A Study on the Lead and Lag Relationship among Taiwan Stock Index, Futures and Options Markets

Chien, Hsuan-Po
Professor of Department of Banking & Insurance
Tatung Instsitute of Commece and Technology
Taiwan, R.O.C.

I.Introduction

This paper is to reveal the current status and perspectives of Taiwan Stock Index, Futures and Options Markets. Moreover, to investigate the price discovery role among options markets with newly established spot and future markets for Taiwan stock Index. The data was measured from January 2,2004 to December 30,2005 every day. They were separated total period, the front year and the rear year. We empirically test the difference between the front year and the rear year for the sample period.

We apply Unit Root Test and Vector Auto Regression Models to examine the lead and lag relationship among these three markets. Finally, the Granger C causality Test and Forecast Error Variance Decomposition are performed in the contex of the VAR model.

The findings from this paper will help us better understand the perspectives of Taiwan Stock Index Futures and Options Markets and the price discovery role among these three markets.

II.The Current Status and Perspectives

1. The Current State of the Futures and Options Industries

With the aim of developing Taiwan as an Asia-Pacific financial center and providing market users and the public with more instruments for price risk hedging, Taiwan has actively worked to set up a domestic futures market. Firstly, the "Futures Trading Law" was promulgated in March 1997 and implemented in June of the same year. Subsequently, relevant bylaws have been continuously promulgated in order to lay a comprehensive legal and regulatory framework for the domestic futures market.

The first domestic futures exchange, the Taiwan Futures Exchange (TAIFEX), began operation on July 21, 1998, formally establishing its first futures contract, the Taiwan Stock Exchange Capitalization Weighted Index Futures (TAIEX futures). Since its 1998 launch, all trading and clearing systems have run smoothly.

As of December 31, 2003, there were 24 futures commission merchants (FCMs), 11 domestic futures dealers, 5 foreign futures commission merchants, 32 securities firms concurrently operating securities-related futures business, 21 futures advisory enterprises, 2 managed futures enterprises, and 85 introducing brokers. In order to strengthen and expand the domestic

futures market, on July 21, 1999, the Commission approved the TAIFEX's proposal to offer for trading two new futures contracts, the Taiwan Stock Exchange Electronic Sector Index Futures (TAIEX futures) and the Taiwan Stock Exchange Banking and Insurance Sector Index Futures. Following that, the Mini TAIEX Futures was launched on April 9, 2001, the Taiwan Stock Exchange Capitalization Weighted Index Options (TAIEX Options) was launched on December 24, 2001, Equity Options was launched on January 20, 2003, and TSEC Taiwan 50 Index Futures(Taiwan 50 Futures) started to trade on June 30, 2003. Together, these futures and options contracts provide market users and the public with multi-faceted price risk hedging instruments. Taiwan will continue to foster and encourage the TAIFEX in developing various product areas in the marketplace.

Since the Taiwan Future Exchange(TAIFEX) was inaugurated in 1998, the futures market has grown rapidly. The diversity of commodities in recognition by tye international participants have played a vital role for hedge and arbitrage and continued to rise to reach a higher international ranking. It also grows by an average or 160 percent a year. In July 2005, of the 123 derivatives exchanges, it rose to 18th in global ranking. There is chance available to benefits from the TAIEX Options Contract, a major product, which is the 4th comparing with the same product in the gloval ranking.

To meet the demand of the market, TAIFEX launched various futures and options contracts products in the next few years. As the years passed, the market is getting sound. Overall speaking, the development of the futures market is discussed three aspects as follows:

(1)The Rapid Growth of Trading Volume and The Large Number of Individual Investors

The total trading volume has growing from 270,000 to 40,000 contracts in less than six years contracts has risen to 240,000 contracts for up to 9 products. The business growth is 100 times than ever before. According to statistics form the Futures Industry Association (FIA), TAIFEX's ,global ranking on total trading volume rose to 20th .The trading volume of TAIEX Options (TXO) WAS ranked 4th globally after KOSPI 200 options, Dow Jones Euro STOXX 50 options contracts, and EURONEXT CAC 40 options contracts. As for the study on market trading structure, the individual investors. This finding reveals that the number of institutional investors has increased in six years after a series of measures and effort. However, there's still more room for institutional, investors participating in the TAIFEX as opposed to the individual investors. In the future, the number of foreign institutional investors will rise gradually following of new measure.

(2)The Major TRADING Volume：Index Futures and Index Options Contract products

So far, a total of 9 futures products are offered in the Taiwan Market. Out of then, TAIEX index option contracts account for most of the trading volume despite of the late entry into the market. With many advantages：such as the well-developed regulations, the tracking stock market feature, the greater leverage, and the participation with less capital, it has grown rapidly after the launch in the market. The Electronic Sector Index future and Finance Sector index future are also favored by the investors regarding the hedge plus dividends. The market for equity options is growing owing to the increase of underlying stock and well-developed related measures.

The contracts forms of Taiwan Stock Index Futures and Options are as Follows：

a.The contract Form of Taiwan Stock Index Futures

Item：Description

Underlying Index：Taiwan Stock Exchange Capitalization Weighted Stock Index (TAIEX)

Ticker Symbol：TX

Delivery Months：Spot Month, the next calendar month, and the next three quarter months

Last Trading Day：The third Wednesday of the delivery month of each contract

Trading Hours：08:45AM-1:45PM Taiwan time Monday through Friday of the regular business days of the Taiwan Stock Exchange

Contract Size：NT$200 x Index

Minimum Price Fluctuation：One index point (NT$200)

Dally Price Limit：+/- 7% of previous day's settlement price

Margin：The initial and maintenance margin levels as well as the collecting measures prescribed by the FOM to its customers shall not be less than those required by the TAIFEX. The margin levels will be adjusted and announced by the TAIFEX in accordance "the Criteria and Collecting Methods regarding the Clearing Margins"

Daily Settlement Price：The last trading price of the closing session or otherwise determined by the TAIFEX according to the trading rules.

Final Settlement Day：The first business day following the last trading day. All of the open interests after the final settlement day shall be settled on the final settlement price

Final Settlement Price：The final settlement price for each contract is computed form the first fifteen-minute volume-weighted average of each component stock's prices in the index on the final settlement

day. For those component stocks that are not traded during the beginning fifteen-minute interval on the final settlement day, their last closing prices would be applied instead

Settlement：Cash settlement

Position Limit：Combined with MTX of the contract-size adjusted

1. Individuals: 2,000 contracts;
2. Institutional investors: 4,000 contracts;
3. Institutional investors may apply for an exemption from the above limit on trading accounts for hedging purpose.
4. Exemptions are allowed for Future Proprietary Firms and mnibus accounts.

Information Vendors：Reuters: Index page:TW/FUTEX1
Bloomberg: TWSE<Index>CT[Go]
Bridge/Telerate:TW@FITX.1

b.The contract Form of Taiwan Stock Index Options

Item：Description

Underlying Index：Taiwan Stock Exchange Capitalization Weighted Stock Index (TAIEX)

Ticker Symbol：TXO

Exercise Style：NT$50(per index point)

Expiration Months：Spot Month, the next two calendar months followed by two additional months from the March quarterly Cycle (March, June, September, and December)Strike price below 3000 points; 50 index points in spot month and the next two calendar months, 100 index points in the two quarter-months Strike price between 3000 and 8000 points; 100 index points in spot month and the next two calendar months, 200 index points in the two quarter-months Strike Price Interval：Strike price between 8000 and 12000 points; 200 index points in spot month and the nest two calendar months, 400 index points in the two quarter-months. Strike price below 12000 points; 400 index points in spot month and the next two calendar months, 800 index points in the two quarter-months. When listing series of new expiration months, one series with at-the-money strike price is listed based on the previous day's closing price of the underlying index rounded down to the nearest multiples of strike price interval, and

Strike (Exercise) Price：1. For the spot month and the next two calendar months; five

in-the-money series and five out-of-the-money series are listed.

2. For the next two quarter-months; three in-the-money series and three out-of-the-money series are listed.

Up to the 5th business days before expiration,

1.For the spot month and the next two calendar months; additional series are added to maintain at least 5 in- and 5 out-of-the-money strike prices.

2. For the next two quarter-months; additional series are added to maintain at least 3 in-and 3 out-of the-money strike prices.

Premium Quotation：<10 points;0.1 point（NT$5）
>=10 points,<50 points; 0.5 point (NT$25)
>=50 points,<500 points; 1 point (NT$50)
>=500 points,<1,000 points; 5 point (NT$250)
>=1,000 points,<10 points(NT$500)

Daily Price Limit：+/- 7% of previous day's closing price of the underlying index

Position Limit：Individuals:8,000contracts on either side of the market.
Institutional investors; 16,000 contracts on either side of the market.
Institutional investors may apply for an exemption from the above limit on trading accounts for hedging purpose.
Exemptions are allowed for Future Proprietary Firms and on bus accounts.

Trading Hours：08:45AM-1:45PM Taiwan time Monday through Friday of the regular Taiwan Stock Exchange business days.

Last Trading Day：The third Wednesday of the delivery month
Expiration Date：The first business day following the last trading day.

Final Settlement Price：The final settlement price for each contract is computed from the first fifteen-minute volume-weighted average of each component stocks prices in that index on the final settlement day. For those component stocks that are not traded during the veginning fifteen -minute interval on the final settlement day, their last closing prices would be applied instead.

Settlement：Cash settlement. An option that is in-the-money and has not been liquidated or exercised on the expiration day shall, in the absence of contrary instructions delivered to the Exchange by the Clearing Member representing the option buyer, be exercised automatically.

(3)The Growing Market for Interest-Rate Future

For years, the development of bonda market has been under the unbalanced status. The banking industru and insurance industry share the large trading in the primary market. Furthermore, the inactive trading in the sub-market resulted in forming e ffectively yield curve. That affected the trading on the related interest-rate products. Since 1999, the TAIFEX has started to do the related research and cooperated with the authorities to promote the structure of Bond Yield Curve. Just then, Because of the regular government bond issuance, the establishments of the bonds lending center and of the major government bonds brokerage systems, the considerable market scale, and the greater demand for hedge, the TAIFEX debuted the first interest-rate futures product Government Bond Future in 2004. The short-term or long-term interest-rate futures products are significantly growing for the present. The average daily trading volume for short-term interest-rate future isup to over 2,000 contracts. In contrast, the average daily trading volume for the government bonds futures is only over 300 contracts. However, the bonds mrket and the trading volume for the interest-rate futures products will expand with the participation of more investors.

2. The Perspectives of the Futures and Options Industries

For the sound development of the futures market, the Commission will continue to amend related regulations and rules applying to juridical persons who participate in the futures market, direct the TAIFEX totimely develop new products, enact the rules regulating futres esrvic enterprises and reinforce the risk-control mechanisms and self-disciplinary functions in place.

a. Major Accomplishments of 2003

(1) Allowing the establishment of futures service businesses

In an effort to invigorate the futures market, after lifting the ban on futures advisory and Managed futures enterprises on Novermber 8, 2002, Taiwan promulgated 11 managed futures enterprise related rules and regulations, and supervised the Taipei Future Association and TAIFEX in setting up the related regulations, which is conducive to the healthy development of the futures market.

(2) Approved additional institutional traders for futures market participation

With respect to both enlarging and internationalizing the domestic futures market,Taiwan Taiwan allowed securities dealers, qualified foreign institutional investors (QFlls), overseas Chinese, foreigners and securities investment trust companies to trade TAIREX’s futures contracts for price risk management.

(3) Introduced new products to the market

①Taiwan has directed the Taiwan Futures Exchange to develop equity options. On January 20, 2003, 5 single stock options were listed. The equity options were the first non-index and physical delivery products.

②Taiwan has directed the Taiwan Futures Exchange to launch the Taiwan 50 Futures on June 30. 2003. 5 . The Taiwan 50 Futures is based on the TSEC Taiwan 50 index, which is the first composite index withselected stocks. As the top 50 stocks on the TSEC are selected by market capitalization to become index constituents, the Taiwan 50 Futures provides better efficiency for hedge and trading strategies.

③Taiwan has directed the Taiwan Futures Exchange to develop interest rate futures, the first product beyond the scope of the current stock based product line. On January 2, 2004, the Taiwan Futures Exchange 10-year Government Bond Futures (TAIFEX GBF) was listed.

(4) Supervised the Taiwan Futures Exchange in promoting FCMs who accept orders over the Internet in order to implement the Internet authentication mechanism.

The Taiwan Futures Exchange in Febru- IV. REGULATION OF THE FUTURES INDUSTRY ary 2004 to amend article 48 of its Operating Rules, so that from August, 2004, FCMs who accept orders through the Internet should implement the Internet authentication mechanism. That is, transmission of futures trading order consignments, order confirmations, trade confirmations, and other electronic documents between a futures commission merchant and a client employing an IC card, the Internet, or other mode of electronic trading shall carry an electronic signature issued by a certified authority for identification and verification.

(5)Promoted futures market surveillance

In order to maintain fairness in the market and prohibit illegal trading, the Taiwan has directed the Taiwan Futures Exchange to develop as integrated mechanism for futuresmarket surveillance,promulgate or amend the relevant regulations, andset uprelated information systems.

(6) Allowed FCMs to participate in securities lending transactions

In order to promote the liquidity of equity options and increase hedging channels for market makers, on October 3, 2003, Taiwan allowed equity options market makers to open another securities transaction account to engage in underlying securities transactions for hedging and

lending purposes. On the other hand, in order to increase the revenues of FCMs by lending securities, and satisfy the need for strategic transactions, on December 9, 2003, Taiwan allowed domestic FCMs to participate in securities lending transactions on the Taiwan Stock Exchange and Gre Tai Securities Market.

(7) Authorized additional foreign futures exchanges and futures contracts

Under and pursuant to Article 5 of the "Futures Trading Law", the futures consignments that a futures commission merchant may undertake shall be confined to those futures and options contracts and exchanges authorized by the competent authority.

(8) Promulgated and amended futures related rules and regulations

For the listing of equity options and government bond futures, in order to attract more participants into our market and promote the liquidity of the market, Taiwan amended the "Rules Governing the Establishment Criteria of Futures Commission Merchants" and the "Regulations Governing Futures Commission Merchants " in January and December 2003. And, to coordinate the amendment of SFAS (Statement of Financial Accounting Statement) No.1 "The Framework of Financial Accounting Concepts and the Presentation of Financial Statements" , Taiwan amended the "Futures Commission Merchants' Financial Report Preparation Requirements" in March 2003. The Commission also set the qualifications for a general manager of an FCM and the responsible person of a foreign FCM's branch within the ROC, Taiwan amended the "Rules Governing Responsible Persons and Associated Persons of Futures Commission Merchants" in July 2003.

(9) Cultivation of additional futures trading specialists

In order to cultivate more futures market specialists, Taiwan has continued to entrust the Securities & Futures Institute with administering the examination of Associated Persons (APs). Taiwan has continued to entrust the Taipei Futures Association and the Securities & Futures Institute with the pre-job training and on-the-job training of associated personnel.

(10) Promulgated the "Rules Governing the Futures Association"

In order to strengthen the supervision and management of the Futures Association in organization, finance, operation, and personnel, and develop sound and effective self-disciplinary schemes,Taiwann promulgated the "Rules Governing the Futures Association " in November, 2003.

b.Major Ongoing Policies

The quota limit for the advantage from the bull and bear market is impeding the participation for general foreign institutional investors and individual investors. Although this, hedge purpose is must for the current foreign investors engaged in Taiwan futures exchange. The TAIFEX plans to open for the foreign investors including oversea Chinese, and foreign institutional investors and individual investors in Taiwan and worldwide in the hopes to attract more diverse market participants and to enlarge the market scale as well. TAIFEX concurrently introduced non-hedging purpose trading and omnibus accounts together with the launch the new products. This crucial plans to enlarge the market scale effectively and promote the Taiwan market more internationally.

In addition, the TAIFEX plans to offer diverse US-dollar dominated products for domestic or international investors. The products are traded for the initial planning: Gold Future, Index Future and option contracts. Of the products, Gold Future is the first product that the TAIFEX introduced.

It is designed as cash settlement with the final settlement price based on the Limited. It aims to meet the demand of investors toward the precious metals. It also provides a way for hedge. With the experience of the success to introduction for the index future and options, the TAIFEX plans to launch the US-dollar dominated index future and options products. It offers the greater convenience for the foreign investors to participate in this market.

The market will prospect in the future to come after the introduction of more new financial instruments and the lifting of the trading restrictions, and with the active promotion by brokerages and theparticipation in this market from growing investors.

The major ongoing policies are as follows:

(1)Continuing to supervise the TAIFEX in developing additional new products, such as interest rate futures and options, DRAM futures, and other new stock price index futures etc, to meet traders' demands.

(2)Continuing to call upon the TAIFEX to globally promote the domestic futures market, sign Memorandums of Understanding (MOU) with other international futures exchanges, and consider the possibility of allowing foreign FCMs as well as futures service enterprises to participate in the domestic futures market, in order that the domestic futures market will evolve into a global futures market.

(3)Instructing the Taipei Futures Association to restructure itself as a nationwide futures association and develop sound and effective selfdisciplinary schemes.

(4)Finally, continuing to direct the Taipei Futures Association and the TAIFEX to promote information about rights protection and the techniques of futures trading to traders and

the general public. Equally important, the Commission continues to entrust the Taipei Futures Association and the Securities & Futures Institute with pre-job and on-the-job training of associated personnel.

c.The Prospectives for the TAIFEX

The domestic spot market has developed far earlier than futures market. In addition, the spot market has developed into the stable phase as opposed to the growing phase for the futures market, The risk is much greater for the futures products owing to the futures market volatility and the trading on margin. That's the reason why the futures market attracts theinvestors. The prospects for the Taiwan futures and options markets are analyzed as follows"

(1)Innovative Products and Supervision Challenges

Like the financial innovations, the constant introductions of the new derivatives result from the futures and options products innovations. However, the more diverse and complicated products they are, the more difficult supervision it is. Under this situation, supervisors not only need to better understand the features of the market, They have to prevent from wrongdoing and further make the improvements on the related supervision systems effectively through the front of the policy.

(2)The Importance of Product Risk Management and Control

Owing to the greater volatility for the futures products, the market participants who lack the knowledge of the product risk will exposure themselves to the high risk In addition, the features of innovative products are getting complicated, so the adjustment and innovation for the operation and management process is crucial not for the futures market but also the institutional investors. Absolutely, The research on the risk management system for the innovative products is the pivotal point for promoting the development of the market. Thus the demand for the professionals on risk management applied with mathematic model and the related experience has been much greater than ever before.

(3)The Diverse Products and the Importance of Promotion & Education

For the futures brokerages of future exchange, the promotion and education model should be innovative and simple for the introduction of the complicated products. Definitely, it is must to recruit more diverse professionals to this market. To provide the current and potential participants with full and accurate trading concepts, it is important

to conduct the professional and marketing structure.

In recent years, with the financial liberalization and internationalization, the government is opening the market at a comparable pace. In terms of the innovations on finance theory, information technology, and risk management concept, we can foresee the futures market will expand rapidly. With the forward-looking insight, the authorities or market participants in Taiwan have no choice but follow the trend of internationalization and globalization to create a win-situation for the futures market.

III: The Empirical Evidence for the Price Discovery Role Among Taiwan Stock Index, Future, and Options Markets

1. Unit Root Test

First of all, we conduct the stationary test for the variables: Spot, Futures, Call Options, and Put Options. The Augmented Dickey-Fuller (ADF) unit root test, statistics and critical value are used. In Table 1, the result reveals that the initial series of Spot and Futures support that null hypothesis is accepted at 1% significant level, which means unit root exists. However, the initial series of Call Options and Put Options reject unit root at 1% significant level, which means the time series are stationary. Thus, we change all the variables into return of closing price for unit root test. In Table 2, the result reveals that all the sample markets in any research period support that null hypothesis is rejected at 1% significant level, which means unit root doesn't exist. That is, the return of closing price for Spot, Futures, Call Options, and Put Options are stationary. In terms of the model of the optimal period lag, we use SBC selection criteria.

Table 1 Unit Root Test : Spot , Futures, Call Options, and Put Options

Entire Research Pariod Data	ADF	Period Lag	Critical value (1%)
Spot	-0.966482	1	-3.9847
Futures	-1.14074	1	-3.9847
Call options	-11.33898	1	-3.9847
Put Options	-11.32954	1	-3.9847

Table 2 Unit Root Test : The Rate of Return of Spot, Futures, Call Options, and Put Options

Panel A Entire peniod Daily Data			
Return of Spot	-19.12826	1	-3.9848
Return of Futures	-20.85107	1	-3.9848
Return of Call Options	-14.2539	3	-3.9849
Return of Put Options	-14.50263	3	-3.9849
Panel B 2004 Daily Data			
Return of Spot	-14.55008	1	-3.9997
Return of Futures	-24.22062	1	-3.9996
Return of Call Options	-14.63407	1	-3.9996
Return of Put Options	-16.19169	1	-3.9996
Panel C 2005 Daily Data			
Return of Spot	-17.00701	1	-4.0165
Return of Futures	-12.93402	1	-4.0165
Return of Call Options	-11.74007	1	-4.0165
Return of Put Options	-18.66933	1	-4.0165

2.Vector Auto Regression Model Estimation

We use VAR model estimation to explore the dynamic relationship among four variables: Spot, Futures, Call Options, and Put Options. As for the model of the optimal period lag, we use SBC selection criteria.

Table 3 VAR Model Empirical Results for The Returns of Futures, Spot, Call Options, and Put Options during the Entire Research Period

Dependent Variavless / Inedpendex vawatle	Peturn of Futures	Peturn of spot	Return of Calloptions	Peturn of put Options
Return of Futures(-1)	-0.203267	0.342045	-1.355131	-12.03270
	[-1.30894]	[2.45521]*	[-0.28920]	[-2.48138]*
Return of Futures(-2)	-0.123668	0.157760	5.260298	-6.622564
	[-0.70150]	[0.99751]	[0.98889]	[-1.20302]
Return of Futures(-3)	-0.170682	0.036956	-0.487730	-5.494144
	[-1.09335]	[0.26388]	[-0.10354]	[-1.12706]
Return of Spot(-1)	0.182761	-0.3239910	-1.589219	12.33196
	[1.10619]	[-2.18590]*	[-0.31879]	[2.39032]
Return of Spot(-2)	0.145748	-0.105643	-6.604299	9.111227
	[0.79820]	[-0.64492]	[-1.19869]	[1.59796]

Return of Spot(-3)	0.218464	0.012031	0.093685	4.3799797
	[1.35747]	[0.08333]	[0.01929]	[0.87153]
Return of Call Option(-1)	0.001473	0.001582	-0.464601	0.243750
	[0.75976]	[0.90914]	[-7.94062]*	[4.02556]*
Return of Call Option(-2)	0.001736	0.002919	-0.205781	0.303003
	[0.79598]	[1.48659]	[-3.11600]*	[4.43351]*
Return of Call Option(-3)	-0.000206	0.000773	-0.153929	0.140957
	[-0.10559]	[0.44092]	[-2.61030]*	[2.30974]*
Return of Put Option(-1)	-0.000732	-0.000632	0.140075	-0.497457
	[-0.37536]	[-0.36130]	[2.38039]*	[-8.16869]*
Return of Put Option(-2)	-0.001668	-0.002371	0.005429	-0.464060
	[-0.80423]	[-1.27396]	[0.08673]*	[-7.16378]*
Return of Put Option(-3)	-0.002542	-0.003067	-0.024327	-0.215656
	[-1.32354]	[-1.78056]	[-0.41984]	[-3.59642]*
Costant	-0.002542	-0.003067	-0.024327	-0.215656
	[-1.32354]	[-1.78056]	[-0.41984]	[-3.59642]*

Remark：T-value; *: 5% significant level.

In Table 3, of daily data from the entire research period, the optimal period lag is 3. First, Futures in comparison with the others posses the price-leading function because they seem not affected by the Futures past value, and each single lag of Spot, Call Options, and Put Options. Second, Spot is affected by Futures one lag and its own one lag. As for Call Options, they seem affected by their own one, two, three lags, and one lag of Put Options. Hence, Call Options seem correlated with their own three lags of series. Finally, Put Options seem affected by one lag of Futures, one lag of Spot, three lags of Call Options, and their own three lags. The results for the entire research period are as follows:(1)Futures leads Spot; (2) Spot leads Call Options; and (3) there is a two-way relationship between Call ptions and Put Options. That is, future market plays the key role in the price-discovery function.

Table 4 The VAR Model Empirical Results for the Returns of Futures, Spot, Call Options, Put Options In 2004

Dependent Variavless / Inedpendex vawatle	Peturn of Futures	Peturn of spot	Return of Calloptions	Peturn of put Options
Return of Futures(-1)	-0.203267	0.342045	-1.355131	-12.03270
	[-1.30894]	[2.45521]*	[-0.28920]	[-2.48138]*
Return of Futures(-2)	-0.123668	0.157760	5.260298	-6.622564
	[-0.70150]	[0.99751]	[0.98889]	[-1.20302]

Return of Futures(-3)	-0.170682	0.036956	-0.487730	-5.494144
	[-1.09335]	[0.26388]	[-0.10354]	[-1.12706]
Return of Spot(-1)	0.182761	-0.3239910	-1.589219	12.33196
	[1.10619]	[-2.18590]*	[-0.31879]	[2.39032]
Return of Spot(-2)	0.145748	-0.105643	-6.604299	9.111227
	[0.79820]	[-0.64492]	[-1.19869]	[1.59796]
Return of Spot(-3)	0.218464	0.012031	0.093685	4.3799797
	[1.35747]	[0.08333]	[0.01929]	[0.87153]
Return of Call Option(-1)	0.001473	0.001582	-0.464601	0.243750
	[0.75976]	[0.90914]	[-7.94062]*	[4.02556]*
Return of Call Option(-2)	0.001736	0.002919	-0.205781	0.303003
	[0.79598]	[1.48659]	[-3.11600]*	[4.43351]*
Return of Call Option(-3)	-0.000206	0.000773	-0.153929	0.140957
	[-0.10559]	[0.44092]	[-2.61030]*	[2.30974]*
Return of Put Option(-1)	-0.000732	-0.000632	0.140075	-0.497457
	[-0.37536]	[-0.36130]	[2.38039]*	[-8.16869]*
Return of Put Option(-2)	-0.001668	-0.002371	0.005429	-0.464060
	[-0.80423]	[-1.27396]	[0.08673]*	[-7.16378]*
Return of Put Option(-3)	-0.002542	-0.003067	-0.024327	-0.215656
	[-1.32354]	[-1.78056]	[-0.41984]	[-3.59642]*
Costant	-0.002542	-0.003067	-0.024327	-0.215656
	[-1.32354]	[-1.78056]	[-0.41984]	[-3.59642]*

Remark：T-value; *: 5% significant level.

In Table 4, of daily data from the research period in 2004, the optimal lag is 2. First, there is no significance that Futures seem affected by Futures past value, and each single lag of Spot, Call Option, and Put Options. Second, there is no significance that Spot seems affected by Futures, Spot past value, Call Options, and Put Options in every lag. In terms of Call Options, they seem affected by their own one, two lags, and one lag of Put Options. Furthermore, Put Options may be affected by one lag of Call Options, and its own one, and two lags as well. In terms of Call Options and Put Options in 2003, they seem affect to each other and exist two-way interactive relationship.

Table 5 The VAR Model Empirical Results for the Returns of Futures, Spot, Call Options, Put Options In 2005

Dependent Variavless / Inedpendex vawatle	Peturn of Futures	Peturn of spot	Return of Calloptions	Peturn of put Options
Return of Futures(-1)	-0.203267	0.342045	-1.355131	-12.03270
	[-1.30894]	[2.45521]*	[-0.28920]	[-2.48138]*
Return of Futures(-2)	-0.123668	0.157760	5.260298	-6.622564
	[-0.70150]	[0.99751]	[0.98889]	[-1.20302]
Return of Futures(-3)	-0.170682	0.036956	-0.487730	-5.494144
	[-1.09335]	[0.26388]	[-0.10354]	[-1.12706]
Return of Spot(-1)	0.182761	-0.3239910	-1.589219	12.33196
	[1.10619]	[-2.18590]*	[-0.31879]	[2.39032]
Return of Spot(-2)	0.145748	-0.105643	-6.604299	9.111227
	[0.79820]	[-0.64492]	[-1.19869]	[1.59796]
Return of Spot(-3)	0.218464	0.012031	0.093685	4.3799797
	[1.35747]	[0.08333]	[0.01929]	[0.87153]
Return of Call Option(-1)	0.001473	0.001582	-0.464601	0.243750
	[0.75976]	[0.90914]	[-7.94062]*	[4.02556]*
Return of Call Option(-2)	0.001736	0.002919	-0.205781	0.303003
	[0.79598]	[1.48659]	[-3.11600]*	[4.43351]*
Return of Call Option(-3)	-0.000206	0.000773	-0.153929	0.140957
	[-0.10559]	[0.44092]	[-2.61030]*	[2.30974]*
Return of Put Option(-1)	-0.000732	-0.000632	0.140075	-0.497457
	[-0.37536]	[-0.36130]	[2.38039]*	[-8.16869]*
Return of Put Option(-2)	-0.001668	-0.002371	0.005429	-0.464060
	[-0.80423]	[-1.27396]	[0.08673]*	[-7.16378]*
Return of Put Option(-3)	-0.002542	-0.003067	-0.024327	-0.215656
	[-1.32354]	[-1.78056]	[-0.41984]	[-3.59642]*
Costant	-0.002542	-0.003067	-0.024327	-0.215656
	[-1.32354]	[-1.78056]	[-0.41984]	[-3.59642]*

Remark：T-value; *: 5% significant level.

In Table 5, of daily data from the research period in 2005, the optimal period lag is 2. First, there is no significance that Futures seem affected by Futures past value, Spot, Call Options, and Put Options. Second, Spot seems affected by one, and two lags of Futures, and its own one lag. As for Call Options, they may be affected by their own one lag. Finally, Put Options seem affected by one, and two lags of Spot, one lag of Call Options, and their own

one, and two lags. In 2005, Put Options seem mainly affected by Spot and Call Options while Spot seems affected by Futures. In generally, Futures remain the key role in price discovery function. The options market lags behind compared with the future market. The possible reason is that the market is not well-developed owing to the relatively shorter establishment time.

3. Forecast Error Variance Decomposition

(1)The Entire Period:

Above of all, we examine that what markets may explain the future market variance. Basically, the other markets are not the effect variables for the future market. In other words, Futures may only be explained by its own variance. Approximately, 85% of the spot market may be explained by the impact of the future market while its own past impact account for 14%. Thus, the spot market seems mainly affected by the future market. Approximately, 88% of Call Options variance is explained by its own impact while the spot market may account for 3%, and the Put Options may account for 2%. Therefore, the call options market may seem affected by Futures, Spot, and Put Options at the same time. Finally, 68% of the put options market variance may be explained by itself while the call options market impact accounts for 17%. The spot market and future market account for 6% respectively. Thus, put options may be affected by the call options, spot, and future markets at the same time.

Overall speaking, the results of variance analysis suggest that the future market is the least affected by the other markets. Therefore, the future market is the key factor to the price discovery. In contrast, the options market still lags behind.

(2)The Research Period in 2004:

First, the future market is mainly explained by itself. About 94% of the variation caused by the spot market may be explained by the impact of the future market while its own impact accounts for only 5%. Therefore, the spot market seems mainly affected by the future market. About 85% of the call options market may be explained by its own impact while the future market accounts for 5% of the impact, and the put options market may account for 6% of the impact. Thus, it suggests that Call Options are still affected by Futures and Put Options. Finally, abut 70% of the variation caused by Put Options may be explained by its own impact while Call Options may account for 22%. Futures and Spot may affect Put Options at the same time. Therefore, Put Options may be affected by the call options, the spot, and the future markets.

(3)The Research Period in 2005

Similarly, Futures may only be explained by its own variation. Still, Spot seems mainly affected by the future market. The impact of call options market itself may account for about 83% while Futures and Spot account for about 9% respectively. Therefore, Call Options may be affected by the future and the spot markets. Finally, about 62% of the

variation caused by the put options market may be explained by its own impact. In addition, Call Options, Futures, and Spot may affect Put Options. Overall speaking, Futures play the crucial role in the price-discovery. The options market plays the lagged role in the price discovery. Also, Put Options lag behind Call Options.

Ⅳ.Conclnsion Remarks

1.The Current State of the Futvres and Options Industry. The development of the futures and option are discussed from three asjsects as follows:

(1)The repid growth of trading volume and the large number of individual investors.

(2)The major trading volume:Stook Index Futures and Stock Index options Contract products.

(3)The growing market for Interest-Rate Futures.

2.The Perspects for the Futures and Options Industries analysed as follows:

(1)Innovative products and Supervision challenges.

(2)The Importance of Product Rise Management and Control.

(3)The Diverse Products and the Importance of Promotion & Education.

3.The price Discovery Role among Taiwan Stock Index. Futures and Options Markets.

The empirical results are as follows

(1)Taiwan stock index futures leads spot, spot leads call option, call option leads put option in the total periods, Means that the future markets price discovery.

(2)Contemporaneous relationship exists between call option and put option in the front year.

(3)The put option is affected by spot and call option. The spot is affected by the futures market in the rear year.

(4)Compared the front year with the rear year thought the option market got more mature than before, but it was still not play the master rote of price discovery.

The future market leads spot, spot leads call option and call option leads put option in conclusion.

References：

1.Abhyankar, A. H., (1995), “Rcturn and Volatility Dynamics in the FTSE100 Stock Index and Stock Index Futures Markets,” The Joural of Futures Markets, Vol. 15, NO. 4,pp. 457-488.

2.Booth, G. G., R. W. So. And Y. Tse. “Price Discovery in the German Equity Index Derivatives Markets,” The Journal of Futures Markets, 19, 6(1999), pp619-643

3.Chu, Q. C., W. G. Hsich, and Y. Tse. “Price discovery on the S&P 500 Index Markets: An Analys is of Spot Index Futures, and SPDRs,” Inernational Rcview of Financial Analysis, 8, 1 (1999), pp21-34

4.Chiang, R, and W. Fong, (2001), “Relative Informational Efficiency of Cash, Futures, and Options Markets: The Case of an Emerging Market,” Journal of Banking & Finance. Vol, 25, pp.355-375

5.Enders, W., Applied Econometric Time Series, 1995. pp257
6.Fleming, J., B. Ostdick and R. E. Whaley, (1996), “Trading Costs and The Rclative Ractes of Price Discovery in Stock, Futures, and Option Markets,” Journal of Futures Markets, Vol. 16, NO.4, pp.353-387
7.Gonzalo, J., and C. GRANGER, “Estimation of Common Long Memory Components in Cointegrated Systems, “ Journal of Business & Economic Statistics, 13, l (1995), pp27-35
8.Gwilym, O. A, and M. Buckle, (2001), “The Lcad-Lag Relationship between the FTSE100 Stock Index and its Derivative contracts,”Applied Financial Economics, Vol. 11, pp.385-393
9.Iihara, Y., K. Kato and T. Tokunaga, (1996), “Intraday Rcturn Dynamics between the Cash and the Futures Markets in Japan,” Journal of Futures Markets, Vol. 16, No. 2, pp.147-162
10.Kim, M., A. C. Szakmary, and T. V. Schwarz, “Trading Costs and Price Diacovery across Stock Index Futures and Cash Markets,” The Journal of Futures Markets, 19, 4 (1999), pp.475-498.
11.Kurov, A.A., and D.J. Lasser. ”The Effect of The Introduction of Cubes on The NASDAQ-100 Index Spot-Futures Pricing Relationship,” The Journal of Futures Markets, 22,3 (2002), pp.197-218.
12.O’Conner, M.L. “The Cross-Sectional Relationship between Trading Costs and Lead/Lag Effects in Stock & Option Markets, “The Financial Review, 34 (1999), pp.95-118
13.Schwarz, T.V., and A.C. Szakmary, “Price Discovery in Petroleum Markets: Arbitrage, Cointegration, and the Time Interval of Analysis,” The Journal of Futures Markets, 14,2,(1994), pp.147-167.
14.Shih, I.C. and Y.C. Huang(2005),”The Study of Lead and Lag Relationship among Taiwan Stock Index, Futures and Options Markets,” Department of Finance National Kawshung 1st University of Technology. pp3-52
15.Tse, Y. “ International linkages in Euromark Futures Markets:
16.Tse, Y. “Price Discovery and Volatility Spillovers in the DJIA index and Futures Markets,” The Journal of Furures Markets, 19, 8 (199), pp.911-930.
17.Roopc, M,. and R. Zurbruegg. “The Intra-day Price Discovery Proccss between. The Singapore Exchange and Taiwan Futures Exchange,” The Journal of Futures Markets, 22, 3 (2002), pp.219-240.