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Stock Index Futures in Switzerland: Pricing and Hedging Performance

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Abstract *The pricing and hedging performance of the stock index futures contract on the Swiss Market Index (SMI) is evaluated. The empirical results show that pricing is in accordance with standard principles, allowing no arbitrage profits to be made. The contract is useful to hedge aggregate risk in the Swiss stock market.*

From the beginning of 1989 to mid-October 1989, Bank Leu made an over-the-counter market for futures contracts on a capitalization-weighted index of 24 stocks, called the Swiss Market Index (SMI). On November 9, 1990, the Swiss Options and Financial Futures Exchange (SOFFEX) started to trade SMI index futures contracts resembling those traded by Bank Leu. The SMI futures contracts are very similar to futures contracts on the S&P 500 traded on the International Money Market in Chicago. This paper evaluates the pricing and hedging performance of SMI futures, based on the experience from the over-the-counter market.

The usefulness of futures contracts to hedge changes in cash prices depends on how closely the futures price tracks the cash price. The record of SMI futures contracts is quite good in this respect, especially if one compares their performance to the performance of other index futures contracts in the months following their introduction. It is furthermore the case that an investor wanting to use SMI futures to reduce the risk of a portfolio indexed to the SMI would generally be able to reduce his risk substantially. While SMI futures are not as useful to hedge individual stocks, they perform well in hedging portfolios that comprise a small number of stocks.

The paper proceeds as follows. In Section 2, the SMI futures contract is described and compared to foreign index futures contracts. In Section 3, evidence on the relation between theoretical and actual SMI futures prices is provided. In Section 4, the hedging effectiveness of SMI futures is evaluated. Some concluding remarks are offered in Section 5.

I. Institutional Characteristics and Data

From January to October 1989, Bank Leu made an over-the-counter market in stock index futures. Contracts expiring in April and October were offered. The underlying index, the Swiss Market Index (SMI), is a value-weighted index of 24 actively traded shares of large Swiss companies from various sectors of the economy. The SMI contains only shares that can be held freely by foreign investors. Dividend payments are neglected in the construction of the index. The various shares are traded on stock exchanges in Switzerland.

During the sample period, the Swiss Options and Financial Futures Exchange (SOFFEX) offered only call and put options on the SMI. The trading of stock index futures started on November 9, 1990. As on SOFFEX, trading of the SMI futures by Bank Leu occurred from 9:30 a.m. until 15 minutes after the close of the Zurich Stock Exchange. Apparently, the market in SMI futures was not profitable for Bank Leu and the decision was made to stop trading in mid-October 1989.

The SMI futures contract is similar to stock index futures traded in other markets. The value of one contract is 25 times the index. The typical contract value during the sample period is about 45,000 Swiss francs compared to about 125,000 U.S. dollars, or about 180,000 Swiss francs, for S&P 500 futures contract. Contracts expire on the third Friday in April and October with cash settlement.

Initial and maintenance margins are each 5,000 Swiss francs per contract with gains and losses settled daily. The maintenance margin on the SMI futures contract is larger than the typical maintenance margin on index futures contracts traded in the United States. For instance, the S&P 500 contract is for 500 times the S&P 500 index and, hence, enables the investor with a long position to buy stocks for a value in excess of $100,000. Yet, for most of the existence of the S&P 500 contract, maintenance margin per Swiss franc of stock purchased has been less than half the margin for the SMI contract.

The most important difference between index futures in the United States and the SMI futures contract is with respect to transaction costs. Most of the success of index futures contracts in the United States can be explained by the low trading costs of these contracts relative to transaction costs in the cash markets. For instance, if a program trader buys 100 S&P 500 futures contracts, he is likely to pay about $1,250 in commissions. However, to buy the stocks that correspond to 100 S&P 500 futures contracts, the commissions would be at least 20 times as much. The second reason why futures trading is cheaper than trading in cash markets is that the markets for index futures are considerably more liquid than the markets for individual stocks. As a result, large futures trades have little impact on futures prices.

In Switzerland, index futures trades are also cheaper than cash market trades of the underlying index.[1] However, the difference in commissions between the two markets is much smaller than in the United States. A reasonable estimate is that, for a trade of 1,000,000 Swiss francs in the SMI index, the commissions and taxes to be paid on the cash market transaction are at least twice the commissions and taxes paid on the futures trade. In the absence of studies on the market impact of transactions in Switzerland, it is not possible to estimate differences in market impacts between futures and cash trades.[2]

Several factors contribute to the difference in transaction costs between SMI and S&P 500 futures contracts. First, the foreign futures contracts are

[1]Commissions charged by Bank Leu are 0.225 percent of contract value for banks and 0.45 percent for private investors.
[2]Reliable data on the volumes of trading in shares and futures are not available in Switzerland.

traded on organized markets in which market-makers compete for orders, whereas the SMI futures contract is traded over-the-counter with one market-maker. Second, the SMI contract is a new contract with limited liquidity compared to foreign contracts.

The data base used in the empirical investigations includes daily closing prices for the two futures contracts expiring in April and October 1989, respectively.[3] Subsequently, these contracts are denoted as the April futures and the October futures. Sample periods for both contracts start on January 23, 1989, and end on the respective expiration days, for example, April 21, 1989, and October 20, 1989. In addition, daily closing prices of the cash index as well as the necessary information about risk-free interest rates and dividends on the shares included in the SMI are collected. Euromarket interest rates on deposits denominated in Swiss francs are used, which mature as closely as possible to the expiration date of the futures. Actual dividend payments are used instead of a proxy for expected payments. Dividends are generally paid once a year in the spring and change little over time. Note further that shares trade ex-dividend on the same day as dividends are actually paid.

II. Pricing of Futures

In this section, descriptive statistics on prices and returns for the two futures contracts and for the underlying index, the SMI, are presented. The basis and pricing errors are also examined.

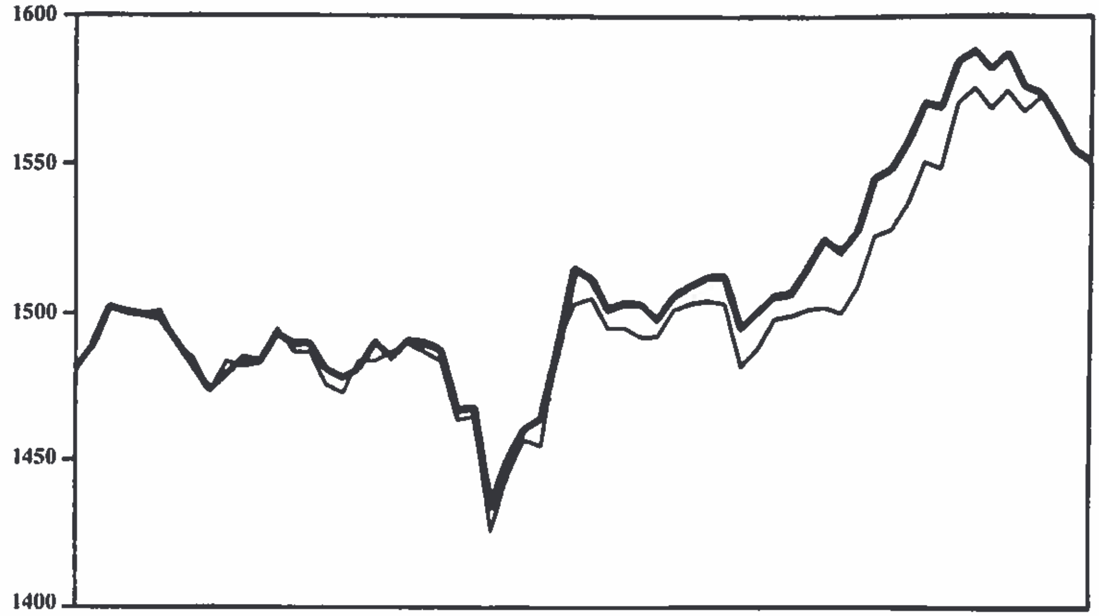
Figures 1 and 2 exhibit the evolution of prices for the April and October futures as well as the SMI. As expected, the two series move closely together. Prices for the April futures are generally below the SMI, whereas the opposite occurs for the October futures. The reason is that the relative importance of interest and dividends for the pricing of futures is different for the two contracts, as shown on the following page.

Table I contains various descriptive statistics for price levels, expressed in natural logarithms. The very high autocorrelation coefficients indicate that prices follow a random walk. Therefore, the statistics on different moments of the distribution are not meaningful and are only included for completeness.

In the second part of Table I, the same statistics are shown for returns, expressed in percent per day. Note that the returns on futures are measured as first differences in futures prices divided by the value of the SMI at the start of the return interval. This measure of returns on futures, suggested by Figlewski [1985], is also used in Section 4 where the hedging characteristics of SMI futures are evaluated.

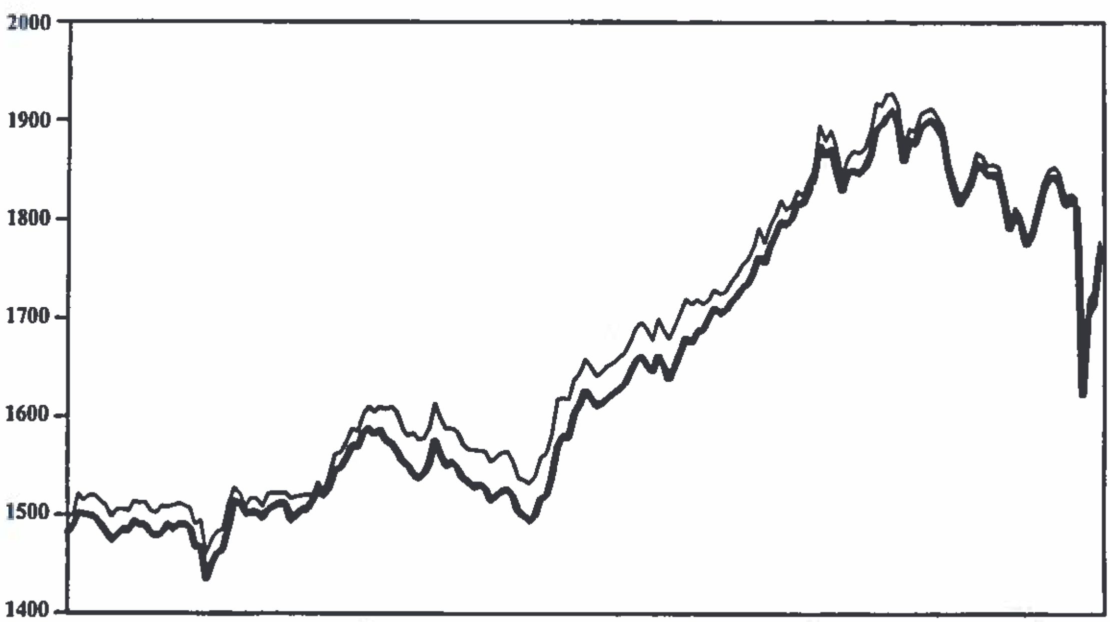
[3] Recently, some papers have been published that use either intradaily transactions data or trading volume. Such data are not available in Switzerland. This means that problems associated with nonsynchronous measurement of cash and futures prices cannot be evaluated.

Figure 1. Futures and spot prices, April 1989



January 23, 1989 - April 21, 1989
— April 1989 futures — SMI

Figure 2. Futures and spot prices, October 1989



January 23, 1989 - October 20, 1989
— October 1989 futures — SMI

Table 1. Prices and returns

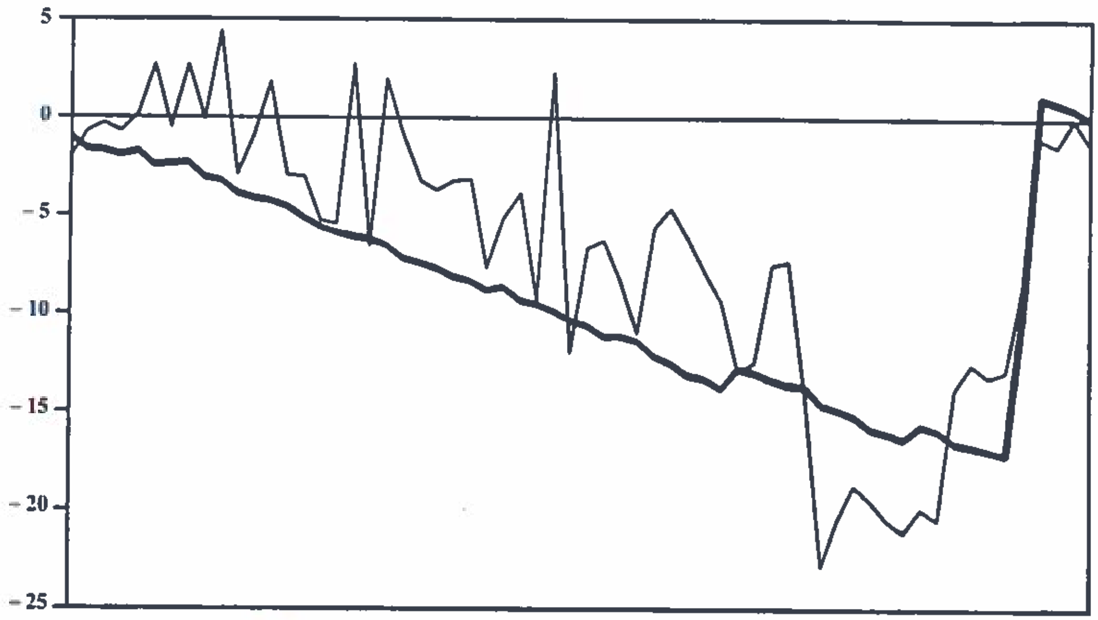
		April 1989[a]		October 1989[b]	
		SMI[c]	Futures[d]	SMI	Futures[e]
Prices[f]	Observations	62	62	187	187
	Mean	7.319	7.315	7.404	7.418
	Standard deviation	0.024	0.022	0.088	0.084
	Skewness[g]	0.645*	0.646*	0.301	0.241
	Kurtosis[h]	−0.321	0.075	−1.453*	−1.430*
	Autocorr. lag 1	0.942*	0.933*	0.986*	0.985*
	2	0.872*	0.858*	0.973*	0.972*
	3	0.792*	0.780*	0.962*	0.961*
	4	0.700*	0.684*	0.952*	0.950*
	5	0.615*	0.603*	0.944*	0.942*
	Autocorr. lags 1-10[i]	250.694*	234.943*	1643.242*	1639.237*
Returns[j]	Observations	61	61	186	186
	Mean	0.075	0.077	0.093	0.096
	Standard deviation	0.677	0.733	1.172	1.161
	Skewness	−0.456	−0.347	−4.367*	−3.369*
	Kurtosis	2.108*	3.052*	44.974*	34.833*
	Autocorr. lag 1	0.095	−0.011	−0.112	−0.150*
	2	0.117	0.116	0.050	0.048
	3	0.104	0.100	−0.051	−0.055
	4	−0.187	−0.329*	−0.010	0.010
	5	−0.310*	−0.048	−0.077	−0.078
	Autocorr. lags 1-10	11.635	10.829	10.394	13.529

[a]Daily observations from January 23 to April 21, 1989
[b]Daily observations from January 23 to October 20, 1989
[c]Swiss Market Index, consisting of 24 shares of large Swiss firms
[d]Futures contract on the SMI expiring on April 21, 1989
[e]Futures contract on the SMI expiring on October 20, 1989
[f]Natural logarithms of value of SMI and futures price per index share, respectively
[g]Third moment around the mean divided by the variance to the power of 3/2. Variance of skewness equals six divided by the number of observations. Positive (negative) values indicate skewness to the right (left).
[h]Fourth moment around the mean divided by the variance squared minus 3. Variance of kurtosis equals 24 divided by the number of observations. Positive (negative) values indicate leptokurtosis (platykurtosis).
[i]Box-Pierce statistic for autocorrelation at the first 10 lags, distributed as chi-square with 10 degrees of freedom
[j]Returns are in percent per day. Returns on futures are calculated as the first difference of futures prices divided by the value of the SMI at the start of the return interval.
*Value significantly different from zero on the 5 percent level

The autocorrelation properties of returns essentially confirm that futures prices as well as the SMI are well described by a random walk. The sample mean implies that the drift is not significantly different from zero over the sample period. The significantly positive kurtosis measures indicate that the familiar leptokurtic distribution for asset returns is also confirmed in this case.

The basis, defined as the difference between the futures price and the current value of the SMI, measured in index points, is shown in Figure 3 for the April futures and in Figure 4 for the October futures. As already indicated by Figures 1 and 2, the basis is generally negative for the contract maturing in April and positive for the one maturing in October. The theoretical basis, implied by the no-arbitrage pricing model discussed below, is also included. The difference between the actual and the theoretical basis is a measure of the pricing error subsequently analyzed. The rapid increase in the basis starting in the middle of April is due to dividend payments, decreasing the value of the SMI relative to the futures price.

Figure 3. Basis SMI futures, April 1989



January 23, 1989 - April 21, 1989
— April 1989 SMI futures — Theoretical basis

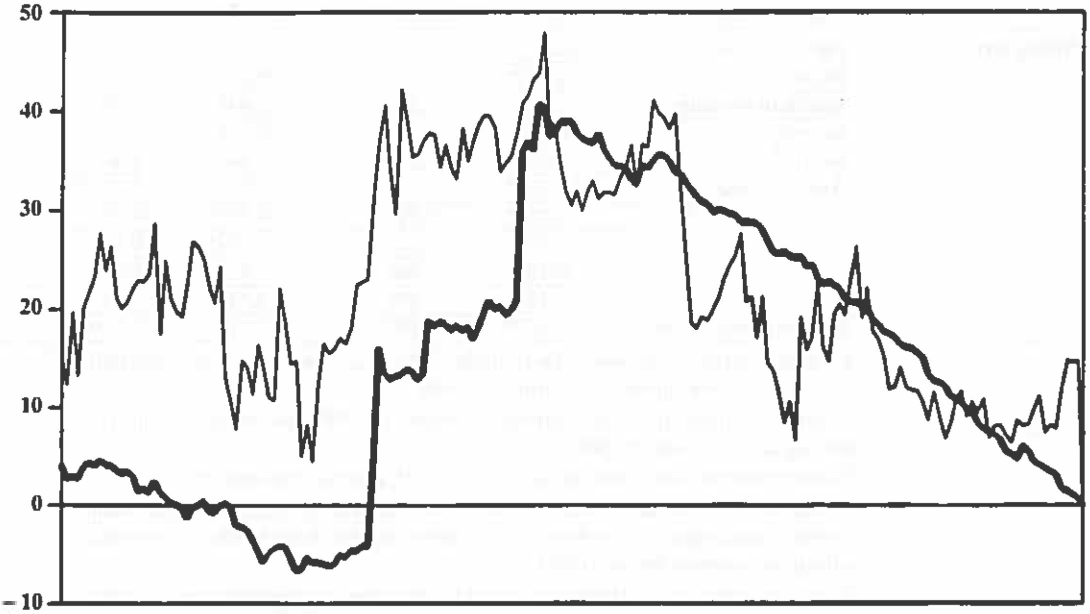
Summary statistics for the basis are presented in Table 2. As indicated in Figures 3 and 4, the mean is significantly negative for the April futures and positive for the contract maturing in October. The autocorrelation structure suggests nonstationarity, which is confirmed by the results for first differences of the basis. Note, however, that the distribution of the basis changes with the remaining lifetime of the contract because convergence of futures and spot prices must occur at maturity in order to prevent arbitrage opportunities. Consequently, the numbers in Table 2 are at best descriptive averages over the observation period.

The behavior of pricing errors is the most important issue with respect to the functioning of the market. Evidence on these errors is contained in Figure 5 and the lower part of Table 2. In the absence of transactions costs and taxes, the no-arbitrage relation linking futures to spot prices is

$$F_t = (1 + R) S_t - D \tag{1}$$

where F is the futures price at t, S is the spot price, that is, the value of the SMI. R denotes the riskless interest rate from now to maturity of the contract. D is the value at maturity of dividends in Swiss francs expected to be paid on the shares included in the SMI until maturity of the futures contract. Reinvestment of dividends occurs at the riskless interest rate until maturity.

Figure 4. Basis SMI futures, October 1989



January 23, 1989 - October 20, 1989
— October 1989 SMI futures — Theoretical basis

If the futures price differs from its theoretical value, investors can expect to make money through index arbitrage. However, for investors to profit from index arbitrage, the futures price has to differ from its theoretical value by an amount large enough to cover transaction costs. Relatively low market liquidity and the price impact of large trades could erode possible arbitrage profits even further.

Deviations from the theoretical futures price given by equation (1) evaluated below are measured in percentage terms as

$$[(\text{Theoretical price} - \text{actual price})/(\text{actual price})] \times 100 \tag{2}$$

Table 2. Basis and pricing errors

		April 1989[a]		October 1989[b]	
		Levels	First diff.	Levels	First diff.
Basis[c]	Observations	62	61	187	186
	Mean	−6.640*	0.011	22.287	−0.081
	Standard deviation	7.094	4.389	10.860	3.926
	Skewness[d]	−0.680*	−0.289	0.298	−0.125
	Kurtosis[e]	−0.484	1.369	−1.047	1.863
	Autocorr. lag 1	0.799*	−0.434*	0.922*	−0.216*
	2	0.764*	0.106	0.887*	0.064
	3	0.687*	−0.028	0.846*	−0.015
	4	0.634*	−0.026	0.804*	−0.048
	5	0.598*	0.135	0.769*	0.012
	Autocorr. lags 1-10[f]	191.006*	21.853*	1107.725*	16.567
Pricing errors[g]	Observations	62	61	187	186
	Mean	0.510*	−0.012	0.264*	−0.007
	Standard deviation	0.273	0.288	0.440	0.234
	Skewness	0.252	0.279	0.162	0.035
	Kurtosis	−0.352	1.590*	−0.304	1.908*
	Autocorr. lag 1	0.394*	−0.484*	0.845*	−0.270*
	2	0.358*	0.084	0.757*	0.031
	3	0.225	−0.035	0.673*	0.016
	4	0.145	−0.047	0.574*	−0.094
	5	0.127	0.098	0.512*	0.017
	Autocorr. lags 1-10	37.673*	25.092*	578.415*	21.570*

[a]Futures contract on the Swiss Market Index, SMI, expiring on April 21, 1989; daily observations from January 23 to April 21, 1989

[b]Futures contract on the SMI expiring on October 20, 1989; daily observations from January 23 to October 20, 1989

[c]Futures price per index share minus value of SMI, measured in index points

[d]Third moment around the mean divided by the variance to the power of 3/2. Variance of skewness equals 6 divided by the number of observations. Positive (negative) values indicate skewness to the right (left).

[e]Fourth moment around the mean divided by the variance squared minus 3. Variance of kurtosis equals 24 divided by the number of observations. Positive (negative) values indicate leptokurtosis (platykurtosis).

[f]Box-Pierce statistic for autocorrelation at the first 10 lags, distributed as chi-square with 10 degrees of freedom

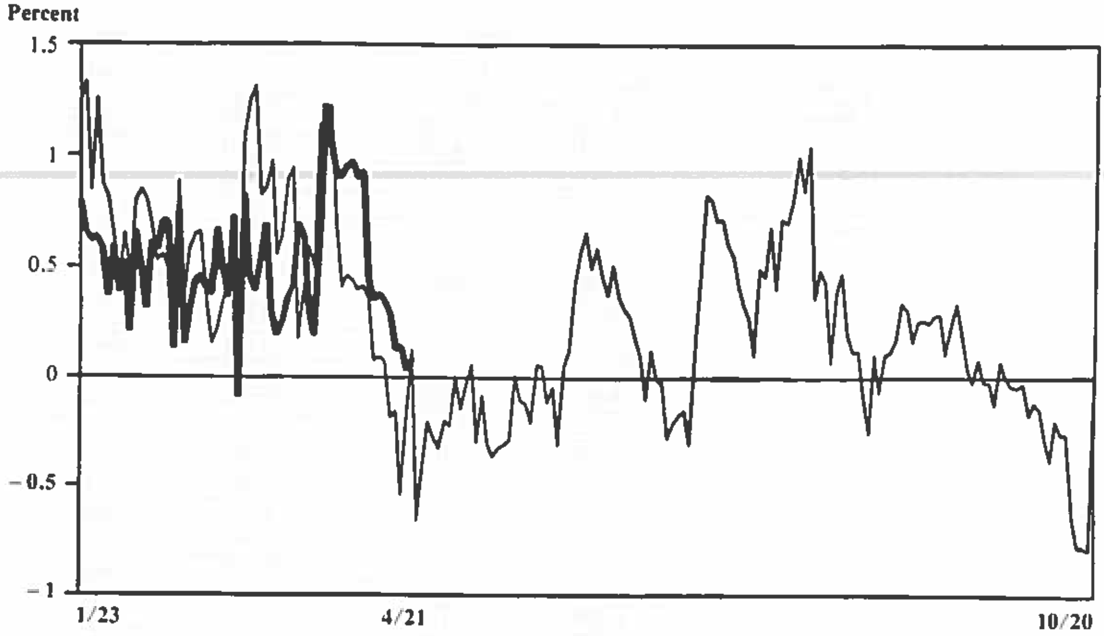
[g][(Theoretical price − actual price)/actual price] × 100

*Value significantly different from zero on the 5 percent level

Figure 5 shows that the pricing errors are generally below 1 percent. The highest error is about 1.3 percent. The correlation of pricing errors for the April and October futures during the overlapping period is only 0.43.

The summary statistics provided in Table 2 demonstrate that mean errors are significantly positive for both contracts. The standard deviation is considerably larger for the October futures, however. The skewness and kurtosis measures do not suggest important deviations from the normal distribution. The autocorrelation structure indicates strong persistence in

Figure 5. Pricing errors of SMI futures, [(Theoretical — actual) / actual] × 100



pricing errors for both contracts.[4] Autocorrelation estimates for first-differenced data show a significantly negative value at the first lag.

Estimates of temporal relationships between spot and futures prices are shown in Table 3. The return on the SMI is taken as the exogenous variable in the regressions. As expected from the pricing model (1), returns on futures and on the SMI show a contemporaneous relationship that is approximately one to one.[5] The explanatory power is very high as indicated by the R^2s. For the April futures, some of the coefficients of leads and lags are also significantly different from zero. Interestingly, analogous results are found for the October contract over the period overlapping with the April contract, but not for the remainder of the sample period. Infrequent trading of both stocks and futures may partly explain this finding. For both contracts, pricing errors appear to be positively linked to past and future returns on the SMI. The April contract exhibits stronger dependencies in that respect.

[4]MacKinlay and Ramaswamy [1988] report similar findings for intradaily transactions data in the United States, observed at intervals of 15 minutes. Based on daily observations, Brenner, Subrahmanyam, and Uno [1989] get analogous results for Japan.
[5]Based on transactions data for the United States, Kawaller, Koch, and Koch [1987] and Stoll and Whaley [1987] show that the futures market leads the stock market by a few minutes. The reason probably is that not all stocks included in the index trade every minute and that the spot index therefore contains partly outdated prices.

Table 3. Temporal relationships[a]

Return on SMI[b]	Futures April 1989[c] Return[e]	Futures April 1989[c] Pricing error[f]	Futures October 1989[d] Return	Futures October 1989[d] Pricing error
Constant	−0.034	0.460*	0.005	0.199*
	(−0.912)	(14.277)	(0.233)	(6.571)
−5	0.294*	−0.108*	−0.012	0.089*
	(5.529)	(−2.327)	(−0.437)	(2.134)
−4	−0.148*	0.180*	−0.002	0.071
	(−2.874)	(4.021)	(−0.082)	(1.735)
−3	0.026	0.048	0.001	0.063
	(0.501)	(1.042)	(0.052)	(1.535)
−2	0.013	0.091*	−0.011	0.064
	(0.256)	(2.002)	(−0.427)	(1.552)
−1	−0.091	0.092*	−0.016	0.049
	(−1.733)	(1.995)	(−0.601)	(1.190)
0	1.098*	−0.036	0.991*	0.054
	(19.068)	(−0.714)	(37.887)	(1.309)
+1	0.068	0.043	−0.010	0.060*
	(1.295)	(0.929)	(−0.599)	(2.256)
+2	0.028	0.107*	−0.002	0.049
	(0.529)	(2.357)	(−0.151)	(1.930)
+3	−0.077	0.167*	0.013	0.043
	(−1.455)	(3.615)	(0.830)	(1.722)
+4	−0.120*	0.106*	−0.006	0.044
	(−2.357)	(2.380)	(−0.383)	(1.793)
+5	0.096	−0.030	−0.002	0.023
	(1.859)	(−0.671)	(−0.133)	(0.923)
Obs.	50	50	176	176
R^2 adj.	0.916	0.470	0.902	0.115
DW[g]	2.633	1.231	2.445	0.405

[a]Ordinary least squares regressions with daily data using returns on futures and pricing errors respectively as endogenous variables and returns on the Swiss Market Index, SMI, as exogenous variables. − and + denote lags and leads; t-statistics are in parentheses.

[b]Daily observations on the SMI, consisting of 24 shares of large Swiss firms; returns in percent per day

[c]Futures contract on the SMI, expiring on April 21, 1989; daily observations from January 23 to April 21, 1989

[d]Futures contract on the SMI expiring on October 20, 1989; daily observations from January 23 to October 20, 1989

[e]Returns, expressed in percent per day, are calculated as the first difference of futures prices divided by the value of the SMI at the start of the return interval.

[f]|(Theoretical price − actual price)/actual price| × 100

[g]Durbin-Watson statistic

*Coefficient significantly different from zero on the 5 percent level

In summary, prices of SMI-futures exhibit essentially the same characteristics as futures prices traded in other countries.[6] This is

[6]The papers already mentioned contain evidence for other countries. See also Bailey [1989] for Japan.

especially noteworthy because these contracts are traded on an over-the-counter market with only one market-maker. Most likely, trading volume is furthermore comparatively small.

Since only closing prices are available, the results could lead to an excessively optimistic view of the pricing of SMI futures contracts if the closing prices of futures contracts are systematically closer to the theoretical prices than prices during the day. Nevertheless, it becomes clear from Figure 5 that, given the size of transaction costs in Switzerland, the futures contracts were priced so that, typically, no arbitrage opportunities were available. In particular, the highest difference between the theoretical and the actual futures prices was of the order of 1.3 percent. To take advantage of the difference, an investor would have had to sell the index short, and buy futures and stocks at maturity to deliver on the short sale. A large trade would have moved the prices to reduce the difference between the theoretical and actual futures prices. A small trade would have had transaction prices substantially in excess of 1.3 percent, however. It is interesting to note that futures prices were almost always too low relative to their theoretical prices. Hence, index arbitrage would almost always have involved selling stocks short, which is difficult and expensive in Switzerland.

The mispricing of the SMI futures was such that arbitrage transactions would not generally have been profitable; it is nevertheless the case that the mispricings were often large enough that an investor who wanted to bet on an increase in the SMI would, most of the time, have been better off to do so with futures contracts—because futures prices were generally too low—rather than using the cash market.

III. Hedging Performance

Investors can increase or reduce their exposure in the stock market by alternatively buying or selling stock index futures. In this section, some evidence concerning the hedging effectiveness of SMI futures is provided.

All stock market risk can be eliminated if the futures contract is correctly priced and the investor hedges the asset underlying the contract until maturity of the contract. In this case, the riskless interest rate is earned on the portfolio. However, futures mispricing increases or decreases the cost of hedging depending on whether the futures price is too low or too high. Mispricing at the end of the hedging period is also relevant if the hedge is implemented for a shorter period than the time remaining to maturity of the futures contract. This so-called *basis risk* cannot be hedged, but it can be minimized through the use of appropriate techniques. Note, further, that basis risk remains even when the portfolio to be hedged is exactly the same as the asset underlying the futures contract.

The evidence presented below is based on minimum variance hedges with respect to different assets using weekly data for the October futures on the SMI. The minimum variance hedge ratio is determined as follows:

Consider an investor holding n units of a risky asset with price S, which he wants to hedge with futures on the SMI. The value of the portfolio at the start of the hedging period, in $t-1$, is $n_{t-1}S_{t-1}$, since the futures contracts require no cash payments. The change in wealth over period t, expressed in monetary units, is given by

$$V_t - V_{t-1} = n_{t-1}(S_t - S_{t-1}) + m_{t-1}(F_t - F_{t-1}) \quad (3)$$

where m_{t-1} is the number of futures contracts held. Note that each futures contract is defined on one unit of the underlying asset. The return on wealth is given by

$$(V_t - V_{t-1})/V_{t-1} = (V_t - V_{t-1})/n_{t-1}S_{t-1}$$

$$= R_{Vt} = R_{St} + h\,R_{Ft} \quad (4)$$

where $R_{St} = (S_t - S_{t-1})/S_{t-1}$ and $R_{Ft} = (F_t - F_{t-1})/S_{t-1}$. The hedge ratio, h, is equal to m_{t-1}/n_{t-1}. Note that the return on the futures contract is given by the change in the futures price divided by the price of the risky asset to be hedged.[7]

The variance of the return on the hedged portfolio is

$$\mathrm{Var}(R_V) = \mathrm{Var}(R_S) + h^2\,\mathrm{Var}(R_F) + 2h\,\mathrm{Cov}(R_S, R_F) \quad (5)$$

where Var denotes a variance and Cov, a covariance. The variance-minimizing hedge ratio, $h_{\min}$, is

$$h_{\min} = -\mathrm{Cov}(R_S, R_F)/\mathrm{Var}(R_F) \quad (6)$$

A positive covariance between R_S and R_F, therefore, involves a sale of futures. If the returns on the cash position and on the futures contract follow stationary distributions, the following regression model can be used to determine $h_{\min}$

$$R_{St} = \alpha + \beta R_{Ft} + \epsilon_t \quad (7)$$

where ϵ is an error term with the usual properties. $h_{\min}$ is equal to $-\beta$, if the relation between R_S and R_F does not change over time.

Table 4 contains results for several hedging experiments with respect to the performance of futures on the SMI. The contract maturing in October 1989 is chosen as the hedging instrument.[8] Five risky assets to be hedged

[7]Expressing the return on the futures in conventional form as $(F_t - F_{t-1})/F_{t-1}$ would make the hedge ratio dependent on the basis. h would in this case be equal to $m_{t-1}F_{t-1}/n_{t-1}S_{t-1}$.
[8]Not enough observations are available for the April futures.

Table 4. Hedging performance

Underlying asset[a]	Unhedged[b]	Hedge ratio[c]	Hedged In sample[d]	Hedged Out of sample[e]
SMI[f]				
I[g]	1.811	−1.030	0.538	
II[h]	2.122	−0.989	0.473	
III[i]	2.445			0.424
IV[j]	2.445			0.420
Index of Swiss Bank Corporation[k]				
I	1.517	−0.829	0.606	
II	1.783	−0.799	0.618	
III	2.056			0.652
IV	2.056			0.671
Equally weighted portfolio[l]				
I	2.109	−1.182	0.713	
II	2.392	−1.067	0.861	
III	2.703			1.065
IV	2.703			1.040
Union Bank of Switzerland, bearer share				
I	2.961	−1.595	1.265	
II	3.261	−1.327	1.710	
III	3.608			2.220
IV	3.608			2.140
Rückversicherung, participation certificate				
I	3.311	−1.202	2.624	
II	4.097	−1.142	3.328	
III	4.821			3.940
IV	4.821			4.117

[a]Asset hedged with futures on Swiss Market Index, SMI, expiring on October 20, 1989
[b]Standard deviation of weekly returns on unhedged underlying asset in percent per week
[c]Number of Swiss francs sold through the futures contract (indicated by a minus sign) per Swiss franc invested in the underlying asset. Minimum variance hedge ratios are shown.
[d]Standard deviation of weekly returns on underlying asset hedged with the futures contract in percent per week. The hedge ratio is estimated during the same period.
[e]Standard deviation of weekly returns on underlying asset hedged with the futures contract in percent per week. The hedge ratio is estimated during a previous period.
[f]SMI, consisting of 24 shares of large Swiss firms
[g]19 weekly returns based on prices from January 25 to June 7, 1989
[h]38 weekly returns based on prices from January 25 to October 18, 1989
[i]19 weekly returns based on prices from June 7 to October 18, 1989. The hedge ratio is estimated over the period January 25 to June 7, 1989.
[j]19 weekly returns based on prices from June 7 to October 18, 1989. The hedge ratio is reestimated every week using data from January 25, 1989, to the beginning of the week over which the respective return is computed.
[k]Broad price index for Swiss stock market (dividend adjusted)
[l]Portfolio consisting of six shares of large companies, namely bearer shares of Brown Boveri, Ciba-Geigy, Jacobs-Suchard, Union Bank of Switzerland, Swiss Bank Corporation, and the participation certificate of Rückversicherung.

are chosen. The first one is the SMI itself. The second is a dividend-adjusted index compiled by the Swiss Bank Corporation, including about

450 shares of Swiss companies. It incorporates both shares accessible by foreign investors as well as registered shares that can generally only be held by Swiss investors. The third asset is an equally weighted portfolio of six stocks.[9] Typical outcomes for two individual shares are also shown.[10]

Weekly observations (Wednesday) are used to estimate hedge ratios through ordinary least squares regressions as implied by equation (11).[11] Hedge ratios are computed for two sample periods in order to assess in-sample hedging performance. Period I extends from January 25 to June 7, 1989 (19 weekly returns), and period II from the same starting date to October 18, which is the Wednesday immediately prior to the expiration of the futures contract (38 weekly returns). The results shown in Table 4 indicate that estimated hedge ratios are quite stable over time for all risky assets investigated.

The in-sample hedging performance is evaluated by comparing the standard deviation of weekly returns (in percent) of the unhedged risky asset with its counterpart for the hedged portfolio using the estimated hedge ratios described above. For the SMI in period I, the standard deviation of weekly returns drops from 1.811 percent to 0.538 percent by selling 1.03 Swiss francs in the futures market for every Swiss franc invested in the SMI. The volatility of returns could, therefore, be reduced by about 70 percent. The reduction is even larger over the total period II.

Similar risk reductions can be achieved by cross-hedging diversified portfolios of shares using futures on the SMI as indicated by the findings for the index of the Swiss Bank Corporation and the equally weighted portfolio of six shares. The hedging performance is, however, poorer for individual shares, especially for the participation certificate of Rückversicherung. Interestingly, the hedging characteristics of the futures on the SMI are about as good as the in-sample performance for American index futures at a similar stage of development of these contracts.[12] It should also be noted that the performance measures are correlated across stocks and portfolios because they are based on the same hedging instruments over the same time period.

In practice, estimates of in-sample hedge ratios are not available when the hedging strategy is implemented. Therefore, the appropriate hedge ratio has to be forecasted based on available information. The results of two such experiments are also shown in Table 4. For period III, the hedge ratio estimated for period I is used from June 7, the end of period I, to October

[9]Included are bearer shares of Brown Boveri, Ciba-Geigy, Jacobs-Suchard, Union Bank of Switzerland, and the participation certificate of Rückversicherung.
[10]Cross-hedging for several other individual shares has also been examined with comparable results.
[11]Weekly data are chosen because daily observations have more noise due to infrequent trading.
[12]See Figlewski [1985].

18, 1989, in order to create the hedged position. There are 19 weekly returns obtained that way. Period IV covers the same weeks as period III. The hedge ratio is, however, reestimated each week based on all observations from January 25, 1989, the start of period I, to the beginning of the week for which the hedged portfolio is formed.

The results for out-of-sample performance, also presented in Table 4, indicate no deterioration relative to in-sampling hedging. Moreover, the findings for periods III and IV differ only marginally, implying that updating the hedge ratio would have been unnecessary over the period considered. The reason for this outcome is that the estimated hedge ratios are relatively stable, as already discussed above.

V. Conclusions

This paper provides some evidence on the pricing and hedging effectiveness of the SMI futures contract based on the experience with the contracts traded by Bank Leu in 1989. Since the SMI futures, introduced on SOFFEX in November 1990, are similar, one would expect them to have initially properties similar to those of Bank Leu, but probably with more liquidity. On the basis of the evidence on Bank Leu SMI futures, it is clear that the SMI futures contract is useful to hedge portfolio risk and that its usefulness will steadily improve as the SOFFEX contract becomes more liquid. As a result, a portfolio manager who wishes to alter his exposure to the Swiss stock market for a short period of time should consider the SMI futures as a cheaper alternative to transactions in the cash market.

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