# THE EFFECT OF FUTURES MARKETS ON SPOT MARKET VOLATILITY: EMPIRICAL EVIDENCE FROM 3-MONTH CANADIAN BANKERS' ACCEPTANCES

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# Abstract


## The Effect of Futures Markets on Spot Market Volatility: Empirical Evidence from 3-month Canadian Bankers' Acceptances

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Futures markets have been blamed for higher volatility in the underlying asset market. A popular belief is that trading activity in futures markets encourage speculation, which destabilizes the spot market. The alleged destabilization takes the form of higher spot market volatility. On the other hand, a favorable view is that futures trading helps stabilizing the underlying market and leads to more complete markets and enhanced information flows. The numerous papers that have studied the effect of the introduction of derivatives on the underlying assets have obtained different results. This paper analyses the effect of the introduction of futures markets on the underlying market for Canadian bankers' acceptances. More specifically this study investigates the contention that the introduction of the futures (BAX) on the Montreal exchange on April 24th 1988 has affected the volatility of the underlying asset. To study this effect, several models and approaches are used such as the GARCH process and others models and approaches formulated by several academics who studied this issue for other underlying spot markets.

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I wish to dedicate this Master's Thesis to my friends and family for their support, understanding and patience. I wish to thank the members of my thesis committee and. Lastly, I wish to thank Professor Lypny for his support, valuable time and helpful suggestions.

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# 1. Introduction

Over the past three decades, financial markets have been characterized by the explosive growth of futures contracts[1]. Their expansion has been the source of a long and controversial debate as to whether futures trading affects the variability of the associated spot market. The debate has been the foundation of one of the most studied topics in financial research and an issue of great interest to both academics and practitioners.

The popular assertion is that futures activities, by providing more efficient and simpler trading techniques, destabilize the spot market by creating excess volatility. Advocates of this argument contend that the opening of futures markets has allowed the possibility of a wide range of speculative and aggressive arbitrage strategies involving the spot and the futures markets. They also assert that futures trading attracts more uninformed and irrational traders in search of short-term gains along with the rational and informed traders, which further increases spot volatility. Events as the stock market crash of 1987 and some recent highly publicized financial debacles are said to have been created by futures and derivatives trading activities, possibly threatening the stability of the entire financial system. As a consequence, asset market volatility and the role of futures trading has been the focus of substantial recent attention, including studies by the New York Stock Exchange, the Commodity Futures Trading Commission, the Securities and

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[1] A futures contract is a standardized contract, traded on a futures exchange, where two counterparties agree to buy and sell an asset at a certain date in the future, at a price (the futures price). The buyer takes a long position and the seller a short position.

Exchange Commission, and a Presidential Task Force, resulting in the proposal of several tighter regulations and supervision of the derivatives industry.[2]

Those on the other side of the destabilization debate claim that arbitrage and speculation in futures markets bring more traders to the stock market in general, thereby increasing its liquidity and decreasing its variability. They also claim that futures markets provide low-cost state-contingent strategies that enable investors to minimize portfolio risk, offer positive information externalities and transfer speculators from spot markets to futures markets. The result, ostensibly, is more complete markets and enhanced information flow.

This study analyzes empirically the effect of trading futures contracts on Canadian bankers' acceptances on the underlying spot market, more specifically, whether the introduction of the BAX contract on the Montreal Exchange on April 24, 1988 has affected the volatility of the underlying asset. Previous research has found that futures trading is generally not a source of higher volatility for the spot asset. Empirical results from this study confirm that BAX futures trading does not cause higher uncertainty for three-month Canadian bankers' acceptances. This may be of interest to Canadian regulatory authorities who, despite their vigilance and cautiousness, might be concerned about the possible ill effects of over-regulating Canadian financial markets, even in light of the current financial crisis.

[2] The Report of the Presidential Task Force on Market Mechanisms (1988), aka the Brady Commission, attributed the sharp fall in stock prices during the 1987 crash to derivative-based trading strategies known as index arbitrage. The regulatory proposals for reform advanced by the Presidential Task Force, regulatory boards and stock markets authorities include a unified clearing system for all financial markets, consistent margin requirements in the cash and futures markets, circuit breaker mechanisms such as price limits and planned trading halts, and integrated information systems across related financial markets.

The plan of this paper is as follows. A discussion of excess volatility, the advantages and disadvantages of futures markets, and a primer on bankers' acceptances are in the section that follows. The theoretical debate on the possible effect of futures trading on spot market volatility, together with the results of previous empirical research, is reviewed in Sections 2 and 3. The research design and results are reported in Section 4. The last section then summarizes the findings and provides some concluding remarks.

### 1.1 Overview of Bankers' Acceptances

A bankers' acceptance (BA) is a secure money market instrument that usually arises in the course of international trade and commerce. Bankers acceptances are also know as commercial bills, bank bills, trade bills, or bills of exchange.

A draft is a legal obligatory order by one entity (the drawer) to a second party (agent or the drawee) to pay a third entity (the payee). An example is a cheque which is simply an order directing a bank to pay a third party. A draft can require instant payment by the second party to the third upon presentation of the draft. This is called a "sight draft". Bank cheques are sight drafts. In commerce, drafts often are for deferred payment. An importer might write a draft promising payment to an exporter for delivery of goods with payment to occur 90 days after the delivery of the merchandise. Because these kinds of drafts mature on the payment, they are named "time drafts". In this case, the importer is both the drawer and the drawee.

When the drawer and drawee of a time draft are different parties, the payee may submit the draft to the drawee for confirmation that the draft is a legal order and that the drawee will compensate on the specified date. Such confirmation is called acceptance because the drawee accepts the order to pay as legitimate. The drawee accepts the draft and is thereafter obligated to make the specified payment on maturity. If the drawee is a bank, the acceptance is called a bankers acceptance (BA). A bankers' acceptance is therefore a written promise, or draft, issued by a borrower to a bank to repay borrowed funds at a future date. Before acceptance, the draft is not an obligation of the bank but simply an order by the drawer to the bank to pay a specified amount of money on a specified date to the bearer of the draft. Upon acceptance, which occurs when an authorized bank accepts and signs it, the draft becomes a primary and unconditional liability of the bank.

Not only is it a primary obligation of the accepting bank, it is usually also a contingent obligation of the drawer. Depending on the bank's reputation, a payee may be able to sell the bankers acceptance, that is, the time draft accepted by the bank, in an active market. The acceptance is negotiable and can be exchanged many times in the secondary market. The investor who buys the acceptance can collect the amount loaned on maturity. If the borrower defaults, the investor has legal recourse to the bank that accepted in the first place.

Bankers' acceptances are sold on a discounted basis just like Treasury bills and commercial paper. Paying discounted value for a time draft is called "discounting the draft". The rate that a bank charges a customer for issuing a bankers acceptance depends on the rate at which the bank believes it will be able to sell it in the secondary market. A commission is added to this rate. The major investors in bankers' acceptances are money market mutual funds and municipal entities.

### 1.1.1 International Trade

Bankers' acceptances are mainly used to facilitate international trade transactions. The use of bankers' acceptances to finance commercial transactions is known as *acceptance financing*. The international transactions for which acceptances are created include the import and export of goods, and the storage and shipping of goods between countries where neither the importer nor the exporter is based in the home country.

Consider an example: A Canadian importer may request acceptance financing from its bank when, as is frequently the case in international trade, it does not have a close relationship with and will not get credit from the exporter it is dealing with. The importer and the bank execute an acceptance agreement, under which the bank will accept drafts from the importer and the importer agrees to repay any drafts the bank accepts. The importer draws a time draft on the bank, listing itself as the payee. The bank accepts the draft and discounts it; that is, it gives the importer cash for the draft but gives it an amount less than the face value of the draft. The importer uses the proceeds to pay the exporter. The bank can then hold the bankers acceptance in its own portfolio or it can sell it at discounted value in the money market. If the bank rediscounted the acceptance in the market, the bank pays the holder of the acceptance the face value on the maturity date.

In another transaction, the exporter accepts a letter of credit from the importer's bank that specifies that the bank will accept time drafts from the exporter if the exporter presents suitable records that the merchandise was delivered. Under this deal, the exporter is the drawer and payee of the draft. As it is frequent in international trade the bank will not deal directly with the exporter but with the exporter's bank. The exporter may realize proceeds from the bankers' acceptance in a number of ways. The bank may discount it for the exporter; the exporter may hold the acceptance until it matures or sell the acceptance to another entity. In the former example, the bank is making a loan to the importer; in the latter, it is in effect substituting its credit for that of the importer.

### 1.1.2 History

Bankers' acceptances date back to the 12th century when they emerged as one of the early instruments used to finance trade. During the 18th and 19th centuries, there was an active market for sterling bankers' acceptances in London. When the United States Federal Reserve was formed in 1913, one of its purposes was to promote a domestic bankers' acceptance market to rival London's in order to boost U.S. trade and enhance the competitive position of U.S. banks. National banks were authorized to accept time drafts, and the Fed was authorized to purchase certain eligible bankers' acceptances.

### 1.1.3 Canadian Bankers' Acceptances in Canada

Introduced in 1962, Canadian Bankers' Acceptances are the major indicator of the short-term commercial interest rates, are fully and unconditionally guaranteed (principal and return if held to maturity) by major Canadian chartered banks for any investment amount. When issued directly by a financial institution such as a chartered bank, they are known as Bearer Deposit Notes (BDNs). Canadian Bankers' Acceptances are not guaranteed by the *Canada Deposit Insurance Corporation (CDIC).* However they have the same low default risk as the guaranteeing bank and usually offer a slightly higher return than Government of Canada T-Bills deposits, GICs and government-issued money market securities. They are liquid and are eligible for Canadian Registered Saving Plans and Canadian Registered Retirement Income Funds Plans. Like all money market investments, they are fully marketable and can be sold at market value at any time. They are available for terms from one month to one year. Minimum investment is (at face value) $5,000 for three months to one year, $25,000 for one or two months, and are available in Canadian and U.S. dollars.

### 1.1.4 The Creation of a Bankers' Acceptance Described

What follows is an illustration of the creation of a Canadian banker's acceptance. These fictitious parties are involved in the process:

- iPC a retailer in Canada that sells a wide variety of computer products
- TekChina a manufacturer of personal computers based in China
- Maple Leaf Bank, a clearing bank based in Canada
- Great Wall Bank, a bank based in China
- Artic Bank, another bank based in Canada
- Harper Investment, a money market fund based in Canada

iPC and TekChina decide to enter into a deal in which iPC will import a shipment of personal computers (PCs) with a transaction value of $20 million. However, TekChina is concerned about the ability of iPC to make payment on the delivery of the PCs. To avoid this uncertainty, both parties decide to fund the transaction using acceptance financing. The terms of the transaction are that payment must be made by iPC within 60 days after the PCs have been shipped to Canada. Before deciding to accept the $20 million transaction, TekChina must calculate the present value of the amount since it will not be receiving this sum until 60 days after shipment. Therefore, both parties agree to the following terms: iPC arranges with its bankers, Maple Leaf Bank to issue a letter of credit (LOC) that states that Maple Leaf Bank will guarantee the payment of $20 million that iPC must make to TekChina 60 days from shipment. The LOC is sent by Maple Leaf Bank to Great Wall Bank, TekChina's bankers. On the receipt of the LOC, Great Wall Bank notifies TekChina, who will then ship the PCs. After the PCs are shipped, TekChina presents the shipping documents to Great Wall and receives the present value of $20 million. This completes the transaction for TekChina Ltd.

Great Wall Bank presents the LOC and the shipping documents to Maple Leaf Bank. The latter will stamp the LOC as "Accepted," thus creating a bankers acceptance. This implies that Maple Leaf Bank agrees to pay the holder of the bankers' acceptance the sum of $20 million on the acceptance's maturity date. iPC will receive the shipping documents so that it can then take delivery of the PCs once it signs a document or some other financing arrangement with Maple Leaf Bank. At this point, the holder of the bankers' acceptance is Great Wall Bank and it has the following two choices available: (1) the bank may retain the bankers' acceptance in its investment portfolio or (2) it may request that Maple Leaf Bank make a payment of the present value of $20 million. If Great Wall Bank decides to request payment of the present value of $20 million then

Maple Leaf Bank becomes the holder of the bankers' acceptance. Once again, it may retain the bankers' acceptance as an investment or it may sell it to another investor. If Maple Leaf chooses the latter, it can sell the bankers' acceptances, for example to one of its clients, Harper Investment who is interested in a high-quality security with the same maturity as the bankers' acceptance. Accordingly, Maple Leaf Bank sells the acceptance to Harper Investment at the present value of $20 million calculated using the relevant discount rate for paper of that maturity and credit quality. Alternatively, it may have sold the acceptance to another bank, such as Artic Bank that also creates bankers' acceptances. In either case, on the maturity of the bankers' acceptance, its holder presents it to Maple Leaf Bank and receives the maturity value of $20 million, which the bank in turn recovers from iPC. The holder of the bankers' acceptance is exposed to credit risk on two fronts: the risk that the original borrower is unable to pay the face value of the acceptance and the risk that the accepting bank will not be able to reimburse the paper. For this reason, the rate paid on a bankers' acceptance will trade at a spread over the comparable maturity risk-free benchmark security, Canadian Treasury bills for example. Investors in acceptances will need to know the identity and credit risk of the original borrower as well as the accepting bank.

## 1.2 Description of the BAX Futures Contract

BAX futures were the first interest rate contracts to be traded on the Montreal Exchange and are recognized as the main indicator for Canadian short-term interest rates. Over the last few years the BAX market has expanded considerably and trading volume continues to grow.[3]

BAX are quoted on an index basis: 100 minus the annualized yield of 3-month Canadian bankers' acceptances. The trading unit for BAX represents a banker's acceptance having a nominal value of 1,000,000$ CAD with a 3-month maturity. In expectation of declining rates an investor will take a long position in the BAX futures contract and in expectation of rising rates he will take a short position. To close a long position the holder has to sell the contract at a later date or wait until the contract expires. The difference between the purchase and sale price or between the purchase price and the settlement price of the maturity's date is the position's profit or loss. BAX are cash settled as opposed to some futures where a physical instrument is delivered on expiry.[4]

Participants in the BAX markets are composed of three major types of investors: hedgers, speculators and arbitrageurs. According to the Montreal Exchange, transactions for hedging purposes represent the most important portion of total trade, accounting for more than 50 per cent of total transactions while each category of arbitrage and speculation strategies represent more or less 25 per cent of all business in the BAX market. Because hedging and arbitrage transactions combined compose most of the total trading in the BAX contract, a plausible assumption is that the 3-month Canadian bankers' acceptance volatility is not affected by the level of trading of the futures contract.

[3] See Appendix – Figure A4

[4] For more details on the mechanisms of the BAX , see Appendix A6

## 1.3 Excess Volatility

Although there is an obvious public perception that inflated volatility has a damaging effect, more asset price variability need not be bad. It may be a manifestation of a well-functioning market. Greater volatility may simply reflect fundamental economic factors or information and expectations about them. In that case, there is no apparent economic cost associated with such volatility.

However price volatility greater than that which can be justified by the level indicated by fundamental economic or by objective new information is problematic. It makes prices inefficient by definition. This has been designated as “excess volatility”. Although too little or deficient volatility is equally bad because it could mean that the market is not responding enough to information, this issue does not seem to have created interest within scholars or practitioners.

Excess volatility may have negative effects by increasing real interest rates and consequently raising the required risk premium on financial assets and the cost of capital. This increase may lead to a reduction in the value of investments, a general loss of confidence, poorer stock market performance, and a loss of market liquidity. This in turn can lead to a redirection of the flow of capital away from spot markets. Regulatory bodies may see a need to interfere in markets by endorsing more regulation, prohibiting certain securities or restricting certain activities, all with potential detriment to allocation efficiency.

Even if it is still difficult to establish concrete connections between volatility and either economic activity or economic welfare, only price volatility greater than that can be justified by fundamental economic conditions is undesirable. Thus, whether futures trading exacerbate the volatility of spot markets is a critical issue because it could have repercussions in several crucial economic activities.

## 1.4 Advantages of Futures Markets

Trading futures instruments offers investors a number of advantages. Futures contracts have a brokerage transaction fee advantage over the direct purchase of the associated spot security. Compared to other investments, the commission charges for futures trading are relatively small. The commission charges may vary, depending on the service level of the broker. Commissions involving online brokers may be as low as $5, while brokers who provide full service in terms of advice on the trades made can charge up to $50 per trade.

Futures contracts provide other economic benefits due to the fact that traders only have to deposit a guarantee or a relatively small investment—called margin. One of the key attributes of these securities is their leverage, that is, for a fraction of the cost of buying the underlying asset, they create a price exposure similar to that of physical ownership. Margins vary as a percentage of the contract, but in general are less than five percent thus enabling investors to effectively trade on accessible credit. This allows futures investors to profit from a relatively low transaction cost to act on new information, hedge against adverse price movements, and diversify or increase market risk in regards to financial futures.

Trading commodity futures does not require the trader to own or have actual physical goods on hand in order to trade them. The actual commodity in the contract that is being traded is only exchanged on rare instances when the delivery of the contract takes place. For most futures traders the trade is a paper transaction, pure and simple. The existence of an organized stock market and of standardized terms gives liquidity and offers to the participants the possibility of closing positions on a date before the expiration. The parties to a contract don't assume any risk of insolvency because the clearinghouse guarantees the liquidation of the contract.

## 2. Theoretical Debate

### 2.1 Speculation in General

The debate of the impact of futures trading activities on the associated spot market is directly related to the more fundamental concern of the extent to which speculation in general affects market prices. Hence, a review of the theoretical literature on speculative trading and price stability is proposed. Early research related to this subject concentrated on the role of speculators in smoothing out seasonal price fluctuations for commodities. Traditional models of this aspect generally conclude that under certain restrictive assumptions, speculative trading stabilizes price. However, when these assumptions are breached, it is often found that speculative trading can stabilize or destabilize prices, depending on a constraint's importance. Numerous theoretical assertions have been advanced over the years to explain the potential impact of speculative trading in general or of derivatives markets in particular on the volatility of the underlying asset.

Adam Smith (1776) observed that during periods of important shortages speculators prevented extreme price movements by purchasing and storing grain before the period of scarcity. John Stuart Mill (1871) expanded this argument by arguing that by buying when prices are low and selling when prices are high, speculators helped stabilize prices by improving the distribution of resources and diminishing seasonal price fluctuations. Mill observed when speculators geographically relocate products by buying in low-price regions and selling in high-price regions, seasonal price fluctuations weakened. Even while acknowledging the possible manipulation of prices, Mill claimed that destabilizing speculation could not persist because it will become less profitable. Friedman (1953) likewise claimed that if speculation has a detrimental effect on spot markets then it implies that speculators lose money; he implicitly suggested that profitable speculation must have a stabilizing effect. Academics have attempted to prove this contention wrong—that speculative trading can, at the same time, be profitable and destabilizing. Kaldor (1939), for instance, claimed that it is possible that speculators as a group could generate unprofitable trades. This group of speculators is composed of two types: seasoned traders and novices. The first make profitable trades on average while the latter incur losses and are forced out of the market. Telser (1959), in defense of Friedman, posed a model in which a profit-maximizing monopolist is a speculator. The monopolist then exploits his observation of mean-reversion in prices, stabilizing them in the process.

Kemp (1963) posed a counter-argument in a model in which supply is inelastic and the asset is a good with a upward-sloping demand curve over a range of prices and with multiple equilibrium prices. He tried to demonstrate that a minor variation in speculative demand can cause a tremendous shift across equilibrium prices thus generating lucrative speculation. Nonetheless, for a linear excess demand function, positive profitable speculation stabilizes prices. Farrell (1966) extended this idea by showing that if demand is intertemporally independent and linear, then profitable speculation causes prices stabilization. Furthermore, Farrell affirmed that even unprofitable speculators may stabilize prices as long as their losses are not too large. However, if demand is not linear, then lucrative speculation may have a destabilizing effect. Hart and Kreps (1986) considered a market where supply is stable and demand is influenced by large but rare shocks. Each period, a noisy signal, either true or false, of the subsequent period's demand is detected. When speculative trading is nonexistent, prices are stable. However when speculators arrive in the market then the price rises in response to the signal as they purchase the asset in anticipation of a possible demand shock. If the signal turns out to be false, then the price in the following period drops as speculators liquidate the asset. Thus, the existence of speculators in the market exacerbates price variations, except in the case when the event actually occurs.

## 2.2 Futures Markets

Under the traditional economic model paradigm, prices are determined by the relationship of supply and demand functions and react in response to movements in these functions. When storage is not present, supply arises from the producers' cost function, and demand is derived from utility-maximizing consumers. However when the product is storable, then the augmented demand function might be caused by speculative investors who expect a rise in prices. Similarly, supply rises when speculators sell their inventories. While predictable and expected variations in production and consumer demand generates trading activity that may be viewed as storage management, arbitrary shifts may be perceived as speculation. When futures market are nonexistent the more risk-averse speculators will hold inventories only if the expected return from doing so is sufficient to compensate them for bearing this risk. However, in presence of futures market, a speculator can buy commodities, through futures, at a certain price and instantly lock in a higher selling price. To the extent that carrying costs are predictable, price smoothing through storage becomes an arbitrage activity. This should lead to increased inter-temporal price smoothing when speculators are more risk averse.

Futures activities markets may also affect spot prices if they have an effect on the behavior of producers since they allow for price risk hedging, which in turn influences a producer's decision of what to produce, how much to produce, and what production techniques to use. In the following sections, different models of this complicated problem, such as the traditional Marshallian paradigm, the rational expectations equilibrium framework and the general equilibrium model will be described.

### 2.2.1 Traditional Approach

Several authors have modeled the relationship between futures markets, storage, and production.

Peck's (1976) model, in which neither demand nor production are stochastic, has price variations governed by adaptive expectations for the various agents, resulting in stabilization of prices when inventory decisions are made on the information of futures prices. Turnovsky (1979) shows that when both supply and demand have random parameters, expectations about the future price are adaptive in the absence of a futures market but rational when futures are introduced. By allowing producers to respond to new information about anticipated demand shocks, Chari and Jagannathan's (1990) model shows that this may affect spot price in the future, through inter-temporal dependence in the production function. The authors give the example of a non-storable good with an increasing marginal cost function next year which is an increasing function of the quantity produced this year. By observing the futures price that provides information that demand will be abnormally high next year, producers may find it beneficial to decrease production this year in order to diminish production costs for next year. In their model, prices will stabilize when demand is inelastic and when supply is elastic.

### 2.2.2 Rational Expectations Equilibrium Approach

Rational Expectations equilibrium models assume that market equilibrium can be stated in terms of expected values of price changes and that all the relevant information in efficient markets is captured into market prices. Moreover, efficient markets studies assert that all sources of uncertainty are normally distributed and that successive price changes are independent and identically distributed random variables.

A number of models have speculators observe a noisy signal of next period's market demand and trade in the futures market. Danthine's (1978) model describes price stability by assuming that producers observe the futures price in making their production decisions. In this model, futures activities have a stabilizing effect as future prices carry information to producers who are then able to adjust production to demand shocks. However, noise in the speculators' signals can have a destabilizing effect. Demers and Demers (1989) create a model in which production risk and demand risk are two sources of uncertainty. In this model, in which information is costly and producers have a comparative advantage at collecting information on production uncertainty, speculators will not pay to acquire poor information. These speculators will specialize in collecting information about demand uncertainty. The authors' framework illustrates that, under these conditions, futures markets clearly stabilize spot prices.

### 2.2.3 General Equilibrium Approach

Yano and Weller (1987) propose a two-agent, two-good, two-state general equilibrium model to investigate the impact of the introduction of futures trading activities. The two agents have different marginal rates of substitution between wealth in state 1 and wealth in state 2. In this perspective, the authors demonstrate that the extent to which futures trading activities allow spot price stabilization depend on the agent's level of risk aversion and their marginal rate of substitution with respect to the two goods.

### 2.2.4 Other Models

Stein (1987) proposes a two-period information-based model, in which two types of traders exist, hedgers and speculators, who are able to observe information about shocks. The supply of the asset is subject to both permanent and transitory shocks. To analyze the impact of futures markets, Stein compares the equilibrium with and without speculators and observes that their arrival has a stabilizing welfare-increasing effect through improved risk sharing when speculators have perfect information about the permanent supply shock.

Subrahmanyam (1991) proposes an information-based model that allows simultaneous trading in individual stocks and stock index futures and assumes that most informed trading is based on firm-specific information. Subrahmanyam shows that when uninformed investors move from the stock market to the index futures market it leaves a greater proportion of informed traders and poorer liquidity in the stock market.

### 2.2.5 Market Manipulation

Newbery (1984) investigated the possible manipulation by producers of spot prices by controlling their output and storage quantities when futures markets are initiated. In his framework, the author analyzes a futures market on a commodity that is produced by monopolist and several smaller producers. Several possible outcomes may appear depending on the different level of producers' risk aversion. An interesting result occurs when, in the absence of futures markets, a dominant producer who is less risk averse than the smaller ones, benefits by deliberately disturbing prices by influencing production or storage, in order to impose higher expenses on smaller competitors. However, in the presence of a futures market, the monopolist producer might not find it as beneficial.

## 3. Empirical literature

Studies on the effect of futures trading on underlying spot assets have been undertaken on markets in many countries, but mostly in the United States, and on data from fixed-income, commodity, individual stock, stock-index, and currency futures. These papers have studied the impact of futures contracts by comparing underlying market characteristics before and after introduction dates and by analyzing enduring effects of futures markets on spot prices' changeability. The literature is far from conclusive and provides mixed evidence as to whether futures trading activities influence the volatility of the spot market. This empirical ambiguity is not all that surprising since the literature proposes both a "destabilizing forces" hypothesis, which predicts increased volatility, and a "market completion" hypothesis, in which volatility is argued to decrease. The principal objective of this study is to expand the body of this theoretical research literature.

### 3.1 Earliest Papers

The earliest papers simply compared standard deviations between different sample periods. Subsequent authors have suggested various procedural refinements, particularly with respect to how "variance" should be defined. Edwards (1988) examines stock market volatility before and after the introduction of futures and provides a small but statistically significant decline in equity volatility subsequent to the advent of the equity S&P500 index futures contract on 21st of April 1982. Most of the research on US

Government National Mortgage Association (GNMA) securities reports that futures trading is not a destabilizing factor in the underlying spot markets [Froewiss (1978); Simpson and Ireland (1982); and Moriarity and Tosini (1985)]. Using a simple comparison analysis, Figlewski (1981) depicts higher volatility following futures introduction. He concludes that a class of futures investors, acting on imperfect information, increased spot volatility. Hodgson and Nicholls (1991) examine the effect of index futures on Australian equity market volatility by comparing pre- and post-introduction variances and contend that the introduction of trading in index futures has not affected the volatility of the underlying spot share market.

## 3.2 Commodity Futures

In commodity futures, several research have reported a decrease in spot prices volatility after the introduction of futures trading in onions [Working (1960); Gray (1963); and Johnson (1973)], and live cattle [Powers (1970); and Taylor and Leuthold (1974)]. Antoniou and Foster (1988) analyze the effect of futures trading on Brent crude oil spot price volatility using a Generalized Auto-Regressive Conditional Heteroskedasticity framework (GARCH), where they find an increase in informational spot market efficiency and a decrease in the volatility.

## 3.3 Currency Futures

Most papers on futures and derivatives contracts have focused on exchange-traded markets, for which data are easily available. In the currency market, exchange-listed futures represent only a small fraction of the global whole forward trading activity.

Therefore, relatively few authors have analyzed the effect of currency futures on the currencies volatilities. Clifton (1985) investigates the Japanese Yen, Swiss Franc, German Mark and Canadian Dollar futures markets between January 1980 and October 1983 and reports a positive relationship between currency futures trading in Chicago and exchange rate volatility. Chatrath, Ramchander and Song's (1996) paper corroborates this result using wider time window sample and a GARCH framework for modeling volatility. Jochum and Kodres (1998), on the other hand, find no significant effect when investigating the effect of futures trading on the volatility of the Mexican Peso, Brazilian Real and Hungarian Forint.

### 3.4 Financial Futures

In regards to financial futures three basic approaches have been employed to analyze the effect of futures on the spot index. The first method and mostly used is to compare the variability of the index before and after the advent of the futures markets, either using an unconditional measure of volatility, or using an ARCH/GARCH framework. For instance, Pericli and Koutmos (1997), using an exponential GARCH model (EGARCH), found that the volatility of the Standard & Poor's (S&P) 500 index decreased after the opening of futures market. Pilar and Rafael (2002) analyze the effect of the introduction of futures in the Spanish stock market and document a diminution in uncertainty in the underlying equity market and an increase in liquidity. Rahman (2001) investigates the contention that the introduction of futures contracts on the Dow Jones Industrial Average (DJIA) could augment the variability of the 30 stocks comprising the index. Using a simple GARCH (1, 1) framework to examine the conditional volatility the author reports no change in conditional volatility between pre- and post-futures periods. Darrat *et al.* (2002) examine the volatility of spot and futures markets by using an EGARCH model to measure spot returns volatility and futures returns volatility for the period after the stock market crash of October 1987 (i.e. November 1987 – November 1997). Their results show that futures trading is not responsible for higher cash market volatility. Bae *et al.* (2004) investigate, in Korea, the effect of the opening of the index futures market on spot price volatility. The empirical evidence shows that there is a raise in spot price instability after the introduction of futures trading. Using U.K. data, Antoniou and Holmes (1995) modeled volatility as a GARCH (1,1) process with a dummy variable to investigate the impact of futures trading on spot market volatility in the Financial Times Stock Exchange (FTSE) 100 stock index futures. Their results show that stock return volatility rose significantly following the listing of index futures in 1984. Lee and Ohk (1992) investigate the impacts of introducing index futures trading on stock return volatility in Australia, Hong Kong, Japan, the United Kingdom, and the United States of America and report greater stock volatility shortly after the introduction of the stock index futures, with the exception of the stock markets in Australia and Hong Kong.

The second approach, illustrated by Harris (1989) Laatsch (1991), and Kumar *et al.* (1995), is to compare the volatility of individual stocks within the index to a control sample of non-indexed stocks. Harris (1989) suggests that after the advent of futures contracts, the volatility of stocks in the S&P 500 increased relative to the volatility of stocks in a control sample of non-indexed stocks. Laatsch (1991) conducts a similar test for the opening of futures on the Major Market Index (MMI), but reports no significant effect. Kumar *et al.* (1995) find that in Japan, the volatility of indexed stocks declined relative to stocks that are not in the index with the introduction of index futures.

A third approach, employed by Bessembinder and Seguin (1992, 1993), among others, is to examine whether the opening of stock index futures influences the volume-volatility relationship in the spot market, and whether spot market volatility is affected by trading volume or open interest in the futures market. The authors partition each trading activity series into expected and unexpected components and report that the unpredictable component of futures trading activity measured by volume or open interest covaries positively with market volatility, suggesting that futures market volume responds to unexpected volatility events. The forecastable and predictable component of trading activity in futures, however, showed an inverse relationship with cash market volatility, suggesting that futures markets help stabilize spot markets and actually reduce uncertainty in the stock market. This empirical evidence supports the belief that futures trading enhances liquidity and depth in spot markets, and rejects the notion of the detrimental effect of futures activities. Gulen and Mayhew (2000) investigate, in several nations, the suggestion that open interest displays a negative relationship to stock index volatility. However, trading volume activities series had no effect across countries.

The empirical evidence suggests that the introduction of derivatives does not destabilize the underlying market—either there is no effect or there is a decline in volatility—and that the introduction of futures contracts tends to improve the liquidity and informativeness of markets.

Before presenting the research design and empirical results, it is important to address one important aspect in regards to the methodological analysis. This paper and others that have studied the effect of futures activities on the volatility of the associated spot asset have, out of necessity, omitted exogenous factors, such as inflation rates, money supply, industrial production and trade, that are possibly sources and causes of changes in spot volatility. The exclusion is due to the interest of this study to measure the internal dynamics of weekly bankers' acceptances rates volatility caused directly by the futures trading activities. Furthermore, a plausible assumption is that these economic variables are already reflected in the level of futures activities or in bankers' acceptances rate volatility in the model used in this paper or previous ones. Finally, the purpose of this paper is to study the change in the weekly volatility of Canadian bankers' acceptances while most macroeconomic series are only available on a monthly or quarterly basis.

## 4. Methodology and results

### 4.1 Data Collection and Preparation

Daily yields on 3-month Canadian bankers' acceptances were obtained from DataStream. The raw data includes observations from January 2, 1980 to May 6, 2008; several sample windows are created depending on the method used as will be discussed below. Implicit 3-month bankers' acceptances are then calculated by subtracting the rates from 100.

Wednesday closing price each week was selected to obtain a series of equally spaced data. This resulted in some loss of information in daily fluctuations that could not be examined.

## 4.2 Comparison Analysis of Pre- and Post-Futures Volatilities

### 4.2.1 Hodgson & Nicholls' Approach

Hodgson & Nicholls (1991) analyze the volatility of the Australian equity market for the periods prior to and following the commencement of index futures trading. Their approach is adopted here to analyze the volatility of the 3-month Canadian bankers' acceptances before and after the introduction of the BAX.

#### Hypothesis Formulation

The analysis of the behavior of the spot returns prior and subsequent to the introduction of the associated 3-month future contract (BAX) necessitates the knowledge of the date of the futures trading activities' commencement. In regards to Canadian bankers' acceptances, the event took place in the Montreal Exchange on the 24th of April 1988.

The hypotheses proposed for the perspective of the analysis are thus:

$H_0$: The introduction of trading in bankers' acceptances futures in Canada has not affected the volatility of the underlying rates.

$H_1$: The introduction of trading in bankers' acceptances futures in Canada has affected the volatility of the underlying rates.

#### Research Design

Let $P_t$ denote the closing price at time t of the Canadian Bankers acceptances, so that the relative price change or percent return $R_t$ is given by

$$R_t = \ln(P_t / P_{t-1}) = \ln(P_t) - \ln(P_{t-1}) \quad (1)$$

If $P_0$, $P_1$,...$P_n$ are random variables that follow a random walk process then {$R_t$, t= 1,2...} is a series of identically and independently distributed random variables. Consequently, a measure of Volatility ($V$) is defined by the standard deviation of {$R_t$}:

$$V = \left[ \frac{1}{N-1} \sum_{t=1}^{N} (Rt - \bar{R}) \right]^{1/2} \quad (2)$$

where N is the number of observations in the series and the sample mean equals:

$$\bar{R} = \frac{1}{N} \sum_{t=1}^{N} Rt$$

In order to gauge the impact of the Canadian bankers' acceptances futures on the volatility of the associated spot market, a comparison of the bankers' acceptances returns' volatilities prior and subsequent to the advent of trading futures activities is required. This approach involves the computation of the population variance of the underlying for the returns both before and after introduction followed by the completion of a test (based on a normal distribution) of equality of variances which corresponds to a test for a change in the level of volatility.

By defining $V_b$ and $V_a$ as the volatility in the returns series before and after the advent of the future contracts (BAX), testing ($H_0$) and ($H_1$) is equivalent to testing:

$$\begin{cases} H_o: \ \sigma_b^2 = \sigma_a^2 \\ H_1: \sigma_b^2 \neq \sigma_a^2 \end{cases}$$

Where $\sigma_b^2$ and $\sigma_a^2$ represent the population variances of the series before and after the intervention, and are estimated by $V_b^2$ and $V_a^2$ respectively. If var($V_a^2$) and var($V_b^2$) are defined correspondingly as the variance of $V_a^2$ and $V_b^2$, when the hypothesis is true then:

$$(V_b^2 - V_a^2) / [\mathrm{var}(V_b^2) + \mathrm{var}(V_a^2)]^{1/2}$$

is asymptotically normally distributed.[5]

## Results

*Effect* of *the BAX Futures - Weekly Data*

Four sub-periods were selected in order to test the impact of the BAX futures on the volatility of the associated underlying. The first window is comprised of 100 observations: 50 before and 50 after the introduction of the BAX future contract. Following the same procedure, the other windows cover 100, 150 and 200 weekly observations either side of the event representing respectively and approximately 2, 3 and 4 years. Appropriate time series models described in the Appendix were considered for each data set in a form which enabled the data to be processed as a general linear model (equation (5.3.49) of Priestly, 1981), which is required for the application of the test of

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[5] See Appendix A1

the hypothesis. For both the pre- and post- introduction periods, the sample correlations were estimated from equation (A.2) and used to compute estimates of the variance of both $V_b^2$ and $V_a^2$ while the test statistic was computed from equation (A.1). Table I shows the findings of the analysis.

**Table I**

Variances of 3-month Canadian Bankers' Acceptances

before and after the Introduction of the BAX

| *Coeff.* | *N* | 50 | 100 | 150 | 200 |
|---|---|---|---|---|---|
| $V_b^2$ | | 0.000780479 | 0.000148359 | 0.000170282 | 0.000114042 |
| $V_a^2$ | | 0.00001482 | 0.00000877 | 0.00001845 | 0.00001393 |
| Z value | | 2.67 | 3.62 | 4.72 | 5.94 |

Significance tests at the 5 percent level.

The results for each sub-period show a standardized normal $Z$ value greater 1.96, which signifies that the tests statistic are significant at the five percent level. The table shows that the variance prior to the introduction of the BAX is higher than after. It is also noticeable as the period window increases in weekly observations, the more significant the Z values become showing a temporal effect of robustness. These tests are significant at the five percent level and lead to the rejection of $H_0$, and note that in the post-introduction periods, the estimated volatility is lower.

### 4.2.2 GARCH Model

To evaluate the volatility of an asset price empirically, the asset price is usually determined at fixed intervals of time (e.g., daily, weekly, or monthly). If $P_t$ is defined as the asset price on a given business day, the relative price change or percent return $R_t$ is defined as

$$R_t = (P_t - P_{t-1}) / P_{t-1} \tag{3}$$

On a continuous compounding basis, the price return over a given period can be calculated as the logarithm of the ending price less the logarithm of the beginning price[6].

$$\text{Price Return } r_t = ln(1+R_t) = ln(P_t / P_{t-1}) = p_t - p_{t-1}; \tag{4}$$

where $p_t = \ln(P_t)$.

When dealing with financial time series, the log price $p_t$ can be modeled as a standard random walk:

$$p_t = \mu + p_{t-1} + \varepsilon_t , \tag{5}$$

$$\text{i.e.} \quad r_t = p_t - p_{t-1} = \mu + \varepsilon_t , \tag{6}$$

where $\varepsilon_t \sim IID\ N(0,1)$.

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[6] $\text{Lim } (1 + r/m)^m = e^r$ as the frequency of compounding $m \to \infty$

The above formulation implies that the returns are normally distributed with mean $\mu$ and constant variance $\sigma_t$ . The postulation of normally distributed returns, for modeling purposes, implies a lognormal price distribution which guarantees that prices will never be negative. Returns series are preferred over prices in analysis of financial time series because they have attractive statistical characteristics such as stationarity[7].

However, it is common in financial time series that returns are not identically distributed with a constant variance $\sigma_t$, at each point in time. Instead, it is frequently stated that $\sigma_t$ varies with time t. This time-varying property of variance is referred to in statistics as *heteroscedasticity*. The persistence of volatility related to the time it takes for the effects of events markets to dissipate is an indication of *autocorrelation* in variances. Heteroscedasticity is related to volatility clustering which is caused by the arrival and transmission of news. In relation to the former, it has been argued that items of news that have a large impact on prices have a tendency to be clustered together, as do items of news that have a small impact on prices. The role of the transmission of news in explaining volatility clustering relates to the market dynamics. For example, if traders have heterogenous expectations with some having inside information, then news may take more than one period to disseminate. In other words, divergences in investors' expectations may take some time to be eradicated. The concept of the transmission of volatility and the role of market dynamics is an alternative to the traditional explanations of the asymmetric response of volatility to news.

[7] In the case of the 3-months, an appropriate assumption is that the mean equals zero and follows a mean-reverting process.

To account for volatility clustering, the Autoregressive Conditional Heteroscedasticity (ARCH) type modeling was introduced by Engle (1982) and is considered the predominant statistical technique used in the analysis of time-varying volatility. In ARCH models, volatility is a deterministic function of historical returns. The original ARCH(p) process models conditional variance as a linear function of the first p past squared innovations.

$$r_t = \mu + \varepsilon_t \qquad \varepsilon_t \sim iid\ N(0,\ h_t), \tag{7}$$

$$h_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 \tag{8}$$

Equation (8) stipulates that the variance of $\varepsilon_t$, $h_t$, has two components: a constant and last period's news about volatility, which is modeled as last period's squared residual (the ARCH term). Observe that in this model $\varepsilon_t$ is heteroscedastic, conditional on $\varepsilon_{t-1}$. Estimations of the equation are done usually by maximum likehood. Given the low cost of computing power, this is not very difficult. Indeed, most widely used econometrics software packages make it possible to estimate ARCH models of this sort very easily.

This model allows today's conditional variance to be substantially affected by the (large) square error term associated with a major market move (in either direction) in any of the previous q periods. It thus captures the conditional heteroscedasticity of financial returns and offers an explanation of the persistence in volatility. A practical difficulty with the ARCH(p) model is that in many of the applications a long length p is called for.

An extension and improvement of Engle's ARCH model is the Generalized Autoregressive Conditional Heteroscedasticity GARCH(p, q) proposed by Bollerslev (1986). With GARCH the current conditional variance depends on the first q past conditional variances as well as the p past squared innovations and is modeled as a linear function of the lagged conditional variance in addition to the past error variances. GARCH can successfully capture thick tailed returns and volatility clustering. It can also readily be modified to allow for several other stylized facts of asset returns.

A GARCH(p, q) process is represented as:

$$h_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^{q} \beta_i h_{t-i} \tag{9}$$

An extension of GARCH is the GARCH-in-Mean (GARCH-M) which differs in that the conditional variance ($h_t$) is included as an explanatory variable in the mean equation. Thus where GARCH permits the conditional variance to be modeled, GARCH-M also allows the conditional variance to directly explain the dependent variable. Under GARCH-M, therefore, equation (5) could be rewritten:

$$r_t = \mu + \phi h_t + \varepsilon_t \qquad \varepsilon_t \sim iid\ N(0, h_t) \tag{10}$$

where $h_t$ is as equation (9).

By accounting for the information in the lag(s) of the conditional variance in addition to the lagged $\varepsilon_{t-i}^{2}$ terms, the GARCH model reduces the number of parameters required. In most cases, one lag for each variable is sufficient.

The GARCH(1,1) model is given by :

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} \tag{11}$$

To gauge the impact of the introduction of the BAX on the volatility of the 3-month Canadian bankers' acceptances, a dummy variable is included. Thus, equation (11) becomes:

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \lambda D_i \tag{12}$$

where $D_i$ takes the value of zero for all observations prior to the commencement of futures trading and the value of one following it.

### 4.2.3 GARCH Analysis

In order to consider the use of the GARCH or GARCH-M models, it is necessary to conduct tests to discern autocorrelation and heteroscedasticity within the 3-month Canadian bankers' acceptances returns series.

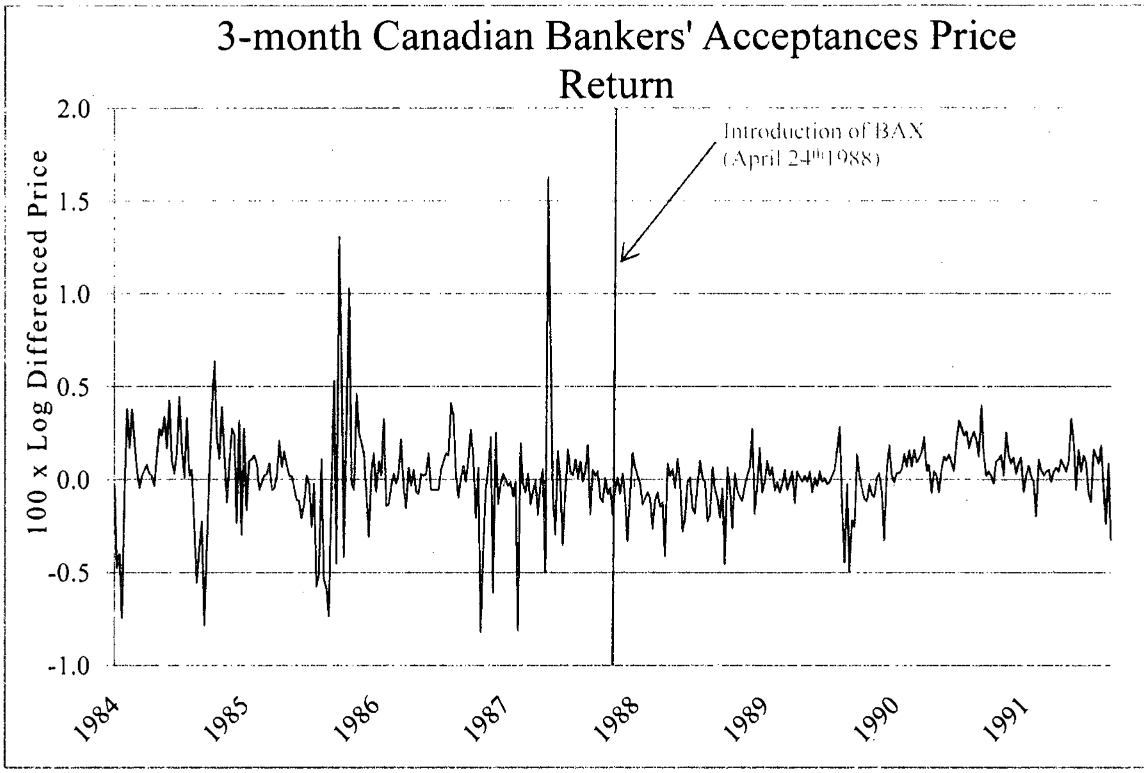
The Box-Ljung statistic BL(p) is useful to test for autocorrelation in variance. Since $h = E\left[r_t - \mu\right]^2 = E(r_t^2)$ for $\mu = 0$; squared returns can be used for the test. Under the null hypothesis that a financial time series is not auto-correlated, BL(p) is distributed $\chi_p^2$ where p is the number of autocorrelations used to compute the statistic. For p=36, the BL(p) statistic (from 1984:06:27 to 1992:02:19, 400 observations) for the squared 3-months Canadian bankers' acceptances weekly price returns is 65.55, which rejects the hypothesis that variances of weekly returns are not auto-correlated[8].

The presence of ARCH effects can be tested using the original Lagrange Multiplier (LM) test. The test statistic $TR^2$ (from 1984:06:27 to 1992:02:19, 400 observations) for first order ARCH effects (distributed as $\chi_1^2$) in weekly return variances for 3-month Canadian bankers' acceptances is 4.52, thus rejecting the null hypothesis that variances are homoscedastic[9].

Thus both GARCH and GARCH-M can be employed to model conditional volatility of the 3-month Canadian bankers' acceptances. Figure I shows evidence of volatility clustering for the analyzed financial instrument.

[8] See Appendix A4
[9] See Appendix A4

Figure I




## Empirical Analysis

Previous empirical research finds that the effect of future trading on the volatility of the associated spot asset can be modeled using conditional variance models when volatility clustering is observable with the financial time series. In other words, it is possible to examine whether futures activities has any impact on the asset's variability by using a GARCH process including a dummy variable in the conditional volatility's regression. The dummy variable takes zero value for the pre-futures period and one for the post-futures period. If the dummy is statistically significant, the existence of a futures market has an impact on spot market volatility. When the coefficient of the dummy variable is positive (negative), there is an augmentation (reduction) of spot asset's volatility due to futures trading activities. Thus, the dummy variable allows determining whether futures prices are associated to any change in the spot market variability.

In regards to the study of this paper, the volatility of the returns of the 3-month Canadian bankers' acceptances is analyzed through four sub-periods windows selected in order to test the impact of the BAX futures. In accordance with previous section (Hodgson & Nicholls' approach) the first window is comprised of 100 observations: 50 before and 50 after the introduction of the BAX future contract. Following the same procedure, the other windows cover 100, 150 and 200 weekly observations either side of the event representing respectively and approximately 2, 3 and 4 years. As mentioned before one lag for each variable is sufficient {GARCH(1,1)}.

Table II in the next page shows the findings of the analysis. Sample windows of 50, 100 and 150 observations either side of the introduction of the BAX show insignificant parameters values for the dummy variable revealing no considerable impact of BAX activities on the 3-month Canadian bankers' acceptances variability. However, sample period window of 200 returns before and after the advent of the BAX show a significant and negative coefficient value of the dummy variable. This result provides evidence in the decline of 3-month Canadian bankers' acceptances' uncertainty. In summary, the introduction of the BAX does not increase the volatility of the associated underlying asset according to the first three sample windows while, in accordance with previous section' findings, the last sample window shows a decrease in the conditional volatility of the primary market.

**Table II**

GARCH and GARCH-M for 3-month Bankers' Acceptances Return including a Dummy Variable

| *N* | 50 | | 100 | | 150 | | 200 | |
|---|---|---|---|---|---|---|---|---|
| *Coeff.* | *GARCH* | *GARCH-in-Mean* | *GARCH* | *GARCH-in-Mean* | *GARCH* | *GARCH-in-Mean* | *GARCH* | *GARCH-in-Mean* |
| $\alpha_0$ | 0.0119 | 0.0120 | 0.0130 | 0.0124 | 0.0122 | 0.0122 | 0.01714 | 0.0168 |
| | (1.55) | (1.83) | (1.97) | ( 1.98) | (2.48) | (2.49) | (4.02) | (3.88) |
| $\alpha_1$ | 0.4151 | 0.3625 | 0.5352 | 0.4937 | 0.4658 | 0.4634 | 0.4332 | 0.4151 |
| | (2.88) | (3.07) | (3.70) | (3.60) | (4.13) | (4.15) | (4.41) | (4.25) |
| $\beta_1$ | 0.5609 | 0.5838 | 0.4094 | 0.4337 | 0.4339 | 0.4353 | 0.4087 | 0.4190 |
| | (5.42) | (6.80) | (3.87) | (4.07) | (4.68) | (4.61) | (4.92) | (4.92) |
| $\phi_1$ | - | 0.6289 | - | 0.2466 | - | 0.0821 | - | 0.3353 |
| | - | (2.49) | - | (1.41) | - | (0.44) | - | (1.74) |
| $\lambda$ | -0.0073 | -0.0079 | 0.0041 | 0.0039 | -0.0017 | -0.0019 | -0.0115 | -0.0112 |
| | (-1.02) | (-1.26) | (0.730) | (0.74) | (-0.43) | (-0.45) | (-3.49)* | (-3.12)* |

*t* values in parentheses.
* significant at the 5% level

## 4.3 Ongoing Effects of Futures Trading Activities

### 4.3.1 Bessembinder & Seguin's Approach

The authors introduce a procedure for computing unbiased estimates of conditional standard deviations that provide additional evidence on interrelations between underlying volatility and futures trading activities. The method involves iterating between a conditional mean and a conditional volatility equation of the form:

$$R_t = \alpha + \sum_{j=1}^{n} \lambda_j R_{t-j} + \sum_{j=1}^{n} \pi_j \hat{\sigma}_{t-j} + U_t \tag{13}$$

$$\hat{\sigma}_t = \delta + \sum_{j=1}^{n} \psi_j \hat{\sigma}_{t-j} + \sum_{j=1}^{n} \omega_j \hat{U}_{t-j} + \varepsilon_t \tag{14}$$

where $R_t$ is the observed percent change in the futures price on day t. Fitted values from Equation (13) estimate conditional expected returns. Residuals from Equation (13), denoted $U_t$ , represent unexpected returns. The study employs estimates of weekly standard deviations obtained using the transformation,

$$\hat{\sigma}_t \equiv \left|\hat{U}\right| \sqrt{\pi / 2} \tag{15}$$

In Equation (14), conditional standard deviations are estimated by regressing volatility estimates against lagged unexpected returns (lagged raw residuals) and lags of the estimated standard deviation series. Lagged raw residuals from (13) are included to allow for possible effects of recent realized returns on volatility. Lags of the estimated standard deviation series are included to measure and accommodate any persistence in price volatility. Past (signed) unexpected returns in the specification are included because many past studies of spot market volatilities find that these lags have explanatory power.

Equations (13) and (14) are estimated consecutively. Equation (13) is initially estimated without lagged volatility estimates. The transformation in Equation (15) is applied to the residuals and Equation (14) is estimated. Subsequent to the first pass, the process is iterated by including fitted standard deviation estimates from (14) as proxies in re-estimating (13). Equation (14) is re-computed using residuals from the estimation of Equation (13). Carrying on this iterative process, the estimation procedure of both equations continues until convergence occurs. This specification allows for possible shifts in expected returns as a function of recent return volatility.

Futures trading activity variables $A_k$ (i.e. volume & open interest) are included to gauge their impact on conditional volatilities. Thus equation 14 becomes:

$$\hat{\sigma}_t = \delta + \sum_{j=1}^{n} \psi_j \hat{\sigma}_{t-j} + \sum_{j=1}^{n} \omega_j \hat{U}_{t-j} + \sum_{k=1}^{m} \xi_k A_k + \varepsilon_t \tag{14a}$$

Moving average process and multivariate forecasting methods are employed to decompose volume activity series into three components. This decomposition allows to examine empirically whether surprises in trading volume convey more information and, thus, have a larger effect on returns than forecastable trading activities.

First, to mitigate any unrelated effects to volume growth a detrended activity series is initially constructed by deducting the 4-week moving average from the original series. Then this detrended serie of futures volume is partitioned into expected and unexpected components using ARIMA(0, 1, 4) specifications (explained below) to assess whether the volume-volatility relation differs for expected versus surprise components. The unexpected component of the detrended series is interpreted as the weekly activity shock. The expected component of the detrended series reflects activity that is forecastable. Slower adjusting changes in forecastable activity are captured by the 4-weeks moving average series. Note that the sum of the three components is the original activity series.

Open interest data provide an additional measure of trading activity and is also partitioned into expected and unexpected components, again using the ARIMA(0,1,4) forecasting method. Open interest measures are pertinent since many speculators do not hold open positions overnight. Open interest as of the close of trading likely reflects primarily hedging activity and, thus, proxies for the amount of uninformed trading. The intercept in (14a) can then be interpreted as the unconditional return standard deviation.

### 4.3.2 ARIMA

Bessembinder and Seguin used an Integrated Autoregressive Moving Average model (ARIMA) procedure to separate expected and unexpected components of the residuals of the moving average of the bankers' acceptances series. In statistics and signal processing, the autoregressive moving average (ARIMA) model is typically applied to time series data and is a tool for understanding and, perhaps, predicting future values in this series.

In the subsequent section, the Autoregressive Moving Average model (ARMA) statistical specification is described followed by the explanation of the Integrated Autoregressive Moving Average model (ARIMA).

The ARMA model consists of two parts, an autoregressive (AR) part and a moving average (MA) part. The model is usually then referred to as the ARMA(*p*,*q*) model where *p* is the order of the autoregressive part and *q* is the order of the moving average model.

First, the notation AR(*p*) refers to the autoregressive model of order *p*. The AR(*p*) model is written

$$X_t = \varphi_1 X_{t-1} + \varphi_2 X_{t-2} + \ldots + \varphi_p X_{t-p} + \varepsilon_t = \sum_{i=1}^{p} \varphi_i X_{t-i} + \varepsilon_t \qquad (16)$$

where $\varphi_1, \ldots, \varphi_p$ are the parameters of the model and $\varepsilon_t$ is white noise.

In the autoregressive process of order p the current observation $X_t$ is generated by a weighted average of past observations going back p periods, together with a random disturbance in the current period.

The notation MA($q$) refers to the moving average model of order $q$:

$$X_t = \mu + \varepsilon_t + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + \ldots + \theta_q \varepsilon_{q-1} = \mu + \varepsilon_t + \sum_{i=1}^{q} \theta_i \varepsilon_{t-i} \qquad (17)$$

where the $\theta_1,\ldots, \theta_q$ are the parameters of the model and the $\varepsilon_t$ are again, the error terms. The moving average model is essentially a finite impulse response filter with some additional interpretation placed on it. In the moving average process of order q each observation $X_t$ is generated by a weighted average of random disturbances going back q periods. The constant term is omitted by many authors for simplicity.

The notation ARMA($p$, $q$) refers to the model with $p$ autoregressive terms and $q$ moving average terms. This model contains the AR($p$) and MA($q$) models,

$$X_t = \mu + \varepsilon_t + \sum_{i=1}^{p} \varphi_i X_{t-i} + \sum_{i=1}^{q} \theta_i \varepsilon_{t-i} \qquad (18)$$

The random disturbances $\varepsilon_t$ are generally assumed to be independent identically-distributed random variables (i.i.d.) sampled from a normal distribution with mean zero, variance $\sigma_\varepsilon^2$ $\varepsilon_t \sim N(0, \sigma^2)$ and covariance $\delta_k = 0$ for $k \neq 0$. ARMA models in general can, after choosing p and q, be fitted by least squares regression to find the values of the parameters which minimize the error term. It is generally considered good practice to find the smallest values of p and q which provide an acceptable fit to the data.

In order to introduce the Integrated Autoregressive Moving Average model (ARIMA), equation (12) can be rewritten:

$$\left(1-\sum_{i=1}^{p}\varphi_i L^i\right) X_t = \left(1+\sum_{i=1}^{q}\theta_i L^i\right) \varepsilon_t \tag{19}$$

where $L$ is the lag operator.

An ARIMA($p$,$d$,$q$) process is obtained by integrating an ARMA($p$,$q$) process. That is,

$$\left(1-\sum_{i=1}^{p}\varphi_i L^i\right) (1-L)^d X_t = \left(1+\sum_{i=1}^{q}\theta_i L^i\right) \varepsilon_t \tag{20}$$

where $d$ is a positive integer that controls the level of differencing (or, if $d = 0$, this model is equivalent to an ARMA model). Conversely, applying term-by-term differencing $d$ times to an ARMA($p$,$q$) process gives an ARIMA ($p$,$d$,$q$) process. Note that it is only necessary to difference the AR side of the ARMA representation, because the MA component is always I(0).

An ARIMA(0,1,0) model is given by:

$$X_t = X_{t-1} + \varepsilon_t \tag{21}$$

which is simply a random walk.

In an ARIMA process where d = 2, the second difference of a series X is not simply the difference between X and itself lagged by two periods, but rather it is the first difference of the first difference i.e., the change-in-the-change of X at period t.

Thus, the second difference of X at period t is equal to

$$(X_t - X_{t-1}) - (X_{t-1} - X_{t-2}) = X_t - 2X_{t-1} + X_{t-2} \tag{22}$$

4.3.3 Results using Bessembinder & Seguin's Approach

Empirical results of the analysis of the relation between volatility and levels of futures-trading activity that include trading volumes and open interest are shown in table III. Four sub-periods of 250, 500, 750 and 1,000 observations were selected, all ending on June 5, 2008. Coefficients estimates of expected, unexpected and moving average (both for volume and open interest) are insignificant for all periods studied which can be interpreted as the nonexistent effect of the variables analyzed on the volatility of the 3-month Canadian bankers' acceptances.

**Table III**

Regression of Weekly 3-month Canadian Bankers' Acceptances Return Standard Deviation Estimates on FuturesTrading Volume and Open Interest

| *Coeff.* | *N* | 250 | 500 | 750 | 1000 |
|---|---|---|---|---|---|
| Intercept | | 3.23 | 0.02 | 0.07 | 0.08 |
| | | (0.00) | (0.00) | (0.00) | (0.00) |
| | | | ***BAX Volume*** | | |
| Expected | | -6.41 e-07 | - 1.44 e-07 | 4.99 e-07 | - 1.49 e-07 |
| | | (0.04) | (0.60) | (0.43) | (0.86) |
| Unexpected | | -4.94 e-09 | 9.67 e-10 | 1.02 e-0.7 | 1.91 e-07 |
| | | (0.96) | (0.36) | (0.67) | (0.54) |
| Moving average | | -3.09 e-07 | - 2.62 e-07 | 6.19 e-0.7 | 3.13 e-07 |
| | | (0.15) | (0.29) | (0.25) | (0.64) |
| | | | ***BAX Open Interest*** | | |
| Expected | | 6.70 e-08 | -9.43 e-08 | -1.01 e-07 | 7.80 e-08 |
| | | (0.12) | (0.24) | (0.59) | (0.75) |
| Unexpected | | 5.88 e-09 | 6.28 e-08 | 1.65 e-07 | 1.05 e-07 |
| | | (0.94) | (0.38) | (0.30) | (0.62) |
| Moving average | | 9.90 e-08 | 2.88 e-08 | - 2.10 e-07 | - 2.26 e-07 |
| | | (0.18) | (0.55) | (0.02) | (0.03) |
| *Adjusted R-squared* | | 0.42 | 0.24 | 0.43 | 0.54 |

Volumes and open interest are detrended by subtracting the 4-week moving average from each series (prior to partitioning into expected and unexpected components). Test statistics for individual coefficients are t-statistics for the hypothesis that the coefficient is zero.

### 4.3.4 An Alternative to Bessembinder & Seguin's Approach

Chatrath *et al.* (1996) propose in their paper to study the relationship between the level of trading in currency futures and the amount of instability in underlying asset. The authors argue that by employing the trading activity variable $Volume_t$ / Open $Interest_t$ , speculation is better reflected in the system of equations (13) and (14a).

Table IV shows the coefficients for different sample windows. The insignificant results provide once again evidence of nonexistent effect of BAX trading activities on the variability of the underlying 3-month Canadian bankers' acceptances.

**Table IV**

Regression of Weekly 3-month Canadian Bankers' Acceptances Return Standard Deviation Estimates on Volume / Open Interest Variable

| *Coeff.* *N* | 250 | 500 | 750 | 1000 |
|---|---|---|---|---|
| Intercept | 0.03 | 0.01 | 0.02 | 0.04 |
| | (0.19) | (0.00) | (0.13) | (0.00) |
| Volume / Open Interest | 0.05 | 0.04 | 0.13 | -0.05 |
| | (0.16) | (0.22) | (0.18) | (0.37) |
| *Adjusted R-squared* | 0.21 | 0.18 | 0.21 | 0.32 |

*t* values in parentheses

## 5. Conclusion

In this paper, the impact of the BAX trading activities has been examined by means of the two main approaches. The first analyzing method was conducted by using an event study methodology. Both Hodgson & Nicholls and GARCH research designs have present support for a decline in the level of uncertainty of the 3-month Canadian bankers' acceptances following the introduction of the BAX contract.

The second research design analyzed the continuing effect of the BAX trading activities on the level of variability of the associated spot asset. The general evidence of the second research design indicates that the 3-month bankers' acceptance volatility is unrelated to futures-trading activity, whether expected or unexpected.

These findings of no change or lower variability after the introduction of the BAX and the nonexistent effect of futures trading on the spot volatility of the 3-month Canadian banker's acceptance are important to the debate regarding the role of futures trading in spot market volatility because it could involve a lesser involvement of Canadian authorities in the regulation of futures market.

# References


Andreas, Pericli and Koutmos Gregory. 1997. Index Futures and Options and Stock Market Volatility. *The Journal of Futures Markets* (1986-1998) Vol. 17, pp. 957-974.

Antoniou, Antonios and Andrew J. Foster. 1992. The Effect of Futures Trading on Spot Price Volatility: Evidence for Brent Crude Oil using GARCH. *Journal of Business Finance & Accounting* Vol. 19, No. 4, pp. 473-484.

Antoniou, Antonios; Phil Holmes and Richard Priestley. 1998. The Effects of Stock Index Futures Trading on Stock Index Volatility: An Analysis of the Asymmetric Response of Volatility to News. *The Journal of Futures Markets* Vol. 18, pp. 151-166.

Bae, Sung C.; Taek Ho Kwon and Jong Won Park. 2004. Futures Trading, Spot Market Volatility, and Market Efficiency: The Case of the Korean Index Futures Markets. *The Journal of Futures Markets* Vol. 24, pp. 1195-1228.

Bessembinder, Hendrik and Paul J. Seguin. 1993. Price Volatility, Trading Volume, and Market Depth: Evidence from Futures Markets. *Journal of Financial and Quantitative Analysis* Vol. 28, pp. 21-39.

Bessembinder, Hendrik and Paul J. Seguin. 1992. Futures-Trading Activity and Stock Price Volatility. *The Journal of Finance* Vol. 47, pp. 2015-2034.

Board, John; Gleb Sandmann and Charles Sutcliffe. 2001. The Effect of Futures Market Volume on Spot Market Volatility. *Journal of Business Finance & Accounting* Vol. 28, pp. 799-819.

Bollerslev Tim. 1986. Generalized Autoregressive Conditional Heteroskedasticity. *Journal of Econometrics*, Vol. 31, pp. 307-327.

Chari, V. V. and Ravi Jagannathan. 1990. The Simple Analytics of Commodity Futures Markets: Do they Stabilize Prices? do they Raise Welfare? Federal Reserve Bank of Minneapolis. *Quarterly Review - Federal Reserve Bank of Minneapolis* Vol. 14, pp. 12-24.

Chari, V. V.; Ravi Jagannathan and Larry Jones. 1990. Price Stability and Futures Trading in Commodities. *The Quarterly Journal of Economics* Vol. 105, pp. 527-534.

Charupat, Narat. 2006. The Effect of Derivative Trading on the Underlying Markets: Evidence from Canadian Instalment Receipts Trading. *International Review of Economics & Finance* Vol. 15, pp. 276-293.

Chatrath, Arjun; Sanjay Ramchander and Frank Song. 1996. The Role of Futures Trading Activity in Exchange Rate Volatility. *The Journal of Futures Markets* Vol. 16, pp. 561-584.

Chatrath, Arjun; Sanjay Ramchander and Frank Song. 1995. Does Options Trading Lead to Greater Cash Market Volatility? *The Journal of Futures Markets* (1986-1998) Vol. 15, pp. 785-803.

Chu, Quentin C.; Wen-liang Gideon Hsieh and Yiuman Tse. 1999. Price Discovery on the S&P 500 Index Markets: An Analysis of Spot Index, Index Futures, and SPDRs. *International Review of Financial Analysis* Vol. 8, pp. 21-34.

Cohen, Benjamin H. 1999. Derivatives, Volatility and Price Discovery. International Finance, Bank for International Settlements, Switzerland Vol. 2, pp. 167-202.

Corgel, John B. and Gerald D. Gay. 1984. The Impact of GNMA Futures Trading on Cash Market Volatility. *AREUEA Journal* Vol. 12, pp. 176-190.

Corredor, Pilar and SantaMaria Rafael. 2002. Does Derivatives Trading Destabilize the Underlying Assets? Evidence from the Spanish Stock Market. *Applied Economics Letters* Vol. 9, pp. 107-110.

Cox, Charles C. Dec. 1976. Futures Trading and Market Information. *The Journal of Political Economy* Vol. 84, pp. 1215-1237.

Danthine, Jean-Pierre. 1978. Information, Futures Prices, and Stabilizing Speculation. *Journal of Empirical Finance* Vol. 17, pp. 79-98.

Darrat, Ali F. and Rahman Shafiqur. 1995. Has Futures Trading Activity Caused Stock Price Volatility? *The Journal of Futures Markets* (1986-1998) Vol. 15, pp. 537-557.

Darrat, Ali F.; Shafiqur Rahman and Maosen Zhong. 2002. On the Role of Futures Trading in Spot Market Fluctuations: Perpetrator of Volatility Or Victim of Regret?, *Journal of Financial Research* Vol. 25, No. 3, pp. 431-444.

Demers, Fanny and Michel Demers. 1989. A Privately Revealing Rational Expectations Equilibrium for the Futures Market. *European Economic Review* Vol. 33, pp. 663-685.

Drimbetas, Evangelos; Nikolaos Sariannidis and Nicos Porfiris. 2007. The Effect of Derivatives Trading on Volatility of the Underlying Asset: Evidence from the Greek Stock Market. *Applied Financial Economics* Vol. 17, pp. 139-148.

Edwards, Franklin R. 1988. Futures Trading and Cash Market Volatility: Stock Index and Interest Rate Futures. *The Journal of Futures Markets* Vol. 8, pp. 421-439.

Edwards, Franklin R. 1988. Does Futures Trading Increase Stock Market Volatility? *Financial Analysts Journal* Vol. 44, pp. 63-69.

Engle, Robert F. 1982. Autoregressive Conditional Heteroscedasticity with Estimates of Variance of United Kingdom Inflation. *Econometrica* Vol. 50, pp. 987-1008.

Engle, Robert F. 2001. GARCH 101: The use of ARCH/GARCH Models in Applied Econometrics. *The Journal of Economic Perspectives* Vol. 15, No. 4, pp. 157-168.

Fabozzi Frank J.; Steve V. Mann and Moorad Choudhry, 2002. The Global Money Markets, published by *John Wiley & Sons Inc.* Hoboken, New Jersey. 336 pages.

Fackler, Paul L. 1993. Delivery and Manipulation in Futures Markets. *The Journal of Futures Markets* Vol. 13, pp. 693-702.

Figlewski, Stephen. 1981. Futures Trading and Volatility in the GNMA Market. *The Journal of Finance* Vol. 36, pp. 445-456.

Fleming, Jeff and Barbara Ostdiek. 1999. The Impact of Energy Derivatives on the Crude Oil Market. *Energy Economics* Vol. 21, pp. 135-167.

Galloway, Tina M. and James M. Miller. 1997. Index Futures Trading and Stock Return Volatility: Evidence from the Introduction of MidCap 400 Index Futures. *The Financial Review* Vol. 32, pp. 845-865.

Hart, Oliver D. 1977. On the Profitability of Speculation. *The Quarterly Journal of Economics* Vol. 91, pp. 579-597.

Hart, Oliver D. and David M. Kreps. 1986. Price Destabilizing Speculation. *The Journal of Political Economy* Vol. 94, No. 5, pp. 927-952.

Hodgson, Allan and Des Nicholls. 1991. The Impact of Index Futures Markets on Australian Sharemarket Volatility. *Journal of Business Finance & Accounting* Vol. 18, No. 2, pp. 267-280.

Jaffee, Dwight M. 1984. The Impact of Financial Futures and Options on Capital Formation. *The Journal of Futures Markets* Vol. 4, pp. 417-447.

Jesse, Richard R. Jr. and Robert C. Radcliffe. 1981. On Speculation and Price Stability Under Uncertainty. *Rev. Econ. Stat.* Vol. 63, pp. 129-132.

Kaldor, Nicholas. 1939. Speculation and Economic Stability. *The Review of Economic Studies* Vol. 7, pp. 1-27.

Kawai, Masahiro. 1983. Price Volatility of Storable Commodities under Rational Expectations in Spot and Futures Markets. *International Economic Review* Vol. 24, pp. 435-459.

Kawai, Masahiro. 1983. Futures Trading Activity and Commodity Cash Price Volatility. *International Economic Review* Vol. 24, pp. 435-459.

Kemp, Murray C. 1963. Speculation, Profitability, and Price Stability. *Rev. Econ. Stat.* Vol. 45, pp. 185-189.

Kurov, Alexander. 2008. Investor Sentiment, Trading Behavior and Informational Efficiency in Index Futures Markets. *The Financial Review* Vol. 43, pp. 107-127.

Lamoureux, Christopher G. and William D. Lastrapes. 1990. Heteroskedasticity in Stock Return Data: Volume Versus GARCH Effects. *The Journal of Finance* Vol. 45, pp. 221-229.

Mayhew, Stewart. 2000. The Impact of Derivatives on Cash Markets: What Have We Learned? *Department of Banking and Finance*, Terry College of Business, University of Georgia, Athens, GA.

McKenzie, Michael D.; Timothy J. Brailsford and Robert W. Faff. 2001. New Insights into the Impact of the Introduction of Futures Trading on Stock Price Volatility. *The Journal of Futures Markets* Vol. 21, pp. 237-255.

Newbery, David M. 1987. When do Futures Destabilize Spot Prices? *International Economic Review* Vol. 28, pp. 291-297.

Paul, Weller and Yano Makoto. 1987. Forward Exchange, Futures Trading, and Spot Price Variability: A General Equilibrium Approach. *Econometrica* (1986-1998) Vol. 55, No. 6, pp. 1433-1450.

Peck, Anne E. Aug. 1976. Futures Trading, Supply Response and Price Stability. *The Quarterly Journal of Economics* Vol. 90, pp. 407-423.

Pok, Wee Ching and Sunil Poshakwale. 2004. The Impact of the Introduction of Futures Contracts on the Spot Market Volatility: The Case of Kuala Lumpur Stock Exchange. *Applied Financial Economics* Vol. 14, pp. 143-154.

Rahman, Shafiqur. 2001. The Introduction of Derivatives on the Dow Jones Industrial Average and Their Impact on the Volatility of Component Stocks. *The Journal of Futures Markets* Vol. 21, No. 7, pp. 417-447.

Ramaswamy, Krishna and Craig A. Mackinlay. 1988. Index-Futures Arbitrage and the Behavior of Stock Index Futures Prices. *The Review of Financial Studies* (1986-1998) Vol. 1, pp. 137-158.

Robbani, Mohammad G. and Rafiqul Bhuyan. 2005. Introduction of Futures and Options on a Stock Index and their Impact on the Trading Volume and Volatility: Empirical Evidence from the DJIA Components. *Derivatives Use, Trading & Regulation* Vol. 11, No. 3, pp. 246-260.

Salant, Stephen W. 1983. A Theory of Futures Market Manipulations - A Discussion of Pete Kyle's Paper.

Sarris, Alexander H. 1984. Speculative Storage, Futures Markets, and the Stability of Commodity Prices. *Economic Inquiry* Vol. 22, pp. 80-97.

Schimmler, Jorg. 1973. Speculation, Profitability, and Price Stability - A Formal Approach. *Rev. Econ. Stat.* Vol. 55, pp. 110-114.

Schwert, G. William. 1990. Stock Volatility and the Crash of '87. *The Review of Financial Studies* (1986-1998) Vol. 3, pp. 77-102.

Schwert, William G. and Paul J. Seguin. 1990. Heteroskedasticity in Stock Returns. *The Journal of Finance* Vol. 45, pp. 1129-1155.

Simpson, Gary W. and Timothy C. Ireland. 1985. The Impact of Financial Futures on the Cash Market for Treasury Bills. *Journal of Financial and Quantitative Analysis* Vol. 20, pp. 371-379.

Stein, Jeremy C. 1987. Informational Externalities and Welfare-Reducing Speculation. *The Journal of Political Economy* Vol. 95, pp. 1123-1145.

Stoll, Hans R. 1978. The Supply of Dealer Services in Securities Markets. *The Journal of Finance* Vol. 33, pp. 1133-1151.

Subrahmanyam, Avanidhar. 1991. Risk Aversion, Market Liquidity, and Price Efficiency. *The Review of Financial Studies* Vol. 4, pp. 417-441.

Subrahmanyam, Avanidhar. 1991. A Theory of Trading in Stock Index Futures. *The Review of Financial Studies* Vol. 4, pp. 17-51.

Telser, Lester G. 1959. A Theory of Speculation Relating Profitability and Stability. *Rev. Econ. Stat.* Vol. 41, pp. 295-301.

Turnovsky, Stephen J. 1983. The Determination of Spot and Futures Prices with Storable Commodities. *Econometrica* Vol. 51, pp. 1363-1387.

Turnovsky, Stephen J. 1979. Futures Markets, Private Storage, and Price Stabilization. *Journal of Public Economics* Vol. 12, pp. 301-327.

Turnovsky, Stephen J. and Robert B. Campbell. 1985. The Stabilizing and Welfare Properties of Futures Markets: A Simulation Approach. *International Economic Review*. Vol. 26, pp. 277-303.

## Websites

- http://www.bankacceptance.com/aboutus.html
- http://www.eagletraders.com/neg_financial_instruments/bankers_acceptance.htm

- http://en.wikipedia.org/wiki/Bankers'_acceptance

- http://www.investorwords.com/406/bankers_acceptance.html

- http://www.mysmp.com/bonds/bankers-acceptance.html

# Appendices

# Appendix A1

In the purpose of testing $H_o$ : $\sigma_b^2 = \sigma_a^2$, the distribution of $V_b^2 - V_a^2$ under $H_o$ is required. If $\hat{\rho}_b(m)$, m = 0,1,2,... represents an estimate of the autocorrelation $\rho_b(m)$ of the series { $R_t$, t=1,w,....} before the date of opening of the 3-month bankers' acceptances futures market, then from Priestly(1981), $N^{1/2}(V_b^2 - V_a^2)$ is asymptotically normally distributed with mean zero and variance

$$2V_b^4 \sum_{m=-p}^{p} \hat{\rho}_b^2(m) = 2V_b^4 \left[ 1 + 2\sum_{m=1}^{p} \hat{\rho}_b^2(m) \right] \qquad \text{(a1)}$$

where p = N/4.

These results are asymptotic but the data sets being evaluated in this process (minimum size 50) are sufficiently large for the asymptotic model to hold. In calculating the estimate of the variance of $V_b^2$ the maximum lag of the sample autocorrelation considered, is selected as N/4. From this, to test $H_o$, the test statistic becomes:

$$Z = (V_b^2 - V_a^2) / [\mathrm{var}(V_b^2) + \mathrm{var}(V_a^2)]^{1/2} \qquad \text{(a2)}$$

where

$$\mathrm{var}(V_b^{\,2}) = 2V_b^{\,4}N^{-1}\left[1 + 2\sum_{m=1}^{p} \hat{\rho}_b^{\,2}(m)\right] \tag{a3}$$

with $\mathrm{var}(V_a^2)$ similarly defined is, asymptotically, distributed as a standardized normal variable. Hence, the estimated value of Z can be evaluated with the critical value selected from the standardized normal distribution.

# Appendix A2

## RATS Code for Autocorrelation and Heteroskedascity Tests

```
calendar(weekly) 1984:06:27
allocate 1992:02:26
open data "e:\Thesis - Aug 26\Thesis - 15 oct\Thesis\22 sept\BOOK.xls"
data(format=xls, org= columns) / dates rates lnrates


diff(center) lnrates / resids
set usq = resids**2
linreg usq
# constant usq{1}
cdf(title="Test for ARCH(1)") chisqr %trsquared 1


boxjenk lnrates / resids
correlate(qstats) resids
```

## RATS Results for Autocorrelation and Heteroskedascity Tests

| Variable | Coeff | Std Error | T-Stat | Signif |
|---|---|---|---|---|
| 1. Constant | 0.0003985833 | 0.0000868672 | 4.58842 | 0.00000600 |
| 2. USQ{1} | 0.1065365717 | 0.0499259242 | 2.13389 | 0.03346385 |

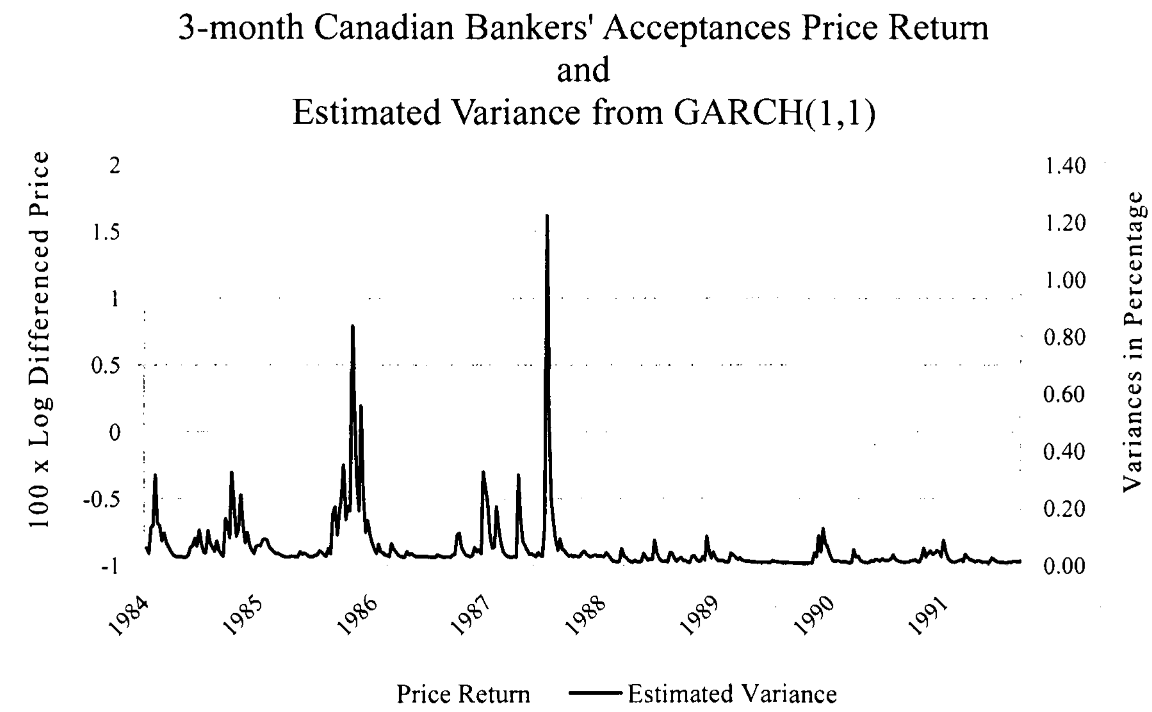
Test for ARCH(1)
***Chi-Squared(1)= 4.524543 with Significance Level 0.03341200***

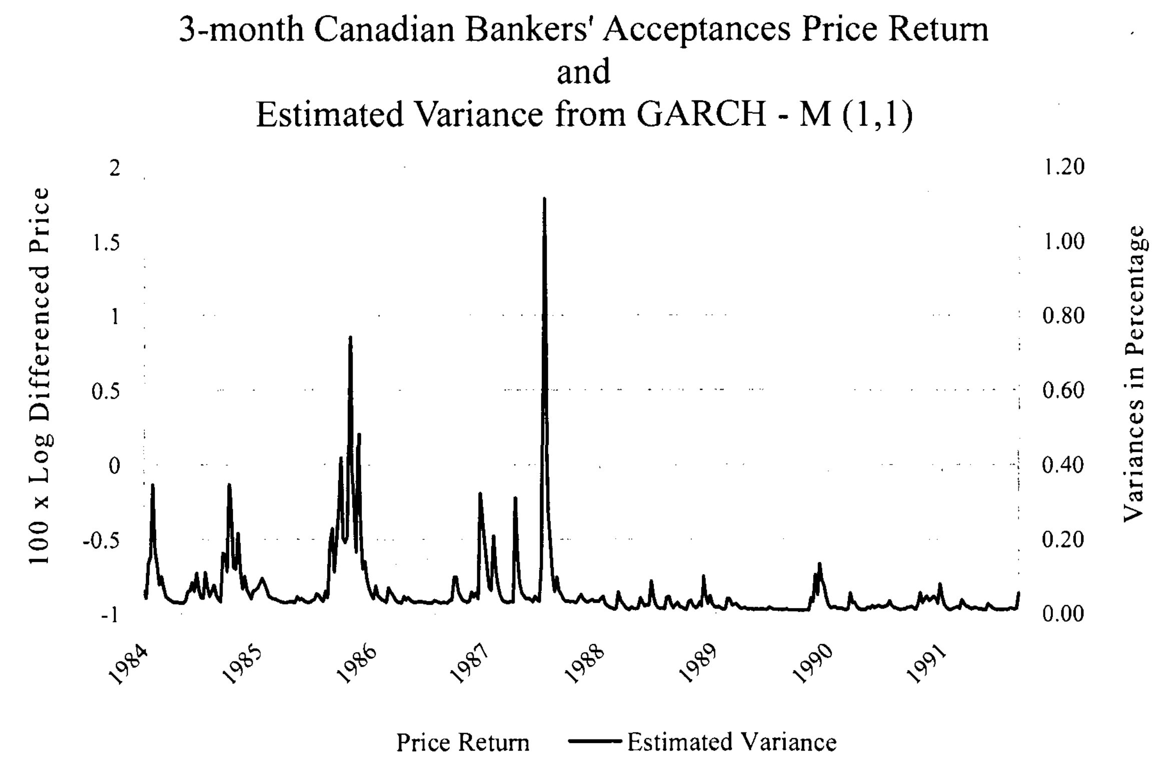
Box-Jenkins - Estimation by LSGauss-Newton
Dependent Variable LNRATES
Weekly Data from 1984:06:27 To 1992:02:19

| | | | |
|---|---|---|---|
| Usable Observations | 400 | Degrees of Freedom | 400 |
| Centered R**2 | -0.002874 | R Bar **2 | -0.000367 |
| Uncentered R**2 | 0.000000 | T x R**2 | 0.000 |

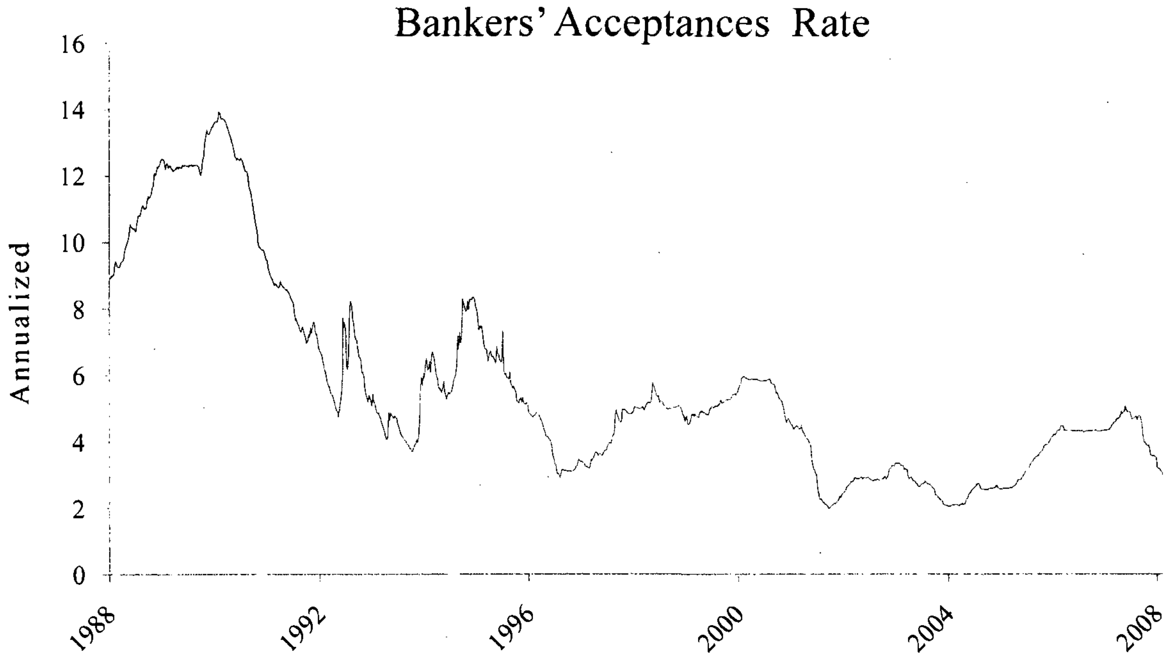
| | |
|---|---|
| Mean of Dependent Variable | -0.001134839 |
| Std Error of Dependent Variable | 0.021196141 |
| Standard Error of Estimate | 0.021200025 |
| Sum of Squared Residuals | 0.1797764234 |
| Log Likelihood | 973.92575 |
| Durbin-Watson Statistic | 1.692708 |
| ***Q(36-0)*** | ***65.553096*** |
| Significance Level of Q | 0.00187385 |

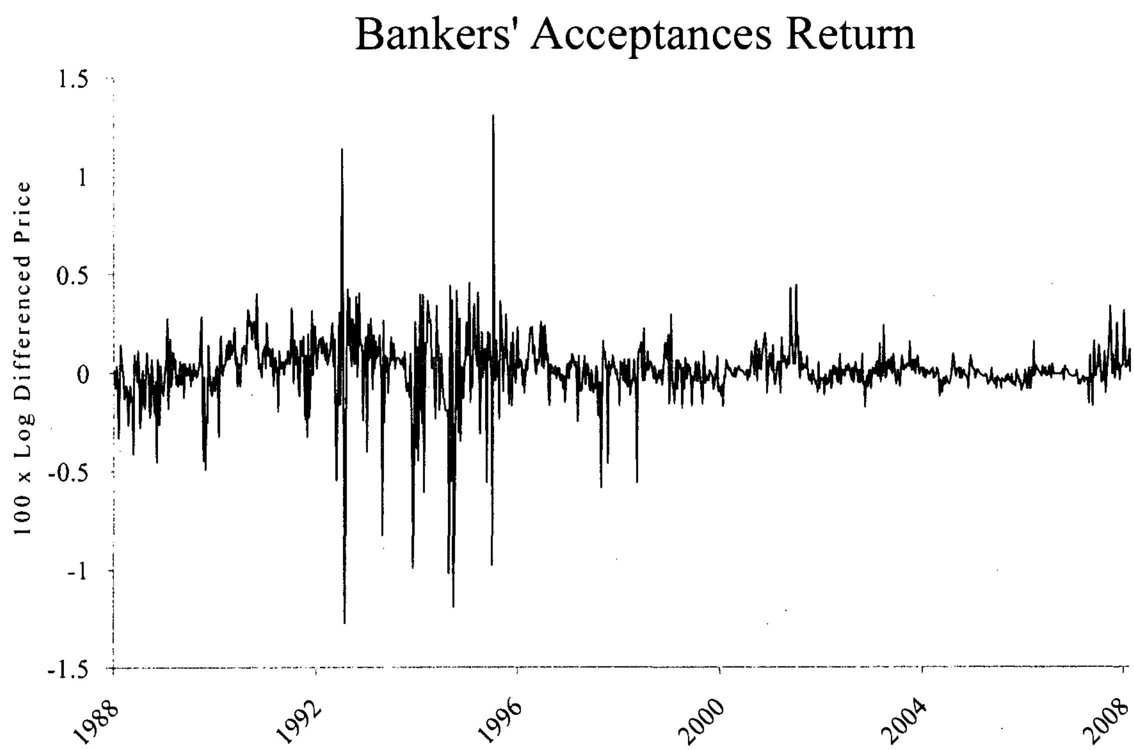
## Figure A1


3-month Canadian Bankers' Acceptances Price Return
and
Estimated Variance from GARCH(1,1)
100 x Log Differenced Price
2
1.5
1
0.5
0
-0.5
-1
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Variances in Percentage
1984
1985
1986
1987
1988
1989
1990
1991
Price Return
Estimated Variance

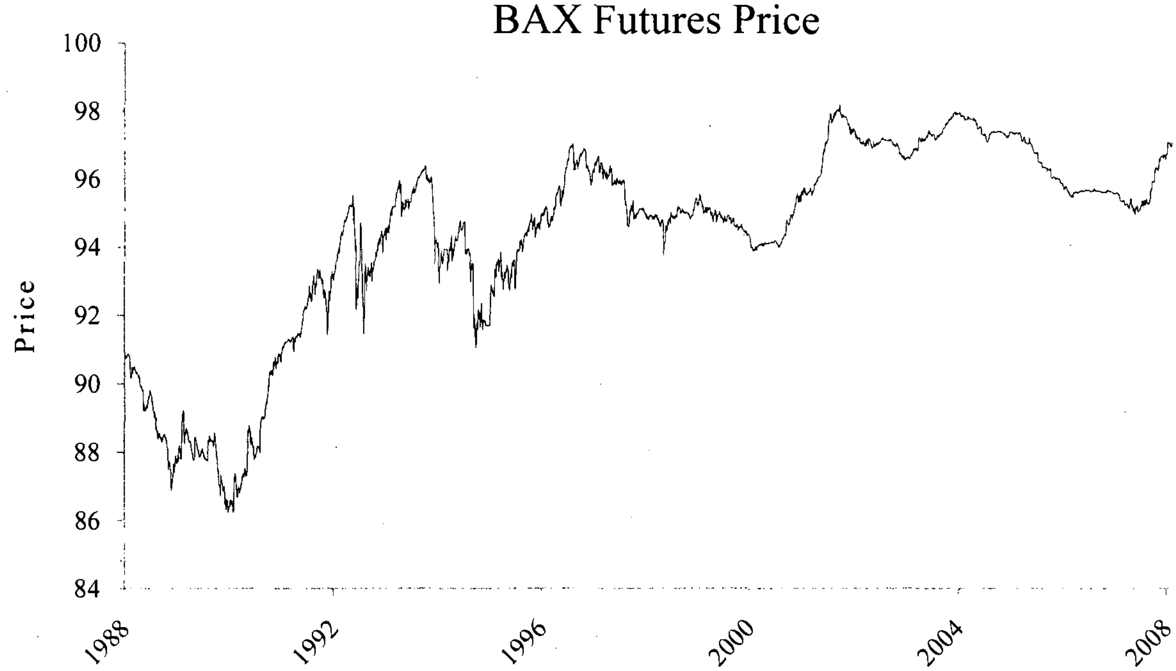

3-month Canadian Bankers' Acceptances Price Return
and
Estimated Variance from GARCH - M (1,1)
100 x Log Differenced Price
2
1.5
1
0.5
0
-0.5
-1
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Variances in Percentage
1984
1985
1986
1987
1988
1989
1990
1991
Price Return
Estimated Variance

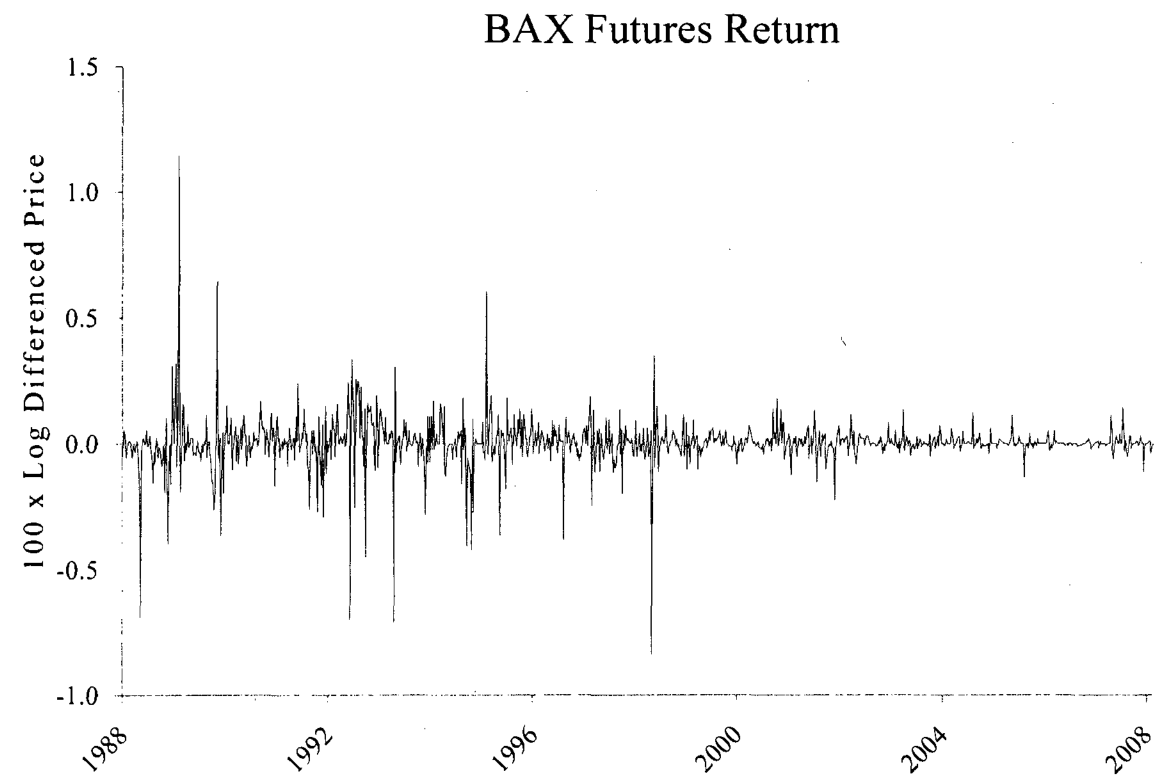
# Figure A2: 3-month Bankers' Acceptances



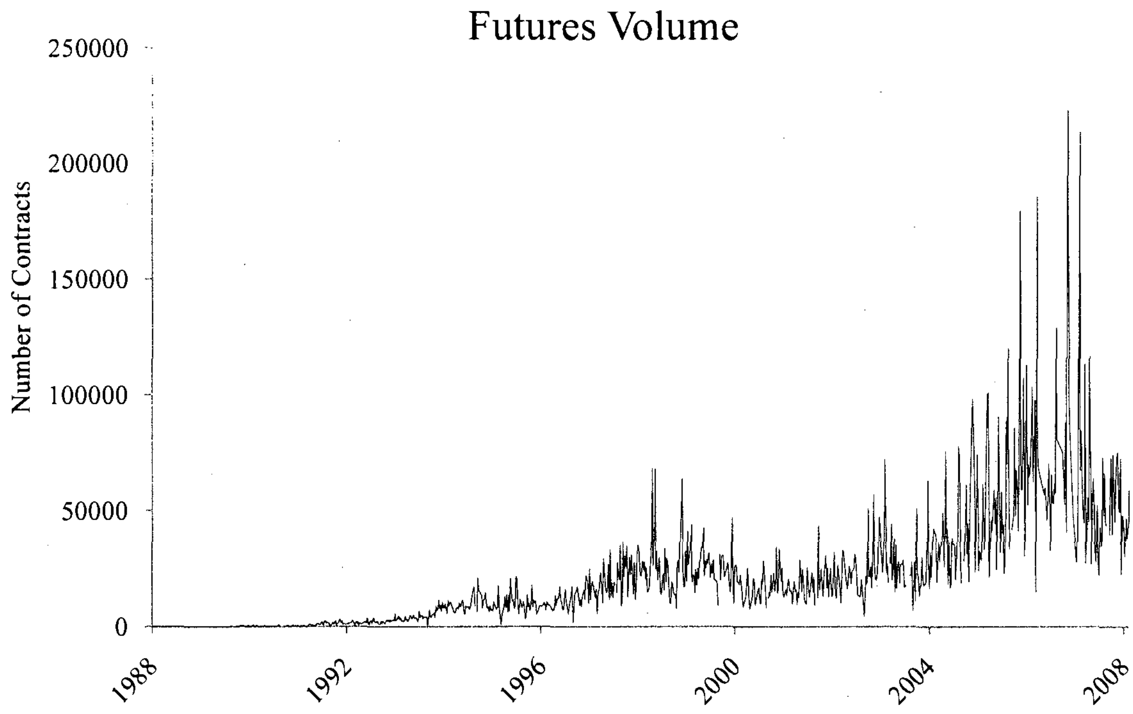



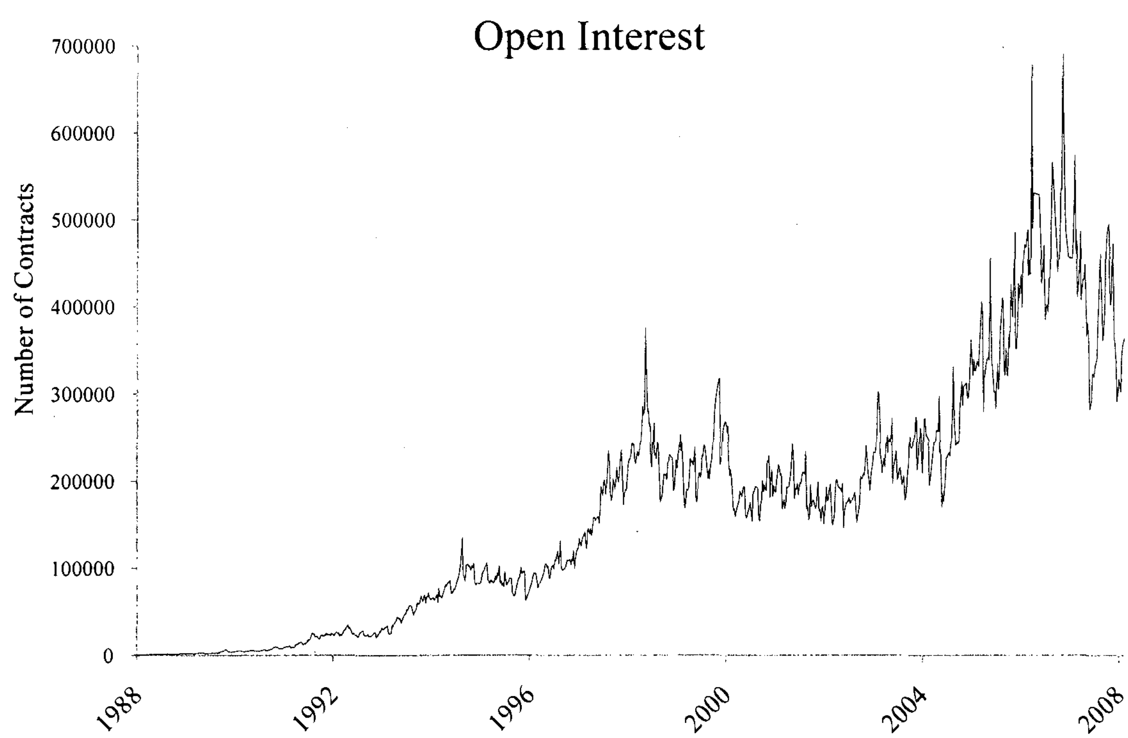
# Figure A3: BAX Futures



# Figure A4: BAX Futures Trading Activities



# Appendix A6

# BAX Description

(Source: Montréal Exchange's BAX Descriptive Brochure)

**Trading hours and operations**

BAX trades from:

- Early session: 6:00 a.m. to 7:45 a.m.
- Regular session: 8:00 a.m. to 3:00 p.m.
- Curb session: from daily settlement to 4:00 p.m.

The early session expands access to the BAX market for the international clientele during non-Canadian business hours.

Orders are executed at the best market price on a "first-in, first-out" (FIFO) basis. As a result, order entry timing is important to ensure priority in the order book.

During the early session, there is a price movement limit based on a risk percentage established by the clearinghouse and on the margin requirements, which are subject to periodic changes. Conversely, throughout the regular trading session, there is no price movement limit.

The regular trading session starts with a pre-opening phase from 7:30 a.m. to 7:58 a.m. During this phase, users can enter, modify or cancel their orders while waiting for the market opening.

From 7:58 a.m. to 8:00 a.m., there is a non-cancellation period during which no cancellation or change is allowed; only entry of new orders is permitted. At 8:00 a.m., the market opens and orders received during the pre-opening are matched, establishing the theoretical opening price, which becomes the opening price of the futures. The trading session continues without any interruption, under normal circumstances, until 3:00 p.m. During the regular trading session, the net price change is established in relation to the previous day's settlement price than the early session's session settlement price.

## Contracts traded

### Quarterly

Three years of quarterly BAX contracts are listed at all times. The standard quarterly cycle consists of March, June, September and December. The first year of contracts is commonly referred to as the *front four* and the contracts do not necessarily have to expire in the same calendar year. The second year of contracts is referred to as the *reds* and the third year, as the *greens*. These three years of quarterly maturities provide portfolio managers with an extended and more precise hedge across the yield curve. The large number of maturities available also offers more opportunities for calendar spreads, allows users to hedge longer-dated interest rate swaps and to combine cash and futures to create longer-term synthetic instruments.

## Serials

In addition, two near-term contracts are listed at all times so there are always three consecutive front months listed. These contracts expire in months other than the standard quarterly contracts. Referred to as *serial* futures, they are identical to the standard BAX contracts in all respects except for the expiry months. For example, on September 17, 2007, the October and November serial BAX futures are listed in addition to the BAX December quarterly contract. With the expiry of the October contract, the January serial BAX contract is immediately listed; with the expiry of the November contract, the February serial is added, and so forth.

The use of serial futures alleviates maturity mismatches and provides market participants with the opportunity to more precisely manage their short-term interest rate exposure. For example, on October 4, 2007, a treasurer knows that he will have a three-month rate fixing on October 15, 2007. Hedging this risk with a December BAX contract exposes the treasurer to date risk between the three-month rate fixing in 11 days and the three-month rate fixing in 74 days based on the expiry of the December BAX contract. By using the October serial BAX contract, the treasurer is able to match the rate fixing date of the hedge to the risk exposure, thereby greatly reducing the date risk.

## Strips

A strip is as simultaneous purchase or sale of an equally weighted series of standard quarterly contracts. There are many benefits in the use of standardized strips, such as executing multiple contract months in a single transaction, rapid trade execution in an active market, eliminating partial fills and more efficient trading in the back months.

The one-, two- and three-year strips consist of, respectively the first four, eight and twelve standard quarterly contracts. The *front strip* consists of the first year of four consecutive standard quarterly contracts. The *red strip* consists of the second year of four consecutive standard quarterly contracts, and the *green strip* third year. In the over-the-counter markets, the *red strip* is commonly referred to as the one-year/one year forward and the *green strip* as the one year/two-year forward.

Strips are quoted on an average net change basis from the previous day's settlement price. For example, a *red strip* bought at +2 indicates the addition of two ticks to the close of the previous day's settlement price for each of the strip's contracts.

## Pricing BAX futures

The BAX price tends to reflect implied forward rates as calculated from the available rates on three-month Canadian banker's acceptances in the cash market. The price also relies on the Eurodollar futures prices with the same maturities and the price of exchange contracts on the Canadian dollar against the U.S. dollar.

**Final settlement procedures**

BAX trading ceases at 10:00 a.m. (Montréal time) on the second London (Great Britain) banking day prior to the third Wednesday of the contract Month. The settlement is based on the average of the three-month Canadian bankers' acceptance bid rates as quoted on the CDO page of Reuters Monitor Service on the last trading day, at 10:15 a.m. (Montréal time), excluding the highest and the lowest values.

**Required margins**

An initial margin is required from all approved participants and their clients. This good faith deposit ensures the financial position of both counterparts to a trade. Deposits are held at the central clearinghouse, the Canadian Derivatives Clearing Corporation (CDCC), and are marked to market on a daily basis. Various types of collateral can be deposited to meet the initial margin requirements including cash, government securities or similar highly liquid instruments. A client's minimum margin deposit is established through the use of a risk-based system and varies for speculators and hedgers. As margin requirements are subject to periodic changes, information on current requirements may be obtained from the Exchange.

In recognition of the more limited-risk characteristics of combined strategies (spreads or butterflies), the CDCC offers reduced-margin requirements for spread positions. For intermonth spreads, the margin applied varies depending on the contract months involved, while for intercommodity spreads (e.g. BAX versus CGB), a fixed ration is used. Full details on current spread margins can be obtained from the Exchange.

**Positions limits**

The Exchange has a position reporting facility, which requires approved participants to supply details on positions over 300 futures contracts.

**Strategies using BAX**

- Managing money market portfolios
- Hedging over-the-counter derivatives: interest rate swaps (floating rate), basis swaps, FRAs, and interest rate options
- Hedging Canadian/U.S. dollar forwards
- Hedging borrowing/investments
- Creating synthetic instruments
- Cross-market trading (BED spread)
- Spread or butterfly trading
- Arbitrage

**Advantages**

- **Regulated market:** As a self-regulatory organization recognized by the Quebec Securities Act, the Exchange is required to ensure that approved participants comply with all regulations to safeguard an orderly and efficient market.
- **Electronic trading:** Through SAM (Montréal Automated System), the Exchange offers continuous immediate disclosure of competitive price quotes in real time,

allowing the market to be more transparent. Trading is carried out at the best market price on a "first-in, first-out" (FIFO) basis.

- **Market transparency:** All market participants have access to quotes as well as market depth (via certain vendors).

- **Liquidity:** Competitive bid and ask spreads resulting from a strong involvement of domestic and global users stimulate volumes. With increasing volumes and greater market depth, trades can be done in a more effective manner.

- **Margins:** Contrary to the over-the-counter marketplace, any market participant meeting established margin requirements is allowed to take part in the futures market. Furthermore, any interest earned on the deposited collateral is paid to the owner of the account held at the CDCC.

- **Central clearinghouse:** The Canadian Derivatives Clearing Corporation (CDCC) ensures market integrity and stability by matching and clearing all trades and by monitoring all open positions on a daily basis.

- **Standardized contracts:** Contrary to over-the-counter financial products, the futures contracts, through their standardization, provide uniformity allowing operational flexibility and rapid execution of positions, in a context of proactive interest rate risk management.

## Canadian Derivatives Clearing Corporation (CDCC)

The Canadian Derivatives Clearing Corporation is the issuer, clearinghouse and guarantor of interest rate, equity, currency and index derivative contracts traded on the Montréal Exchange. It also offers clearing services to other exchanges and partners. Established in 1975, the CDCC is a for-profit company owned by Bourse de Montréal Inc. The CDCC requires each member to maintain margin deposits with the clearinghouse in order to cover the market risk associated with each member's positions. The assessment of this risk is based on a set of well-defined criteria established by the clearinghouse. Margins are collected daily or more frequently during periods of market volatility.