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SMI Futures: Pricing and Hedging Performance

1. Introduction

From the beginning of 1989 to mid-October 1989, Bank Leu made a market for futures contracts on a capitalization-weighted index of 24 stocks called the Swiss Market Index (SMI). The Soffex will soon start trading SMI index futures contract similar to those traded by Bank Leu. The SMI futures contracts are very similar to futures contracts on the S&P 500 traded on the IMM in Chicago. Index futures contracts are extremely useful instruments for portfolio management in the US. This paper evaluates the early pricing and hedging performance of SMI futures by focusing on portfolio management applications of these contracts.

The usefulness of futures contracts to hedge changes in cash prices depends on how closely the futures price tracks the cash price. We show that the SMI futures price tracks the SMI cash price fairly well. This is especially true if one compares the SMI futures performance to the performance of other index futures contracts in the months following their introduction. 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 by more than half. While SMI futures are not useful to hedge most individual stocks, they seem helpful in hedging portfolios that comprise a small number of stocks.

The paper proceeds as follows. In section 2, we describe the SMI futures and compare them to foreign index futures contracts. In section 3, we show how the SMI futures should be priced and provide evidence on the relation between theoretical and actual SMI futures prices. In section 4, we provide evidence on the hedging effectiveness of SMI futures. Concluding remarks are presented in Section 5.

2. SMI futures

A futures contract is similar to a forward contract. Through a long position in a futures contract, one promises to buy at maturity a fixed number of units of some commodity or asset at a price agreed upon at the inception of the contract. For instance, with a futures contract for dollars, one promises to buy a fixed number of dollars at maturity at an exchange rate agreed upon when the futures position is opened. With a forward contract, no money changes hands until maturity. In contrast, with a futures contract, gains and losses are settled daily.

The SMI futures contract enables investors to buy or sell positions in the SMI for future delivery. For instance, the SMI futures contract maturing in April 1989 allowed investors to buy or sell positions in the SMI for delivery on April 21, 1989. On March

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29, 1989, the SMI futures price for the April 1989 contract was 1502, whereas the SMI stood at 1524.80. Although the SMI futures and cash prices are not generally the same, we will show in the next section that they should be closely related.

A position in a SMI futures contract is in units of 25 times the index. It is convenient to think of the SMI as the price of a share of common stock, which we call an SMI share in the following. The value of an SMI share is the value of a portfolio of common stocks with weights identical to those used in the construction of the index. With this terminology, the SMI futures contract is for 25 SMI shares. The futures price changes every day. Figures 1 and 2 plot the SMI and futures prices for the SMI April 1989 futures contract from January 25, 1989 until April 21, 1989 and for the SMI October 1989 futures contract from January 25, 1989 until August 9, 1989. With a long position in the SMI contract, the investor benefits from increases in the futures price because he has promised to buy index shares at a fixed price. An investor who opened a long position on March 29 in the April 1989 contract promised to buy 25 SMI shares at 1502. For instance, if the futures price increases by 10 points, the investor receives 250 francs. The investor would have to pay 250 francs if the futures price fell by 10 points. The investor can get out of his position at any time by taking a short position in the index that offsets his long position.

If the investor kept his long SMI futures position until maturity, he would have bought 25 times the index at a price of 1502 per share on April 21, 1989. On April 21, the SMI cash price was 1559. Consequently, the investor made a profit of 1425 francs, namely 25 times 57 francs. Because of the fact that

Figure 1: Prices of the April 89 SMI Futures Contract and the SMI Spot Values.

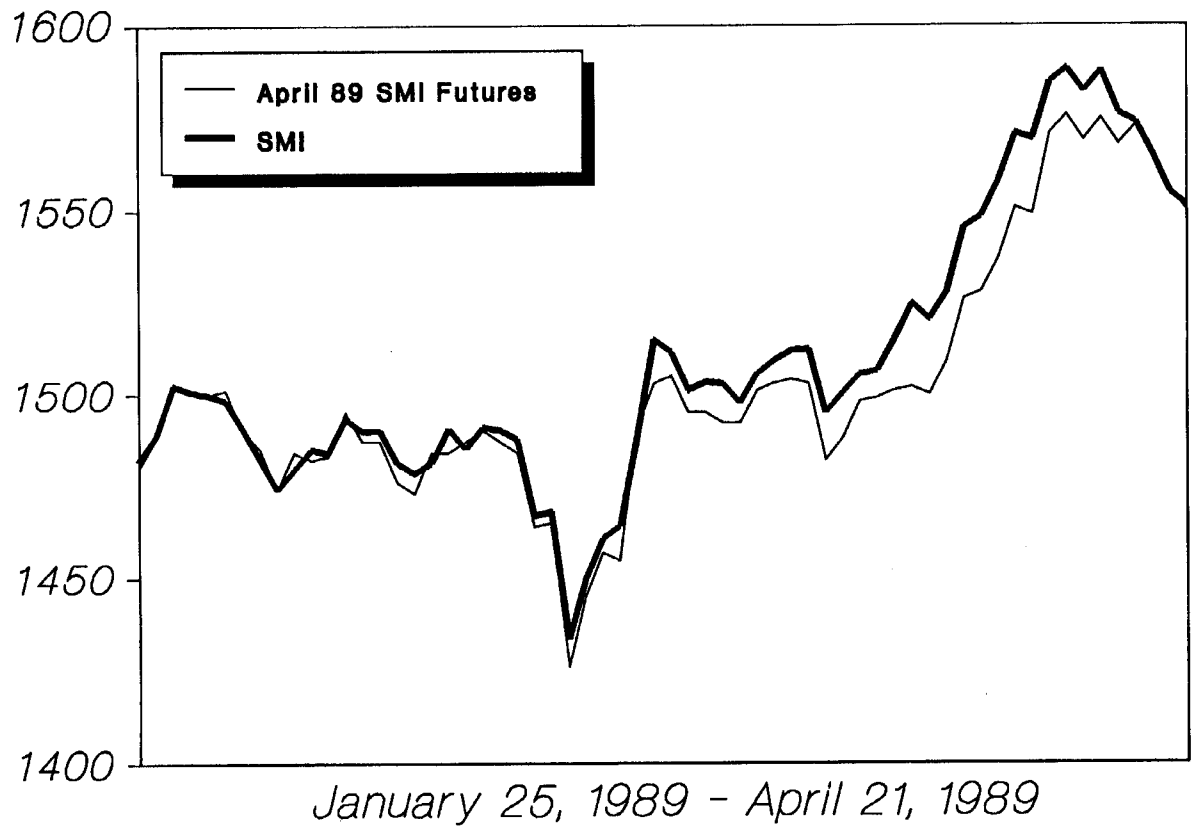
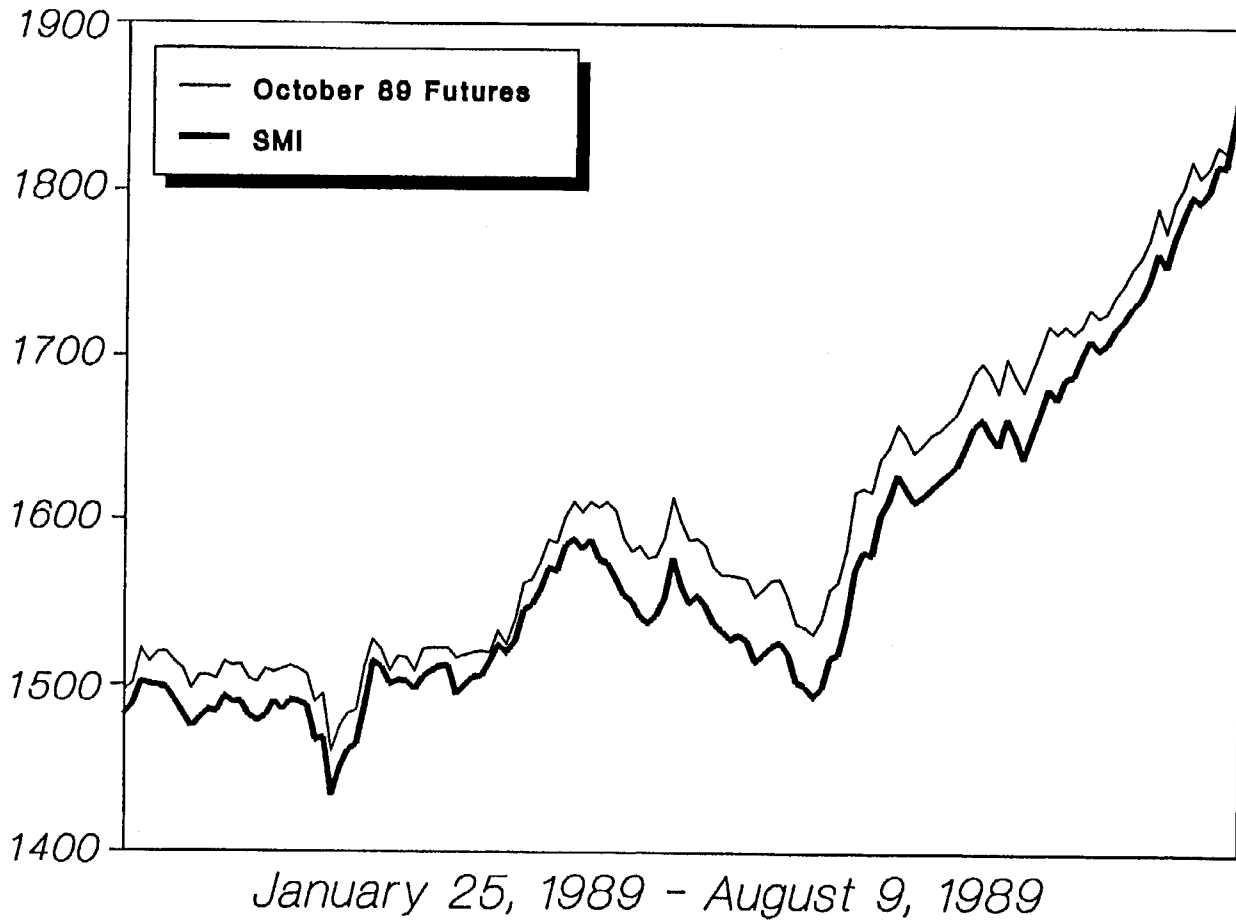


Figure 2: Prices of the October 89 SMI Futures Contract and the SMI Spot Values.



gains and losses are transferred daily with futures contracts, the investor would have received this profit while holding his position rather than on April 21. Since the SMI futures contract has cash settlement, no stocks are transferred on the delivery date, but only gains and losses in cash.

An investor who opens a futures position promises to buy (or sell) 25 index shares at a price agreed upon when the position is opened, irrespective of how the SMI evolves. To decrease the investor's temptation to walk away from his commitment, he has to establish a margin account in which funds are deposited to guarantee performance. The balance of the margin account belongs to the investor. This balance grows if the investor gains and falls if he loses. The minimum balance of the margin account is called the maintenance margin. The investor must deposit money in his margin account if its balance falls below the maintenance margin to bring the balance back to the required level. The minimum balance required when the account is opened is called the initial margin. For the SMI futures contract, the initial and maintenance margins are the same and equal 5000 francs. The maintenance margin on the SMI futures contract is larger than the typical maintenance margin on American index futures contracts. 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, the maintenance margin for this contract per franc of stock purchased is less than

half the margin for the SMI contract. Table 1 compares the characteristics of the SMI contract to the characteristics of the S&P 500 and the Nikkei 225 contracts. The most important difference between the foreign index futures contracts and the SMI futures contracts is the difference in transaction costs. Most of the success of index futures contracts in the US can be explained by the low trading costs of these contracts relative to the trading costs of the cash markets. For instance, if a program trader buys 100 S&P 500 futures contracts, he is likely to pay about $1250 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. However, the difference in commissions between the two markets is much smaller than in the US. A reasonable estimate is that, for a trade of 1'000'000 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 trades in Switzerland, it is not possible to estimate differences in market impacts between futures and cash trades.

Table 1: Characteristics of Different Futures Contracts.

	SMI	S&P 500	Nikkei 225
Trading place:	Zurich (Bank Leu, OTC)	Chicago (CME)	Singapore (SIMEX)
Underlying index:	24 shares capitalization-weighted	500 shares capitalization-weighted	225 shares equally-weighted
Contract multiplicator:	25	500	500
Maturity:	third Friday of April and October	third Friday of March, June, September and December	third Wednesday of March, June September, December and the current month
Settlement:	cash	cash	cash
Futures commissions:	0.225% for banks 0.45% for private investors	negotiable, generally less than $ 100	negotiable
Initial margin:	SFr. 5000	negotiable	Y 750'000
Typical contract value:	SFr. 45'000	$ 200'000 (≈ SFr. 125'000)	Y 17'500'000 (≈ SFr. 150'000)

Several factors contribute to the difference in transaction costs between SMI futures and S&P 500 or Nikkei 225 futures contracts. First, the foreign futures contracts are 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 the foreign contracts. As the use of the SMI contract grows, one would expect transaction costs to fall.

3. The pricing of SMI contracts

Consider an investor who, on March 29, 1989, thought that the SMI was undervalued and expected it to increase over the next three weeks. This investor wanted to take a long position in the SMI. With the SMI futures contracts available to him, the investor has two alternative ways to take such a long position, as presented in table 2. First, the investor could buy 25 SMI index shares on the cash market at a price of 1524.80 per index share and hold the shares. Second, the investor could take a long position in one April 1989 SMI contract. The futures position requires no cash payment when opened. The same is true of the cash position if the investor borrows to buy the shares. Hence, to make both positions comparable, we consider the case where the investor does not want to pay for the shares now, but rather on April 21, which is the delivery date of the futures contract. If he uses the cash market, the investor must therefore borrow 38'120 francs until April 21 (namely, 25 times 1524.80). On March 29, 1989, the one month Euro-franc rate was 5.75% per annum and we assume that the investor could borrow at that rate.

Table 2: Arbitrage Strategies for Buying SMI Shares.

	Cash Strategy		Futures Strategy	
On March 29	Buy 1 SMI share	-1524.80	Buy 1 SMI share	
	Borrow money	+1524.80	in futures for 1502	0
Net investment		0		0
On April 21	Repay money borrowed	-1524.80	Buy 1 SMI share at maturity of the	
	Pay interest	- 5.76	futures contract	-1502
	Receive dividends (reinvested)	+ 10.13		
		-1520.43		-1502
Cost of 1 SMI share:		1520.43		1502

Notes:
The numbers represent the cash flow for buying 1 SMI share. Positive numbers are cash inflows and negative numbers are cash outflows. One SMI share represents the 24 shares included in the SMI. Transaction costs are neglected.

On April 21, 1989, delivery takes place on the April contract. At that time, the investor gets enough cash so that the cash received per index share plus the futures price would enable him to buy an index share on the cash market. Hence, on April 21, 1989, the investor effectively pays 1502 per index share if he bought the index shares through the futures contract. If the investor used the cash market to buy the shares, on April 21, he repays the amount borrowed, namely 1524.80 per index share plus interest charges equal to 5.76 franc per index share. However, by holding the shares, the investor received dividends that he can also use to repay part of the amount borrowed. If the investor reinvested the dividends received until April 21, he then had 10.13 in cash per index share. Hence, on April 21, he had to repay the principal plus interest, namely 1530.56, minus 10.13 of reinvested dividends. This means that on that date the cost of the shares purchased on the cash market was 1520.43 per share. If the investor bought the shares on the cash market, we will say that he followed the cash strategy and, otherwise, that he followed the futures strategy.

It is important to note that both the futures and the cash strategies enable the investor to buy stocks on April 21 at a price determined on March 29. Once, the investor has decided to buy stocks on March 29 for delivery on April 21, there is no uncertainty as to how much he will have to pay. The price paid by the investor depends in no way on the cash market value of the index on April 21. Since we defined two ways to purchase stock with delivery on April 21 and prices agreed upon on March 29, one would expect both strategies to be equally costly for the investor. This is not the case here, since the futures strategy is less expensive than the cash strategy. Hence, it would not make sense for our investor to buy stocks with the cash strategy.

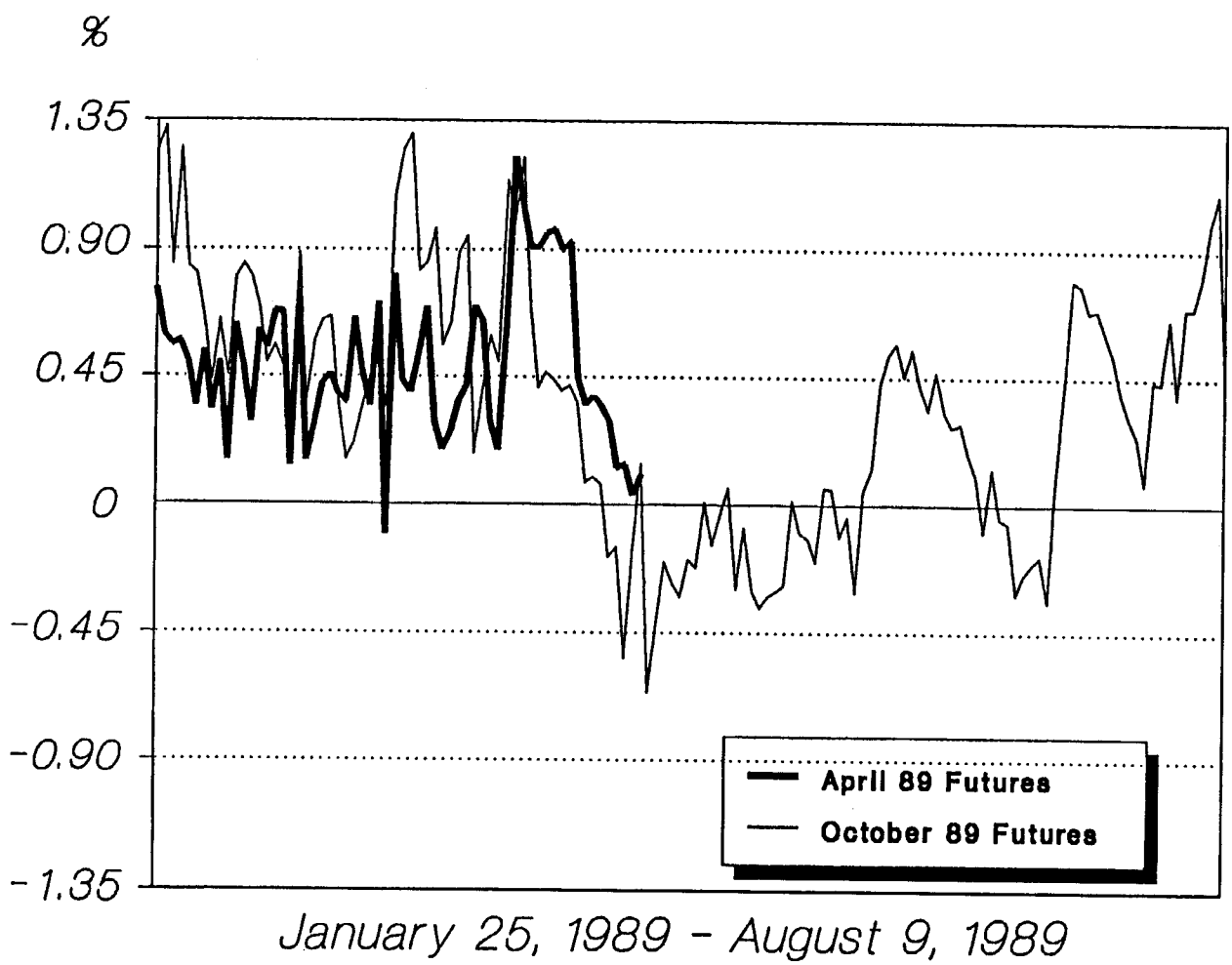
In the absence of transaction costs, the fact that the futures strategy is cheaper than the cash strategy would enable the investor to make money for sure. To see this, note that the investor could buy stocks with the futures strategy and resell them immediately using the cash market. Since the investor does not have the index shares, he would have to borrow them and sell them short. This presumes that short-sales with full use of the proceeds are permitted. The investor would invest the short-sale proceeds until April 21 and then use the stocks bought through the futures strategy to deliver on the short sales. With this approach, the investor would buy stocks at an April 21 price of 1502 and sell them at a price of 1520.43. Buying the index on the futures market and selling it cash to make money for sure is called an index arbitrage. The careful reader will have noticed, however, that the investor makes money for sure only if he knows what the dividend payments will be while he holds the short position. Transaction costs can transform a seemingly sure profit into a loss. For instance, suppose that the investor in our example has to pay 1% to borrow the stocks, 0.5% to take the futures position and 0.5% to buy stocks on April 21. In this case, the total transaction costs amount to 2%, but the profit found above is slightly more than one percent, i.e., 18.43 francs per index share. Without transaction costs, our example implies that there would be no profit opportunities if the futures price equals the price of buying stocks on the cash market and paying for them at the delivery date of the futures contract, namely:

$$\text{Futures price} = \text{SMI}(1 + \text{Interest rate}) - \text{Reinvested dividends}$$

where the interest rate is the one that applies until maturity of the contract and where dividends are reinvested until maturity of the contract. If the futures price differs from its theoretical value, investors can expect to make money through index arbitrage. However, with transaction costs, the futures price has to differ from its theoretical value by an amount large enough to cover the transaction costs for investors to expect to profit from index-arbitrage. As we just saw, on March 29, 1989, the SMI futures price was such that investors could have made money through index arbitrage in the absence of transaction costs, but not with transaction costs unless these costs were less than 1.2% (i.e., 18.43*100/1524.80).

In Figures 3 and 4, we provide some evidence that SMI futures were priced so that investors could not make money through index arbitrage. Figure 3 shows the differences between the theoretical and the actual futures price for the April 1989 contract over its whole life and for the October 1989 contract until the beginning of August 1989. Figure 4 provides a histogram of these differences. The prices are obtained from the "Neue Zürcher Zeitung". Since we do not have the prices of all transactions, but rather one price a day, our 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 intra-day prices. Nevertheless, it is clear from both figures 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%. To take advantage of the difference, an investor would have had to sell the index short, buy futures and buy stocks at maturity to deliver on the futures. 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%, however. It is interesting to note that futures prices were almost always too low relative to their theoretical prices. Hence, index

Figure 3: Relative Differences Between the Actual SMI Futures Prices and the Theoretical Prices, Calculated as ((Theoretical Price - Actual Price) / Actual Price) * 100.

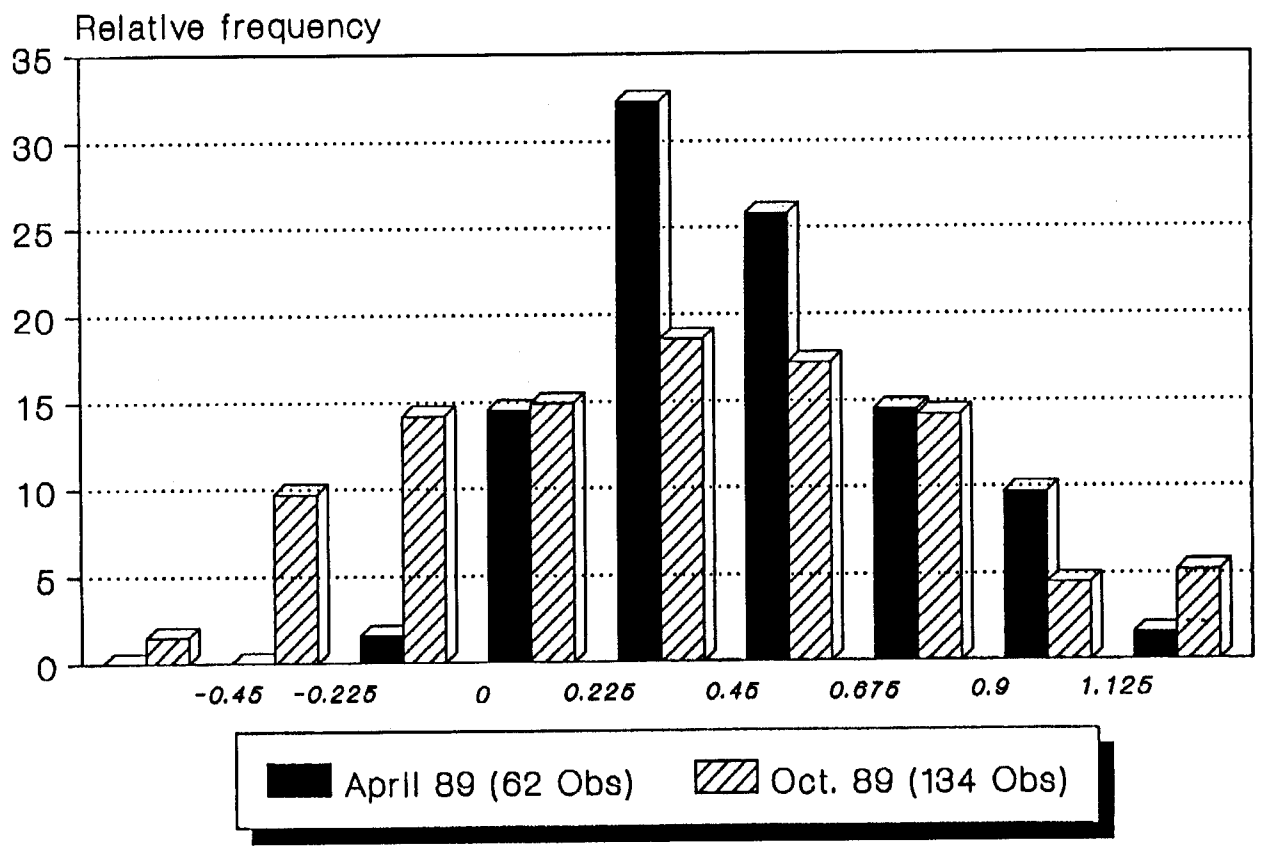


arbitrage would almost always have involved selling stocks short, which is difficult and expensive in Switzerland.

While 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. As an example, consider an investor who on March 29 thought that the SMI would appreciate over the coming month. By buying the SMI on the cash market, the investor would have earned about 37 francs per index share since on April 21, 1989, the SMI stood at 1551.30. By buying the SMI on the futures market, the investor would have earned 49 francs per index share. Since no payment is required to open a futures contract, buying the SMI through the futures market would have enabled the investor to keep the use of the cash that would have been required to buy the SMI on the cash market. Further, the investor would have paid less in transaction costs using the futures market. In sum, therefore, an investor believing that the SMI would increase on that date would have been much better off to take a long SMI position with futures rather than with cash.

An investor betting on an increase or a decrease in the SMI can choose to do so either through the cash market or through the futures market. At maturity of the futures contract, the futures price equals the cash price of the index. Hence, if the futures price is too low now, one knows for sure that if one takes a bet on an increase in the SMI using the futures

Figure 4: Frequency of the Relative Differences Between the Actual SMI Futures Prices and the Theoretical Values in Percent.



contract and holding it to maturity, one will do better than if one uses the cash markets. However, if one wants to hold a long position in the SMI for a short period of time and the futures is mispriced, it might turn out that the mispricing of the futures gets worse, so that one does not benefit as much as one had hoped.

4. Hedging with SMI futures: An introduction

Consider an investor who holds stocks and believes that the market will fall over the next month. This investor obviously would like to reduce his market exposure for the coming month. He could do so by selling his stocks, which would be expensive. Alternatively, if futures trading is cheap, the investor could hedge his stocks over the coming month against market movements. With SMI futures, an investor could in principle hedge his portfolio against market movements in Switzerland. In this section, we discuss how the investor would construct his hedge and provide some evidence as to the effectiveness of such hedging. It is important to note, however, that by hedging, the investor reduces the risk of his portfolio of stocks and hence, over long periods of time, also reduces the expected return of his portfolio. It therefore does not make sense to buy stocks and always hedge them - one would be better off investing in Euro-franc deposits. Selective hedging, however, is a useful strategy for most investors. In particular, it is widely used in dynamic allocation strategies such as portfolio insurance or market timing.

The simplest example of hedging with the SMI futures is one where the investor holds a portfolio indexed to the SMI and wants to hedge it until maturity of the futures contract. For instance, suppose that on March 29, 1989, an investor holding a portfolio indexed to the SMI decided that he wanted to eliminate his stock exposure until April 21. To do so, the investor could sell SMI April futures contracts. We saw that the theoretical value of the SMI futures on March 29 was 1520.43. For each 25 index shares in his portfolio, the investor could sell one contract on the futures market. Suppose for illustration's sake that the SMI fell by 20 points until April 21, so that on that date it was at 1504.20. The investor would have lost about ten francs per index share (the value of the shares fell by 20 francs, but the investor received slightly more than 10 francs in dividends) if he had not hedged. Having hedged and had the contract been priced at its theoretical value, he would have received 16 francs per futures contract, so that he gains 6 francs per index share. The gain per index share corresponds to the interest he would have earned had he invested in Euro-franc deposits instead. This is not surprising, since a perfectly hedged portfolio is equivalent to an investment in a riskless asset.

If the futures contract is correctly priced and one hedges the asset underlying the contract until maturity of the contract, one can eliminate all risk. However, futures mispricing increases or decreases the cost of hedging depending on whether the futures price is too low or too high. For example, we saw in the previous section that on March 29 the futures price was too low relative to its theoretical value, i.e., 1502 rather than 1520.43. This means that, until maturity, the futures price had to increase faster or fall less than the cash price to make up for the mispricing. Since, to hedge the SMI portfolio, the investor must sell futures contracts, it follows that the investor sells an undervalued contract and will earn less on his short position than he would if the futures contract were correctly priced. As mentioned before, on April 21, the SMI stood at 1551.30. Hence, the investor made a 26.50 franc capital gain and received a 10.10 dividend payment on his cash position for a total gain of 36.60. The futures price increased from 1502 to 1551.30, so that the investor lost 49.30 on the futures contract. This means that the insured portfolio lost 12.70 francs. The loss is caused only by the futures mispricing; even if the cash index would have fallen substantially, the investor would have lost that amount of money. Of course, had the index fallen substantially and had the investor not been hedged, he would have lost much more money. Had the futures price been correct, the investor would have

earned the risk-free rate on his insured portfolio irrespective of the true change in the SMI.

Suppose now that the investor wants to hedge for periods of time shorter than the time to maturity of the futures contract. A simple solution would still be to short a futures contract for each 25 index shares held in the portfolio. However, there is now some uncertainty to the hedge. In the above example, futures mispricing affects only the cost of the hedge since one knows that on April 21, the futures price must equal the cash price. If, instead, the investor decides to hedge on March 29 for two weeks only, the mispricing on April 12 is not known as of March 29. If the investor sells futures contracts at a price that is too low and then has to close his position when the futures price is too high, he gets hurt by the mispricing both when opening and when closing the position. It could also happen, however, that the futures mispricing does not change, in which case the investor had a perfect hedge for two weeks.

In futures markets, participants usually refer to the difference between the futures price and the cash price as the basis. The basis for the SMI contract is therefore the difference between the SMI futures price and the SMI cash price. Hedges with maturities that differ from the maturity of the futures contract have basis risk. The basis risk cannot be hedged, but it can minimized through the use of appropriate techniques. Because of mispricing, there is basis risk even when one uses the SMI futures to hedge the SMI cash index.

5. Minimum variance SMI hedges.

Most investors don't hold portfolios indexed to the SMI. How can these investors use the SMI futures to hedge? For such investors to be able to use SMI futures to hedge, it must be the case that their portfolio moves in a fairly predictable way in relation to the SMI. To see this, suppose that an investor believes that his portfolio increases by 10% whenever the SMI futures price increases by 5%. In this case, the investor can hedge his portfolio by selling futures contracts for a value equal to twice the value of his portfolio. For instance, if the investor's portfolio is worth 500'000 francs, the investor should sell 500'000*2/(25*Futures price) contracts. In this case, if the investor's portfolio falls by 100'000 francs, i.e., 20%, he expects the futures price to fall by 10%. However, since for each franc invested in the portfolio, he sold two francs through futures contracts, his futures gain is 10% of 1'000'000 francs, namely 100'000 francs. Hence, the investor is perfectly hedged as long as he has correctly predicted the relation between changes in the value of his portfolio and changes in the futures price. Suppose, for instance, that the investor is wrong about this relation and that, instead, the futures price increases when his portfolio falls. In this case, the investor would have an extremely poor hedge, since the value of his futures position would fall at the same time that the value of his portfolio falls!

In forming his hedge, the investor wants to minimize the variance of his hedged portfolio. Let R_u be the return of the unhedged portfolio and R_f be the return of the futures contract (defined as the change in the futures price over a period divided by the beginning-of-period spot index price) [1]. The return of the hedged portfolio, R_h, is:

$$R_h = R_u + hR_f$$

where h is the number of francs purchased through the futures contract for each franc invested in the uninsured portfolio. In our above example, h is -2, i.e., the investor sells two francs through the futures contract for each franc invested in his portfolio. The investor who hedged wants to minimize the variance of the return of his insured portfolio:

$$\mathrm{Var}(R_h) = \mathrm{Var}(R_u + hR_f) = \mathrm{Var}(R_u) + h^2\mathrm{Var}(R_f) + 2h\mathrm{Cov}(R_u,R_f)$$

where Var(.) denotes a variance and Cov(.,.) denotes a covariance. The value of h that minimizes the variance of the hedged portfolio, called henceforth the optimal hedge ratio, is:

$$h^* = -\frac{Cov(R_u, R_f)}{Var(R_f)}$$

The expression for h* provides a simple formula for the optimal hedge that yields the same result than the simple reasoning we used in our example. To construct the hedge, the investor must figure out how on average his portfolio moves when the SMI futures price moves by one franc. The usefulness of the formula for h* is that it shows that finding the proper hedge is a statistical exercise for which statistical tools can be used.

Suppose that the relation between a portfolio and the SMI is fairly stable. In this case, one can use past data to estimate h*, since the relation between the portfolio and the SMI in the past is a good predictor of what it will be in the future. In particular, using regression analysis, one can estimate the coefficients α and β in the following regression:

$$R_u(t) = \alpha + \beta R_f(t) + \varepsilon(t)$$

If the relation between R_u and R_f does not change over time, then h* is equal to $-\beta$. Table 3 shows estimates of the optimal hedge ratio for six stocks, the SMI index and an equally-weighted portfolio of the six stocks. It is interesting to note that the optimal hedge for the SMI index is not to short the futures contract for each 25 index shares held in the portfolio. This is, because of basis risk, the futures price moves by less than one franc for each one franc change in the index, so that one has to sell more futures contracts.

How can we evaluate the performance of a hedge? The simplest measure is the ratio of the standard deviation of the hedged portfolio and the standard deviation of the unhedged portfolio. We call this measure the performance ratio. A performance ratio of zero means that the standard deviation of the hedged portfolio is zero. In other words, the hedge is perfect and the hedged portfolio has no risk. As the performance ratio increases, the hedge becomes worse. Table 3 reports performance ratios for the period from January 25, 1989 until June 7, 1989 used to estimate hedge ratios (in-sample perfor-

Table 3: Hedging Effectiveness of the SMI Futures.

Underlying	Hedge ratio	In-sample performance ratio	Out-of-sample performance ratio
SMI	-1.030	0.297	0.492
Equally-weighted Portfolio	-1.184	0.338	0.871
BBC BS	-1.731	0.666	0.738
Ciba-Geigy BS	-0.913	0.869	0.838
Jacobs-Suchard BS	-0.615	0.804	0.947
Rückversicherung PC	-1.202	0.793	1.141
SBG BS	-1.595	0.427	0.979
SBV BS	-1.054	0.568	1.031

Notes:
BS = Bearer shares, PC = Participation certificates
Performance ratio = Standard Deviation (hedged portfolio) / Standard Deviation (unhedged portfolio)
In-sample period: January 25, 1989 - June 7, 1989 (19 weekly observations)
Out-of-sample period: June 14, 1989 - August 9, 1989 (9 weekly observations)

mance ratios) and for a period of nine weeks afterwards without re-estimation of the hedge ratios (out-of-sample performance ratios). These performance ratios are for hedges of one week. Since SMI futures have been available only for a short period of time, these statistical results should be interpreted with caution. In particular, our out-of sample hedging results are obtained using nine weekly observations during a period where the SMI increased every week. Nevertheless, several important conclusions emerge from Table 3. First, during the period used to estimate hedge ratios, the hedging performance of the SMI futures is excellent for hedging the SMI, the equally-weighted portfolio, and SBG shares. It is poor for all other individual shares. Out-of-sample, the performance of SMI futures is less impressive and outright poor for all individual stocks except BBC.

Which measure of performance reflects more accurately the hedging effectiveness of the SMI futures? The in-sample measure uses considerably more data and hence is probably a more reliable measure of the performance of weekly hedges. While the in-sample measure uses data not available to the hedger to construct the optimal hedge ratios, our evidence is that hedge ratios are fairly stable at least for portfolios. The out-of-sample measure reflects the performance of weekly hedges over a nine week period, so that it may not be a good predictor of the future performance of weekly hedges [2]. It has the advantage, however, of only using information available when the hedge is implemented. The out-of-sample measure emphasizes that short-term hedges may not work very well because of basis risk. The issue of basis risk becomes less important for hedges maintained for longer periods of time and/or to maturity of the futures contracts. For instance, in our example of the previous section, there was no basis risk for an SMI hedge that expired at maturity of the SMI futures contract. To put our results in

Table 4: Hedging the SMI and an Equally-Weighted Portfolio.

	SMI	Equally-Weighted Portfolio
Hedge ratio	-1.0301	-1.1839
Hedge ratio re-estimated	-1.0253	-1.1584
Average weekly return		
- unhedged portfolio	1.762%	1.782%
- hedged without re-estimation	0.051%	-0.185%
- hedged with re-estimation	0.051%	-0.157%
Standard deviation		
- unhedged portfolio	1.011	1.289
- hedged without re-estimation	0.497	1.123
- hedged with re-estimation	0.495	1.112

Notes:
The equally-weighted portfolio consist of six shares (BBC BS,Ciba-Geigy BS, Jacobs-Suchard BS, Rückversicherung PC, SBG BS, SBV BS)
Estimating period: January 25, 1989 - June 7, 1989
Estimating period of re-estimation: January 25, 1989 - July 5, 1989
Hedging period: June 14, 1989 - August 9, 1989

perspective, however, it is useful to note that the in-sample hedging performance of hedges for the SMI and for the equally-weighted portfolio are as good or better than in-sample hedging performance for the American index futures at a similar stage [3]. Table 4 provides the details of hedging the SMI and the equally-weighted portfolio for nine weeks. To construct the hedge, we use weekly data on SMI futures to estimate the regression that yields β. The motivation to use weekly data is that daily data are more noisy due to infrequent trading and other considerations. During the hedge period, the hedge is kept constant. We also re-estimated the hedge ratio in the middle of the hedge period. Using four more weeks of data, the hedge ratio for the SMI becomes -1.0253, which is hardly different from the hedge ratio obtained without these four weeks, namely -1.0301. Since the SMI increased during the hedging period, it is not surprising that the return of the hedged portfolio is lower than the return of the unhedged portfolio.

6. Concluding remarks

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 SOFFEX SMI futures will be similar, one would expect them to have initially properties similar to those of Bank Leu, but with probably more liquidity. On the basis of the evidence of Bank Leu SMI futures, it is clear that the SMI futures contract is useful to hedge portfolio and that its usefulness will steadily improve as the SOFFEX contract becomes more liquid. As a result, once the SOFFEX contract is traded, 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.

Footnotes

[1] See FIGLEWSKI (1985).

[2] The reader should note further that, because all our performance measures cover the same period of time, they are correlated across stocks and portfolios. For instance, a correction of SMI futures pricing during the out-of-sample period would affect the performance of all hedges rather than only one.

[3] See FIGLEWSKI (1985).

Reference

FIGLEWSKI, S. (1985): "Hedging with Stock Index Futures: Theory and Application in a New Market". Journal of Futures Markets 5, pp. 183-199.