INDEX PARTICIPATION UNITS AND THE PERFORMANCE OF INDEX FUTURES MARKETS: EVIDENCE FROM THE TORONTO 35 INDEX PARTICIPATION UNITS MARKET

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The enhanced participation of institutional investors in equity markets has increased the popularity of "basket trading." A basket is simply a portfolio of stocks that moves with general market trends. Buying and selling baskets of stocks can be expensive in terms of both the time and cost to execute all the trades for each individual holding. In response to the need for a simple product that enables all investors, large and small, to easily and quickly participate in the Canadian market, the Toronto Stock Exchange (TSE) in March 1990 developed Toronto 35 Index Participation units, also known as TIPs. Each TIPs unit represents

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an interest in a trust that holds baskets of the stocks in the Toronto 35 Index. Thus, they are backed by the underlying stocks and the shares are redeemable for the underyling stocks at any time.[1]

From the inception, TIPs have attracted significant trading volume, and have been deemed a great marketing success by the TSE. Currently the TIPs enjoy the status of being one of the most actively traded shares on the TSE. The substantial demand for TIPs can be attributed to several features that make TIPs an easy tool to track the market movement while avoiding the costs associated with similar products on the market index. Index mutual funds may not have complete freedom of trading and can impose management fees. Index futures, which do not include dividends of the underlying shares[2] are subject to margin requirement, marking to market, and inaccurate tracking of current market movements. Finally, index options require constant rebalancing to track the movement of underlying index because the hedge ratio changes constantly as the level of the index changes.

The purpose of this article is to examine the effects of TIPs trading on the index derivatives market, more specifically on the trading and pricing efficiency of index futures contracts. Some plausible implications of TIPs on the index futures and options markets are discussed in the next section. In the second section, the trading volumes of futures after the introduction of TIPs are analyzed and the third provides results on the pricing efficiency of index futures contracts.

IMPLICATIONS OF TIPs ON INDEX DERIVATIVE MARKETS

If participation units provide more diverse payoffs to investors than the existing securities, the capital market will be more complete. One way to observe any benefit arising from the trading of TIPs is to test the market efficiency of products based on the index. If TIPs indeed make it easy to track market movement and to arbitrage away any discrepancy between the index and the index products, trading in index futures and

[1] Investors may redeem their TIPs if they hold a minimum (or multiples) of the prescribed number of TIPs. The prescribed number, or "creation units" of TIPS is currently about 51,431 units worth approximately $1 million. If the number of units held is less than the creation units, investors can still redeem their TIPs for cash, but the cash redemption involves the fees associated with odd-lot trading. A summary of contract specifications of TIPs is given in the Appendix.

[2] TIP holders do not pay management fees. They receive dividends generated from the 35 underlying stocks. Thus, the TIPs holders miss the interest earned by the interim dividends held by the trust. Also, reinvestment of dividends in new units, possible with the conventional funds, is difficult because of TIPs' closed-end status.

options should become more active.[3] With increased activity, the index futures and options markets may exhibit more efficiency in revealing price information. This article examines only the index futures market. The options market is not considered because (1) the futures contracts are in many ways more similar to TIPs than to options, and (2) any immediate effect of the TIPs' introduction would be more apparent in the futures markets than in the options market.

The impact of TIPs trading on volume is indeterminate. The large daily trading volume of TIPs coupled with their redemption option, may generate increased trading in the underlying 35 stocks of the T35 index. However, TIPs trading may reduce the trading volume of the underlying 35 stocks if some investors are using those stocks as part of a diversified portfolio that tracks the general market movement. If the TIPs are easily used in index arbitrage, trading of index futures would increase. However, if TIPs take away the market indexing functions of index futures used in portfolio management, the presence of TIPs may reduce trading of futures. Since TIPs holders receive quarterly dividends, they are not subject to dividend uncertainty as is the case with index futures holders. TIPs do not have to be rolled over frequently as do futures. Also, they may be attractive to small investors who cannot afford the high margin requirements of futures contract trading. Finally, as studies on the relationship between the index and index futures have shown [Kawaller et al. (1987); Harris (1989)], index futures tend to lead the index in price and volume, indicating that investors with new information are more likely to use index futures than the individual stocks underlying the index as their first choice for exploiting the value of that information. With the presence of TIPs, such information trading can be shifted from futures since investors may find the fixed maturity and margin requirement associated with futures unattractive. If TIPs act as a close substitute for index futures, volume in the futures markets would decline. If TIPs create new interest in market indexing and become an easy tool for index arbitrage, volume in the futures would be expected to increase.

THE INTRODUCTION OF TIPs AND TRADING ACTIVITY IN INDEX FUTURES CONTRACTS

Whether TIPs on balance serve as a substitute product or complement index futures is assessed by examining the trading volume of index

[3]TSE officials confirm that volume has grown as dealers have increased their use of index futures and options to arbitrage/hedge TIPs and vice versa.

futures in a two-year window before and after the TIPs' introduction date in March 1990. Figure 1 shows the monthly trading volumes of T35 stocks and T35 futures, where the dotted line represents March 1990. Although the observed trading volumes do not exhibit any particular monotonically increasing or decreasing pattern, these volumes are not adjusted by other market factors which would impinge on futures trading irrespective of TIPs' trading. To account for such market factors, trading volumes are adjusted by the trading volumes of Toronto 300 Composite Stocks. For T35 stocks, the adjusted relative trading volume represents the volume of T35 stocks divided by the volume of the TSE 300 Composite Index without the T35 stocks and TIPs. This relative volume represents the activity of T35 stocks relative to other stocks in TSE 300. The volume for futures is adjusted by dividing by the same factor.

The increase in activity for futures is apparent. However, trading activity in the underlying T35 stocks does not show much change. Table I shows the results of *t*-tests for changes in the mean trading volumes for these securities. The mean difference covers two 23-month periods from April 1988 to February 1990 and from April 1990 to February 1992. Since trading activities may be subject to seasonal patterns, 23 months around March 1990 are selected, where each month of the year is represented twice and March is represented once in the period. The mean differences in the trading volumes are positive for both securities. For futures, the difference is statistically significant at the 1% level. This finding supports the conjecture that TIPs increase trading volume of index products. Since the volume of T35 stocks traded did not change after March 1990, it is evident that TIPs created a "new" opportunity for investors to engage in index arbitrage.

The T35 Index Futures market experienced a large change in activity after the introduction of TIPs.[4] In the next section, the impact of TIPs on the efficiency of this market is examined in greater depth, focusing on a possible change in the pattern of mispricing in this market.

[4]The changes in volume may be attributable to changes in prices, or price volatility. A large body of literature has documented the relationship between price volatility and volume [e.g., Tauchen and Pitts (1983); Harris (1987); and Jain and Joh (1988)]. This study standardizes the volume of index futures with respect to the volumes of other securities in the market (non-T35 stocks). This standardization procedure separates any security-specific effect on volume from the market-wide volatility effect in the aggregate stock market. To verify the market-wide effect of price volatility, the volatility of the T35 index is compared to a small stock index. The difference between the volatilities of the two indices does not change much during the testing period.

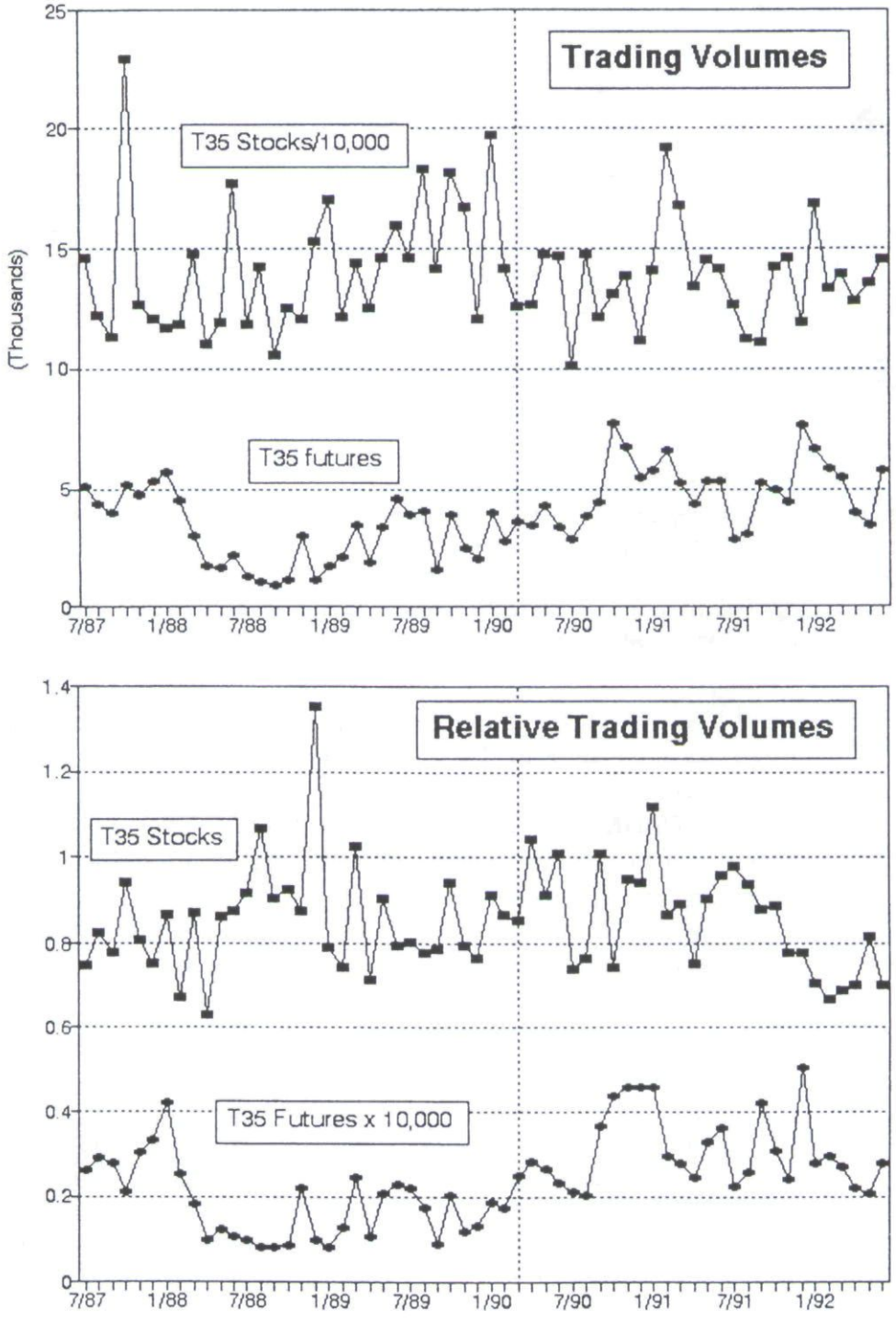

FIGURE 1
Monthly trading volume of Toronto 35 stocks and index futures: July 1987–June 1992.

TABLE I

Mean Values of Relative Monthly Trading Volumes for T35 Stocks and Index Futures: April 1988–February 1992

Security	*(a) April'88–Feb.'90*	*(b) Apri.l'90–Feb.'92*	*Mean Difference (b) − (a)*	*t-Statistic for Difference in Means*[a]
T35 stocks	0.869	0.879	0.009	0.23
T35 futures ($\times 10^{-4}$)	0.142	0.322	0.180	7.99[b]

[a]This *t*-stat tests the hypothesis that the true means of the two periods are the same. The underlying assumption here is that the variables are normally and independently distributed within each group.
[b]Statistically significant at 1% confidence level.

$$\text{Relative Trading Volume} = \frac{\text{Trading Volume of Security}}{\text{Volume of (TSE 300 Composite-T35 Stocks-TIPs)}}$$

DIFFERENCES BETWEEN THEORETICAL AND ACTUAL FUTURES PRICES

Theoretical Futures Price Based on the Cost-of-Carry Model

The theoretical price of an index futures contract is based on the level of index, financing costs, and any interim dividend received until the maturity date. Consider the investment strategy of buying the index portfolio, selling an equal amount of index futures against it, and holding the position until the futures contract expires. The hedge fixes the capital gain on the portfolio at $F_o - I_o$, and there will also be a flow of dividends over time. Since the position is effectively riskless (assuming dividend risk to be negligible), it should earn the riskless rate of interest. This yields the following theoretical equilibrium value for the futures price to prevent profitable arbitrage:

$$F_t^e = I_t e^{r(T-t)} - \sum_{\tau=t+1}^{T} D(\tau) e^{r(T-\tau)} \tag{2}$$

where T is the maturity date and the second term is the cumulative value of dividends paid, assuming reinvestment at the riskless interest rate, r, up to date T.[5]

[5]Equation (1) takes no account of marking to market of the futures, essentially treating it as a forward contract. The difference between the two contracts have been found to be rather small by Hill, Schneeweis, and Mayerson (1982) and Elton, Gruber, and Rentzler (1984). The value of the tax timing option discussed by Cornell and French (1983b) is left out because it is presumed to be in small magnitude. If the tax timing option is considered, the forward pricing model will give an upward-biased estimate for the futures price.

Cornell and French (1983a, 1983b); Modest and Sundaresan (1983); Figlewski (1984); and MacKinlay and Ramaswamy (1988) among others look at the deviation of actual U.S. index futures prices from their theoretical values. The studies on S&P 500 Index futures find minimal differences between actual and theoretical prices. When transaction costs are recognized, the observed futures prices have fluctuated within a bounded interval without giving rise to arbitrage profits most of the time. Modest and Sundaresan (1983) and Figlewski (1984) find some discrepancies between the two prices shortly after the introduction of S&P 500 Index futures but the deviations from the theoretical price have diminished over the years. From the intra-day prices, MacKinlay and Ramaswamy (1988) find that the average mispricing of index futures (actual − theoretical) is slightly positive but very small in magnitude.

Mispricing Results

Daily data on Toronto 35 index values, dividend yields of underlying T35 stocks, and closing futures prices are from by the Toronto Stock Exchange. Short-term Banker's Acceptance (BA) rates are used for the riskless rate. Daily three- and six-month BA rates are obtained from the *Financial Post* and interpolated when the number of days to futures' maturity, $T - \tau$, is between three and six months. Three-month BA rates are used if the number of days to maturity is less than three months.

The daily mispricings of Toronto 35 index futures are plotted in Figure 2. Only the nearest futures contracts are considered and rolled over to the next contract one week before expiration because the expiring contract loses most of its open interest and the mispricing becomes negligible in the final week. The mispricing, x_t, is defined as follows:

$$x_t = \frac{F_t - F_t^e}{I_t} \tag{3}$$

which is the difference between the market futures price and its theoretical futures prices, normalized by the index value. The summary statistics on the average daily mispricing are reported in Table II. MacKinlay and Ramaswamy find that "mispricing" increases on average with maturity. Therefore, the average maturities of the futures before and after March, 1990 are compared to assure that the maturities of the futures within the two periods are comparable.

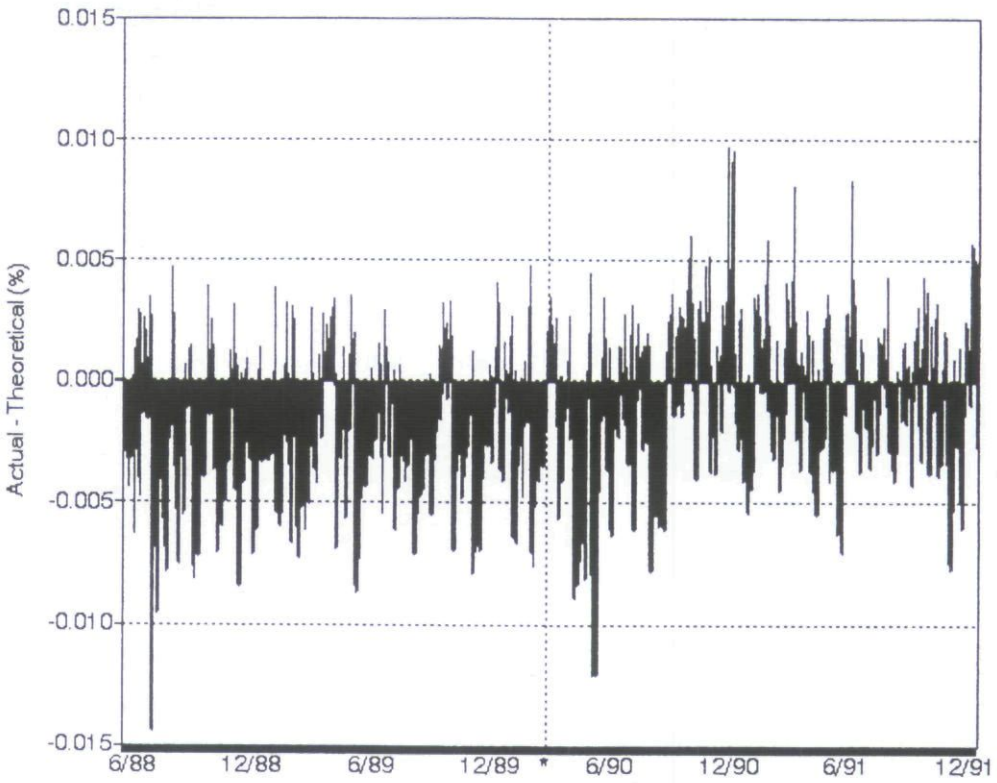

FIGURE 2
Daily mispricing (in percent of index value) of Toronto 35 index futures: June 1, 1988–December 31, 1991.

As Table II shows, the average days to maturity are not different between the first half and the second half of the testing period. However, the average daily mispricing of T35 index futures contract decreases significantly in the second half. Since elements of the mispricing series can be positive or negative, and pricing error in either direction can be costly, the absolute values of the mispricing series are computed. Table II shows that the absolute value of mispricing decreases in the second half but without significance, while the variability of mispricing does not change much. Figure 2 graphically shows the apparent decrease of mispricing in the second half. The dotted line represents March 9, 1990. The average mispricing series shows that most of the actual futures prices are below the theoretical futures prices in the first half of the testing period. In the second half, the upward bias of theoretical prices is reduced substantially but does not disappear completely.

The upward bias observed for theoretical prices is consistent with the hypothesis that the cost-of-carry model overvalues futures

TABLE II

Summary Statistics on the Differences between Actual and Theoretical Futures Price (in Percentage of Index Value) June 1, 1988–December 31, 1991

	June'88–Feb.'90	*April'90–Dec.'91*	*June'88–Dec.'91*
Number of observations	441	440	903[a]
Average mispricing	−0.21	−0.06[b]	−0.14
($\times 10^{-2}$)	(0.28)	(0.32)	(0.31)
Average absolute values of	0.28	0.25	0.27
mispricing ($\times 10^{-2}$)	(0.21)	(0.21)	(0.21)
Average days to maturity	15.16	15.16	15.21
	(9.15)	(9.12)	(9.16)

Standard deviations are in parentheses.

[a]Includes March 1990.

[b]*t*-stat for difference in means (of the first half and the second half) is significant at 5% level of significance.

price. This may be due to the tax-timing option, but the short-time period prohibits one from drawing strong conclusions. In addition, the average mispricing in absolute values for futures prices is very small in nominal terms. For instance, if T35 index level is assumed to be 200 and an index futures contract is near maturity, the arbitrageable dollar amount with 0.25% deviation from theoretical price is only \$250 ($= 200 \times 0.0025 \times 500$ multiplier). Such an amount is minuscule when one contract, with the quote price near 200, can cost \$100,000. Despite the relatively small magnitude of mispricing, it is apparent that such mispricing has been reduced after the introduction of TIPs.

Mispricing Series under GARCH Model

The pattern of mispricing shown in Figure 2 depicts a typical pattern exhibited by a series with autocorrelation and heteroskedasticity. The variance of mispricing seems to change over time and the changing variance is related to the previous level of mispricing. Such a time-varying variance can be modeled using the Generalized Autoregressive conditional Heteroskedastic (GARCH) framework of Engle (1982) and Bollerslev (1987). The GARCH process has been known to accurately fit the distributions of security and commodity price changes. If the mispricing series of index futures follow a GARCH process, examination of a structural shift in mispricing series under the GARCH distribution should provide a more rigorous test of mean differences in mispricing than the previous *t*-test that is based on the assumption of a normal distribution.

Under a GARCH(1,1) model, the mispricing at time t, x_t, and its error from the mispricing series, ϵ_t can be defined as follows:

$$x_t = \alpha_0 + \alpha_1 \mathrm{DUM}_t + \epsilon_t, \tag{4}$$

where

$$\epsilon_t \sim N(0, h_t)$$

and

$$h_t = \beta_0 + \beta_1 \epsilon_{t-1}^2 + \beta_2 h_{t-1}$$

Thus, the mispricing is assumed to hover around the value of α_0, which could be 0 but does not necessarily have to be. "DUM" is a dummy variable that takes the value of "1" after March 9, 1990, and "0" before the date. The coefficient of the dummy variable, α_1, captures any structural shift that exists after the introduction of TIPs under the time-varying variance of mispricing series.

Table III shows the results of GARCH estimation on the mispricing series. The parameter estimates are all significant except that of the previous variance term. The Likelihood Ratio (LR) test against an alternative model of constant variance shows a high level of significance. The estimate of α_0 is negative. The estimate of α_1 is positive and significant, which indicates that the negative mispricing is reduced after March 9, 1990. Since the estimates of β_2 are insignificant, eq. (3) is

TABLE III
Estimates of GARCH(1, 1) Model for Futures
Mispricing Eq. (3): June 1, 1988–December 31, 1991

α_0	α_1	β_0	β_1	β_2
−2.134E-03	1.840E-03	4.596E-06	0.447	5.527E-02
(1.310E-04)[a]	(1.929E-04)[a]	(7.270E-07)[a]	(7.200E-02)[a]	(9.240E-02)
	Log-likelihood	4845.38		
	LR test for GARCH effects ($\beta = 0$)	128.72		
	Number of observations	851		

Numbers in parentheses are asymptotic standard errors.
[a]Indicates t-stat is significant at 1% level.

run as an ARCH model with virtually identical results.[6] Thus, when the time-varying variance of mispricing series is accounted for, a significant structural shift in mispricing is found after the introduction of TIPs.

SUMMARY

This article examines the effects of TIPs trading on the index futures market in Canada. Market participants have expressed concern as to whether index participation units, which trade as shares of common stock, can attract sufficient trading volume and, if they do, whether they will take any significant volume away from similar products based on the market index, such as index futures, options, and mutual funds. Easy availability of a security that tracks the movement of a stock index can contribute to increased activity and market efficiency of other index related products. But if such a security provides a better substitute for other index products in tracking general market movements, these other index products will show reduced activity and market efficiency. Two attributes of efficiency in the Toronto 35 Index futures markets, trading volume and mispricing, are tested to observe any change after the introduction of TIPs.

When measured with respect to the volume of TSE stocks not included in the Toronto 35 index, index futures have shown an increase

[6]A similar GARCH(1,1) model is tested also for absolute values of mispricing by substituting x_t in eq. (3) with $|x_t|$. All parameters are significant and of the expected signs. The results support the conjecture that the introduction of TIPs trading reduces absolute mispricing.

$$|x_t| = \alpha_0' + \alpha_1' \mathrm{DUM}_t + \epsilon_t ,$$

$$\text{where } \epsilon_t \sim N(0, h_t)$$

$$\text{and } h_t = \beta_0' + \beta_1' \epsilon_{t-1}^2 + \beta_2' h_{t-1} . \qquad (3)'$$

The parameter estimates based on GARCH(1, 1) Model are as follows:

α_0'	α_1'	β_0'	β_1'	β_2'
2.614E-03	−4.602E-04	1.351E-06	0.300	0.391
(8.186E-05)[a]	(1.128E-04)[a]	(1.911E-07)[a]	(5.789E-02)[a]	(6.034E-02)[a]
	Log-likelihood	5177.44		
	LR test for GARCH effects ($\beta = 0$)	143.98		
	Number of observations	851		

Numbers in parentheses are asymptotic standard errors.
[a]Indicates *t*-stat is significant at 1% level.

in trading volume since the introduction of TIPs' trading. Thus, participation units seem to have enhanced the demand for index futures presumably because of the increased ease of hedging and arbitrage. Comparison of actual with theoretical index futures prices shows that the T35 index futures price has conformed to the theoretical value much better after the introduction of TIPs. When the mispricing series is fit under a GARCH model to account for time-varying variance, the reduction of mispricing is shown to be highly significant. Thus, the performance of the index futures market seems to have improved with TIPs.

Of course, these results may be caused by economic reasons other than the presence of TIPs in the market. To arrive at an irrefutable conclusion on the effects of TIPs, other factors that are attributes of market efficiency such as basis risk of futures and the bid/ask spread need to be examined. Also, a comparative study on the effects of index participation units in other markets should be of interest. In the U.S., the American Stock Exchange recently (January 1993) introduced S&P Depositary Receipts (SPDRs). These represent a share in a unit trust that tracks the movement of S&P 500 Index. Studies on the effects of the SPDRs on S&P 500 Index futures market may shed more light on the economic role of index participation units.

APPENDIX

Summary of Contract Specifications for Toronto 35 Index Participation Units (TIPs)

Ticker Symbol:	TIP
Underlying Index:	Toronto 35 Index
Trading Units:	Each TIP unit represents approximately 1/10th of the value of the Toronto 35 Index level. For example, if the Toronto 35 Index level is 185, each TIP unit would be priced at about $18.50.
Price Quotations:	Units trade in increments of $0.05.
Trading Hours:	9:30 AM–4:00 PM (Eastern)
Trading Information:	TIPs are quoted each day in the financial press.

Dividends & Distribution:	Dividends received by the trust are distributed to unit-holders quarterly in April, July, October, and December of each year.
Eligibility:	The dividends are eligible for the Canadian Dividend Tax Credit. TIP units are also eligible for Registered Retirement Savings Plans, deferred profits sharing plans, and registered retirement income funds.
Settlement:	Standard five-day settlement.
Redemption Privilege:	Investors holding a minimum of the prescribed number of TIPs may redeem their TIPs for the underlying basket of stocks at any time. The prescribed number of TIPs is currently 51,431 units, worth approximately $1 million based on stock market values at December 1992. Investors holding less than a basket of TIPs may redeem for cash based according to a sliding scale as outlined on page 6 of the TIPs Prospectus.

Source: "TIPs—Index Participation Units," The Toronto Stock Exchange, 1992.

BIBLIOGRAPHY

Bollerslev, T. (1987): "Generalized Autoregressive Conditional Heteroscedasticity," *Journal of Econometrics*, 31:307–328.

Cornell, B., and French, K. (1983a): "The Pricing of Stock Index Futures," *The Journal of Futures Markets*, 3:1–14.

Cornell, B., and French, K. (1983b): "Taxes and the Pricing of Stock Index Futures," *Journal of Finance*, 38:675–694.

Elton, E., Gruber, M., and Rentzler, J. (1984, February): "Intraday Tests of the Efficiency of the Treasury Bill Futures Market," *Review of Economics and Statistics*, 66:129–137.

Engle, R. (1982): "Autoregressive Conditional Heteroscedasticity with Estimates of Variance of United Kingdom Inflation," *Econometrica*, 50:987–1007.

Engle, R., and Bollerslev, T. (1986): "Modelling the Persistence of Conditional Variances," *Econometric Reviews*, 5:1–50.

Figlewski, S. (1984): "Hedging Performance and Basis Risk in Stock Index Futures," *Journal of Finance*, 39:657–669.

Harris, L. (1986, June): "Transaction Data Tests of the Mixture of Distributions Hypothesis," *Journal of Financial and Quantitative Analysis*, 22:127–141.

Harris, L. (1989, March): "The October 1987 S&P 500 Stock Futures Basis," *Journal of Finance*, 44:77–99.

Hill, J., Schneeweis, T., and Mayerson, R. (1982): "An Analysis of the Impact of Marking-to-Market in Hedging with Treasury Bond Futures," Paper presented at the International Research Seminar, Chicago Board of Trade.

Jain, P., and Joh, G. (1988, September): "The Dependence between Hourly Prices and Trading Volume," *Journal of Financial and Quantitative Analysis*, 23:269–283.

Kawaller, I., Koch, P., and Koch, T. (1987, December): "The Intertemporal Price Relationship between S&P 500 Futures and the S&P 500 Index," *Journal of Finance*, 5:1309–1329.

MacKinlay, A. C., and Ramaswamy, K. (1988): "Index-Futures Arbitrage and the Behavior of Stock Index Futures Prices," *The Review of Financial Studies*, 1:137–158.

Modest, D. M., and Sudaresan, M. (1983): "The Relationship between Spot and Futures Prices in Stock Index Futures Markets," *The Journal of Futures Markets*, 3:15–41.

Tauchen, G., and Pitts, M. (1983, March): "The Price Variability-Volume Relationship on Speculative Markets," *Econometrica*, 51:485–505.