independent variables as follows.

$$\frac{e_i^2}{\sigma_i^{2(1)}} = \alpha_0 \frac{1}{\sigma_i^{2(1)}} + \alpha_1 \frac{PR}{\sigma_i^{2(1)}} + \alpha_2 \frac{INFR}{\sigma_i^{2(1)}} + \alpha_3 \frac{VIN}{\sigma_i^{2(1)}} + \alpha_4 \frac{SIZE}{\sigma_i^{2(1)}} + \alpha_5 \frac{AIM}{\sigma_i^{2(1)}} + \alpha_6 \frac{MIP}{\sigma_i^{2(1)}} + \alpha_7 \frac{MAXPR}{\sigma_i^{2(1)}} + \alpha_8 \frac{AGE}{\sigma_i^{2(1)}} + \alpha_9 \frac{NOM}{\sigma_i^{2(1)}} + \alpha_{10} \frac{NOTC}{\sigma_i^{2(1)}} + \alpha_{11} \frac{PET}{\sigma_i^{2(1)}} + \alpha_{12} \frac{FET}{\sigma_i^{2(1)}} + \alpha_{13} \frac{EFTR}{\sigma_i^{2(1)}} + \alpha_{14} \frac{TA}{\sigma_i^{2(1)}} + \alpha_{15} \frac{VOLAT}{\sigma_i^{2(1)}} + \frac{V_i}{\sigma_i^{2(1)}}$$

where

$$
\begin{aligned}
\sigma_i^{2(1)} = \; & + \alpha_0^{(1)} + \alpha_1^{(1)} PR + \alpha_2^{(1)} INFR + \alpha_3^{(1)} VIN + \alpha_4^{(1)} SIZE + \alpha_5^{(1)} AIM + \alpha_6^{(1)} MIP \\
& + \alpha_7^{(1)} MAXPR + \alpha_8^{(1)} AGE + \alpha_9^{(1)} NOM + \alpha_{10}^{(1)} NOTC + \alpha_{11}^{(1)} PET + \alpha_{12}^{(1)} FET \\
& + \alpha_{13}^{(1)} EFTR + \alpha_{14}^{(1)} TA + \alpha_{15}^{(1)} VOLAT
\end{aligned}
$$

Next the predicted value obtained from this regression, is used as the weight in the original equation, as follows

$$
\begin{aligned}
\frac{lgATV_i}{\sigma_i^{2(2)}} = \; & \beta_1 \frac{PR}{\sigma_i^{2(2)}} + \beta_2 \frac{INFR}{\sigma_i^{2(2)}} + \beta_3 \frac{VIN}{\sigma_i^{2(2)}} + \beta_4 \frac{SIZE}{\beta_i^{2(1)}} + \beta_5 \frac{AIM}{\sigma_i^{2(2)}} + \beta_6 \frac{MIP}{\sigma_i^{2(2)}} \\
& + \beta_7 \frac{MAXPR}{\sigma_i^{2(2)}} + \beta_8 \frac{AGE}{\sigma_i^{2(2)}} + \beta_9 \frac{NOM}{\sigma_i^{2(2)}} + \beta_{10} \frac{NOTC}{\sigma_i^{2(2)}} + \beta_{11} \frac{PET}{\sigma_i^{2(2)}} + \beta_{12} \frac{FET}{\sigma_i^{2(2)}} \\
& + \beta_{13} \frac{EFTR}{\sigma_i^{2(2)}} + \beta_{14} \frac{TA}{\sigma_i^{2(2)}} + \beta_{15} \frac{VOLAT}{\sigma_i^{2(2)}} + \varepsilon_i
\end{aligned}
$$

where

$$
\begin{aligned}
\sigma_i^{2(2)} = \; & + \alpha_0^{(2)} + \alpha_1^{(2)} PR + \alpha_2^{(2)} INFR + \alpha_3^{(2)} VIN + \alpha_4^{(2)} SIZE + \alpha_5^{(2)} AIM + \alpha_6^{(2)} MIP \\
& + \alpha_7^{(2)} MAXPR + \alpha_8^{(2)} AGE + \alpha_9^{(2)} NOM + \alpha_{10}^{(2)} NOTC + \alpha_{11}^{(2)} PET + \alpha_{12}^{(2)} FET \\
& + \alpha_{13}^{(2)} EFTR + \alpha_{14}^{(2)} TA + \alpha_{15}^{(2)} VOLAT
\end{aligned}
$$

where $w = \sigma_i^{2(2)}$

The results of this weighted regression model are presented in *Table 9.*

Appendix 2B

Iterative Weighted Least Squares Regression on the Reduced Model 3

The variables causing multicollinearity have been removed from the model, the reduced model as showed in equation (5) is used in the first stage of the iterative weighted least squares procedure. The first stage of this transformation involves using the squared residuals of equation (5) and regress it on the independent variables.

$$e_i^2 = \alpha_0 + \alpha_1 \mathrm{INFR} + \alpha_2 \mathrm{VIN} + \alpha_3 \mathrm{SIZE} + \alpha_4 \mathrm{AIM} + \alpha_5 \mathrm{MIP} + \alpha_6 \mathrm{AGE} + \alpha_7 \mathrm{NOTC} + \alpha_8 \mathrm{PET} + \alpha_9 \mathrm{FET} + \alpha_{10} \mathrm{TA} + \alpha_{11} \mathrm{VOLAT} + v_i$$

The second stage involves obtaining the predicted value of this transformed regression equation and using it as the weight in a model where the squared error terms of equation (4) are regressed on the independent variables as follows.

$$\frac{e_i^2}{\sigma_i^{2(1)}} = \alpha_0 \frac{1}{\sigma_i^{2(1)}} + \alpha_1 \frac{INFR}{\sigma_i^{2(1)}} + \alpha_2 \frac{VIN}{\sigma_i^{2(1)}} + \alpha_3 \frac{SIZE}{\sigma_i^{2(1)}} + \alpha_4 \frac{AIM}{\sigma_i^{2(1)}} + \alpha_5 \frac{MIP}{\sigma_i^{2(1)}} + \alpha_6 \frac{AGE}{\sigma_i^{2(1)}} + \alpha_7 \frac{NOTC}{\sigma_i^{2(1)}} + \alpha_8 \frac{PET}{\sigma_i^{2(1)}} + \alpha_9 \frac{FET}{\sigma_i^{2(1)}} + \alpha_{10} \frac{TA}{\sigma_i^{2(1)}} + \alpha_{11} \frac{VOLAT}{\sigma_i^{2(1)}} + \frac{V_i}{\sigma_i^{2(1)}}$$

where

$$\sigma_i^{2(1)} = + \alpha_0^{(1)} + \alpha_1^{(1)}INFR + \alpha_2^{(1)}VIN + \alpha_3^{(1)}SIZE + \alpha_4^{(1)}AIM + \alpha_5^{(1)}MIP + \alpha_6^{(1)}AGE + \alpha_7^{(1)}NOTC + \alpha_8^{(1)}PET + \alpha_9^{(1)}FET + \alpha_{10}^{(1)}TA + \alpha_{11}^{(1)}VOLAT$$

Next the predicted value obtained from this regression, is used as the weight in the original equation, as follows

$$\frac{lgATV_i}{\sigma_i^{2(2)}} = \beta_0\frac{1}{\sigma_i^{2(2)}} + \beta_1\frac{INFR}{\sigma_i^{2(2)}} + \beta_2\frac{VIN}{\sigma_i^{2(2)}} + \beta_3\frac{SIZE}{\sigma_i^{2(2)}} + \beta_4\frac{AIM}{\sigma_i^{2(2)}} + \beta_5\frac{MIP}{\sigma_i^{2(2)}} + \beta_6\frac{AGE}{\sigma_i^{2(2)}} + \beta_7\frac{NOTC}{\sigma_i^{2(2)}} + \beta_8\frac{PET}{\sigma_i^{2(2)}} + \beta_9\frac{FET}{\sigma_i^{2(2)}} + \beta_{10}\frac{TA}{\sigma_i^{2(2)}} + \beta_{11}\frac{VOLAT}{\sigma_i^{2(2)}} + \frac{V_i}{\sigma_i^{2(2)}}$$

where

$$\sigma_i^{2(2)} = + \alpha_0^{(2)} + \alpha_1^{(2)}INFR + \alpha_2^{(2)}VIN + \alpha_3^{(2)}SIZE + \alpha_4^{(2)}AIM + \alpha_5^{(2)}MIP + \alpha_6^{(2)}AGE + \alpha_7^{(2)}NOTC + \alpha_8^{(2)}PET + \alpha_9^{(2)}FET + \alpha_{10}^{(2)}TA + \alpha_{11}^{(2)}VOLAT$$

The results of this weighted regression model are presented in *Table 11*.