# Selective foreign exchange hedging for Korean importers

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**Abstract**

This study tries to examine the selective hedging performances of fixed-term contracting and hedging with futures available to Korean importers facing exchange rate risks. A simple forecasting rule is formulated based on moving averages that generate the signals for selective hedging. A simulation technique is adopted to perform the empirical analysis with the sample data for the period of January 2002 to March 2013. According to the empirical results, the selective hedging strategies produce a maximum of 6 percent reduction in the averages of effective exchange rate flows compared to no-hedging type strategies. However, the maximum percent reductions in variances by these hedging types become prominent, ranging from zero to 56 percent depending on the hedging period.

*Keywords*: selective hedges, hedging performance, exchange rate risks, moving-average forecasts

*JEL Classification*: C15, F31, G32

## 1 Introduction

Like the prices of commodities and financials, the price of foreign currency or the exchange rate is always volatile. During the global financial crisis the exchange rate of Korean won (KRW) to US dollar (USD) showed drastic volatility that was historically rare. Sometimes,

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the exchange rate moved up and down by 100 to 200 won per USD in a single day. That is, the exchange rates might fluctuate in a day by more than ten percent. This situation was said to be comparable to the Asian Financial Crisis that gripped much of Asia beginning in July 1997.

For Korean companies importing goods from abroad, this depreciation of KRW relative to USD would be a financial burden. It is critical for them to find an appropriate measure to deal with exchange rate risk. There have been several traditional ways to protect against the risk exposures of the exchange rate including leading, lagging, netting, and so on. One could fix the exchange rate in advance by making a fixed-term contract for the exchange rate. He or she could also enter derivatives markets to make hedging positions.

Related to the foreign exchange risk by Korean importers, the Korea Exchange (KRX) introduced a US dollar currency futures and options in 1999. In addition, Japanese yen and euro currency futures contracts have been trading in the KRX since May 2006. Each contract covers 5 million yen and 50 thousand euro, respectively. Local and foreign market participants have been utilizing these derivatives contracts as an effective? hedging tool for the major foreign currency risks as well as investment opportunities.

The main objective of this study is to examine the quantitative performance of fixed-term contracting and hedging with futures against exchange rate risks. For this purpose, a simple forecasting rule based on moving averages is introduced to identify future price trends and to make a signal for selective hedging. In order to check the robustness of the empirical results, various hedging periods are considered with different combinations of moving averages.

The remainder of this paper is organized as follows. Section 2 summarizes the main findings of previous studies. Section 3 lays out a theoretical framework that highlights the forecasting rule and the selective hedging strategy. Section 4 describes the data used, the analysis procedure, and the empirical results of hedging performances. Finally, section 5 offers some concluding thoughts.

## 2 Literature review

A considerable amount of research deals with the question of how to protect against exchange rate risks. The issue addressed in this review of literature is how the exposure to these risks can be reduced or eliminated and what the performances of the adopted strategies are in the context of the stabilization of portfolio returns.

One of the most popular approaches to protect against exchange rate risks is risk management using derivatives markets. As Newbery and Stigliz (1981) state, futures and option markets are viable tools by which international traders can reduce their trade-related risks. In fact, there is growing literature related to the optimal hedging strategies using futures markets (Kamara 1982).

Although the problem of offshore commodity traders is not explicitly addressed, some studies analyze currency hedging using foreign exchange futures (Dale 1981; Hill and Schneeweis 1982). Others suggest offshore hedging opportunities when exchange rates are floating (Thompson and Bond 1987; Liu et al. 2001). On the other hand, some provide the analytical frameworks for risk management strategies such as buffer stocks of major raw materials and foreign exchange pegging (Massell 1969; Johnson and Summer 1976).

There are also empirical works related to various forms of hedging strategies to cope with multiple risks such as commodity price and exchange rate (Fackler and McNew 1993; Lapan and Moschini 1994; Vukina et al. 1996; Li and Vukina 1998; Liu et al. 2001; Yun, 2009). Furthermore, the risk exposure of ocean freight rates is explicitly considered with commodity price and exchange rate risks (Hauser and Neff 1993; Haigh and Holt 2000, 2002).

However, there are few studies regarding selective hedging opportunities for traders' exposure to exchange rate risks. First labeled by Stulz (1996)[1], selective hedges refer to the hedging strategy based on

[1] Stulz points out the value-adding aspect of hedging. In fact, few companies routinely use derivatives to take a "naked" speculative position. Most institutions make use of their own forecasting about future asset prices. There are several studies describing the real-world practice of selective hedging (Dolde 1993; Bodnar et al. 1998; Brown 2001; Brown et al. 2001; Glaum 2002; Naik and Yadav 2003).

the hedger's market expectations by which he may decide to hedge only part of his position or not at all. Basically, a selective hedging strategy involves forecasting future spot prices. That is, a trader makes the decision of whether to hedge or not depending on price expectations. For example, a cash buyer would take a long position in futures if he is confident about the surge in spot prices. Contrary to this, he would leave his cash position unhedged when the spot price is expected to decrease.

Eun and Resnick (1997) suggest a selective hedging strategy for exchange rate risks using a random walk model. Compared to the unhedged and routine hedging strategies, the selective hedging strategy appears to exhibit superior performance. Other studies related to selective hedging include Perold and Schulman (1988), Filatov and Rappoport (1992), Glen and Jorion (1993), Solnik (1998), and Beltratti et al. (1999) for a securities portfolio, Linn and Zhu (2002) for natural gas, and Yun (2006) for oil stockpiling among others.

## 3 Theoretical model

This study sets up a theoretical framework for selective hedging strategies. And it simulates the weekly exchange rate flow faced by Korean importers. Korean importers are assumed to face the risk exposures of foreign exchange only, specifically the exchange rate of Korean won to US dollar. Finally, it compares the stability of exchange rate flow by different hedging type and period. The hedging types are classified as the following four: (1) the "spot-only" or "no-hedging" type that refers to purchasing US dollars at the current exchange rate; (2) the "term-only" type that fixes the exchange rate at an earlier date corresponding to the hedging period assumed; (3) the "selective hedging (1)" type with spot or term contracting depending on the pricing signals; and (4) the "selective hedging (2)" type with long futures position depending on the pricing signals. The twelve hedging periods are assumed to range from one to twelve months.[2]

[2] The numbers of weeks corresponding to one to twelve months are 4, 8, 13, 17, 21, 26, 30, 34, 39, 43, 47, and 52, respectively.

Assume that Korean importers measure their terminal importing costs in Korean won and that the hedging decisions are influenced by the exchange rate only. In order to protect against an unfavorable exchange rate change, they would decide whether to purchase US dollars at a floating spot rate later or a constant term rate fixed now. Simply stated, one would fix the exchange rate by taking a term contract now if the exchange rate is expected to rise. However, he or she would wait to purchase US dollars until a remittance date when the exchange rate is forecasted to drop. The key issues are how to forecast the exchange rate, and how accurate the forecasted results will be.

For this purpose, an empirical analysis is performed to test the usefulness of the selective hedging strategy available to Korean importers facing exchange rate risks. The usefulness of the selective hedging strategy is evaluated in terms of hedging effectiveness. The hedging effectiveness measures the percent reduction in variance from the unhedged portfolio. In this context, the main purpose of selective hedges by Korean importers would be to reduce the volatility of exchange rates, thus stabilizing the exchange rate flow inherent in the import costs.

The selective hedging strategy is primarily based on a simple moving average forecast. Moving averages are one of the most popular and easy tools for technical analysis. They smooth a data series and make it easier to identify trends, making them especially helpful in volatile markets. Using moving averages, one can also build blocks for many other technical indicators and overlays. In this study, moving averages are utilized to indicate the signal of whether to take spot or term positions. The $k$-week moving average ($MA_k$) is created by simply taking an average of spot price observations corresponding to previous $k$ weeks ($SP_t$) shown as below. This averaging proces is repeated for each subsequent subset of the full data set at a time until the final value.

$$MA_k = \frac{1}{k}\sum_{t=t-k}^{t-1} SP_t \ (k = 2,3,4,...) \tag{1}$$

The relationship between moving averages and price trend forecasting is as follows. When the short-term moving average turns out to be greater than the long-term one, that is, $MA_{short} > MA_{long}$, the spot prices

are expected to increase indicating an up trend of spot prices. The effective exchange rate at time $t$ established at an earlier time $t$-$i$ ($EFX_{t,i}$) would be the following form:

$$EFX_{t,i} = 0 \times SP_t + 1 \times FP_{t-i} \; (i = 4,8,13,...,52) \tag{2}$$

Here, $SP_t$ and $FP_{t-i}$ stand for spot and futures prices at time $t$ and $t$-$i$, respectively. And, subscript $i$ corresponds to the number of weeks for the hedging period. Contrary to this situation, when $MA_{short} \leq MA_{long}$, the spot prices are forecasted to decrease or remain steady. The effective exchange rate at time $t$ would be the following form:

$$EFX_{t,i} = 1 \times SP_t + 0 \times FP_{t-i} \; (i = 4,8,13,...,52) \tag{3}$$

Alternatively, the effective exchange rate would be obtained by assuming a traditional long hedge using futures contract shown below:

$$\text{If } MA_{short} > MA_{long}, \; EFX_{t,i} = 0 \times SP_t - 1 \times (FP_t - FP_{t-i}) \; (i = 4,8,13,...,52) \tag{4}$$

$$\text{If } MA_{short} \leq MA_{long}, \; EFX_{t,i} = 1 \times SP_t - 0 \times (FP_t - FP_{t-i}) \; (i = 4,8,13,...,52) \tag{5}$$

In eq. (4), one would take a long and full position in futures when $MA_{short} > MA_{long}$ implying an up trend of spot prices. In eq. (5), he or she would speculate on the spot market without hedging if $MA_{short} \leq MA_{long}$ indicating a down trend of spot prices. In a traditional hedging framework, one needs to estimate the optimal hedge ratio that minimizes the variance of the hedged portfolio. However, this study ignores the hedge ratio, and adopts a simple rule of all-or-nothing hedging strategy depending on the pricing signals.

# 4 Empirical results

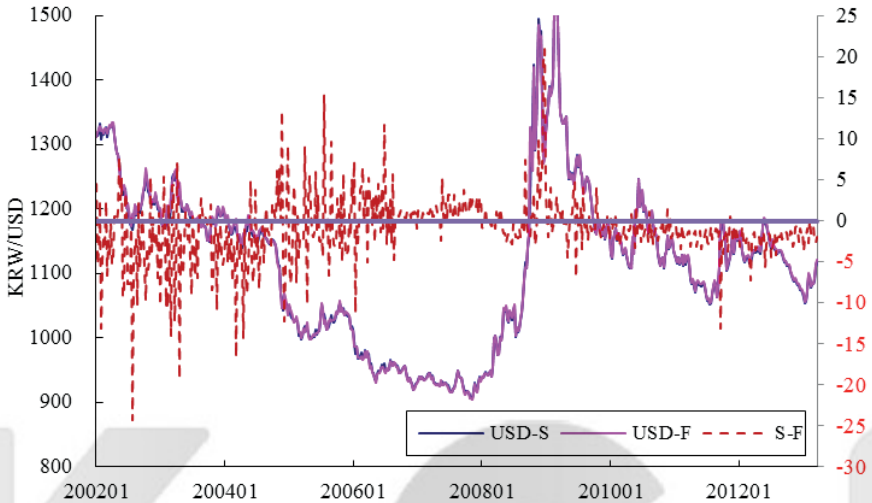
## 4.1 Data and analysis procedure

This study uses every Friday spot and the most nearby futures settlement prices of US dollar currency denominated in Korean Won. The data set is available from the Korea Exchange (KRX). The sample covers the period of January 2002 to March 2013. This weekly data set has 586 observations, and is reduced to 534 observations by deleting the first 52 observations for differencing up to the maximum twelve months of the hedging period.

For ex ante analysis, the whole sample period is divided into two sub-samples. The first sub-sample period ranges from January 2002 to September 2007 (300 observations) for finding the signals for spot or term contracting by different combinations of long- and short-term moving averages. The second sub-sample period covers from October 2007 to March 2013 (286 observations) for testing the hedging effectiveness by different hedging type and period.

Figure 1 shows the data series of spot and futures prices for the whole sample period. It also presents the basis defined as spot prices minus futures prices. As noticed in Figure 1, contangos appear more frequently (about 65%). Backwardations dominate in some periods of the sample when the exchange rates are relatively high.

Figure 1. Spot and futures prices of KRW/USD exchange rates




In order to simulate the effective exchange rate flow each week of the out-of-sample period, the following steps are performed:

(1) Finding the signals for spot or term contracting by different combinations3 of long- and short-term MAs using the sub-sample corresponding to the original in-sample period;
(2) Calculating the effective exchange rates of different hedging types and periods for the first week of the out-of-sample period;
(3) Repeating steps (1) and (2) until the final week of the out-of-sample period by subsequently altering the in-sample period, that is, rolling forward the in-sample by one week at a time;
(4) Generating the effective exchange rate flows of different hedging types and periods for the whole out-of-sample period; and
(5) Comparing the averages and the variances of the effective exchange rate flows compared to the spot-only or no-hedging type.

Especially, the variances of the effective exchange rate flows are compared in terms of hedging effectiveness. Following Johnson (1960) and Ederington (1979), the hedging effectiveness (*HE*) refers to the gain or loss in the variance of terminal revenue resulting from the price

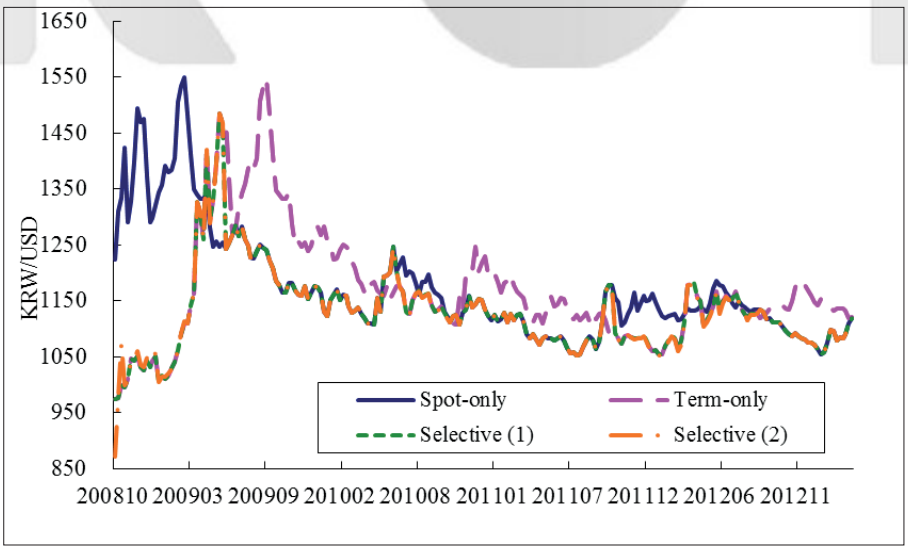
changes in an unhedged position relative to those in a hedged position defined as:

$$HE = \frac{(\text{var}^{u}(\pi_t) - \text{var}^{h}(\pi_t))}{\text{var}^{u}(\pi_t)} \tag{6}$$

where $\text{var}^{u}(\pi_t)$ and $\text{var}^{h}(\pi_t)$ are the variances for the unhedged and the hedged positions, respectively.

Figure 2 depicts the simulated exchange rate flows of four different hedging types for the whole out-of-sample period. Note that the hedging period is assumed to be 26 weeks (6 months). The long- and the short-term MAs are 43 weeks (10 months) and 8 weeks (2 months), respectively. The in-sample and the out-of-sample sizes are 300 and 286 weeks, respectively. Below the exchange rate of 1,200 KRW/USD corresponding to the period of September 2009 to March 2013, the effective exchange rate flows of the four hedging types are quite similar. How-

Figure 2. Simulated series by different hedging type




*Note*: the hedging period is assumed to be 26 weeks (6 months). The long- and the short-term MAs are 43 weeks (10 months) and 8 weeks (2 months), respectively. The in-sample and the out-of-sample sizes are 300 and 286 weeks, respectively.

ever, the effective exchange rate flow of the spot-only type dramatically differs from those of the other three hedging types above this level of exchange rate. This result indicates that there would be some threshold level from which up and down price trends are clearly identifiable.

## 4.2 Empirical results

Table 1 presents the maximum percent reduction in averages by hedging period for the out-of-sample period. The spot-only or no-hedging type produces the averages of 1,173.3 KRW/USD regardless of hedging periods. The term-only type shows a maximum of 2.3 percent reduction in the averages of effective exchange rate flows. The selective hedging (1) type with spot or term contracting yields a maximum of 6.9 percent reduction in the averages. The selective hedging (2) type with long futures position exhibits similar but slightly better results than those of the selective hedging (1) type.

Table 1. Maximum percent reduction in average by hedging period

| Hedging Period (week) | Spot-Only | Term-Only | % Change[1)] | Selective Hedging (1) | % Change[2)] | Selective Hedging (2) | % Change[3)] |
|---|---|---|---|---|---|---|---|
| 4 | 1173.3 | 1174.9 | 0.141 | 1172.5 | -0.066 | 1172.2 | -0.095 |
| 8 | 1173.3 | 1174.4 | 0.090 | 1166.9 | -0.548 | 1166.5 | -0.580 |
| 13 | 1173.3 | 1173.4 | 0.006 | 1153.7 | -1.672 | 1153.3 | -1.704 |
| 17 | 1173.3 | 1172.6 | -0.059 | 1144.6 | -2.442 | 1144.3 | -2.474 |
| 21 | 1173.3 | 1171.8 | -0.129 | 1137.6 | -3.043 | 1137.2 | -3.075 |
| 26 | 1173.3 | 1169.3 | -0.344 | 1128.8 | -3.795 | 1128.4 | -3.827 |
| 30 | 1173.3 | 1166.9 | -0.547 | 1122.5 | -4.328 | 1122.1 | -4.359 |
| 34 | 1173.3 | 1163.6 | -0.827 | 1115.9 | -4.893 | 1115.5 | -4.925 |
| 39 | 1173.3 | 1159.3 | -1.197 | 1109.6 | -5.426 | 1109.3 | -5.456 |
| 43 | 1173.3 | 1155.1 | -1.550 | 1104.6 | -5.856 | 1104.2 | -5.887 |
| 47 | 1173.3 | 1150.9 | -1.906 | 1099.1 | -6.320 | 1098.8 | -6.349 |
| 52 | 1173.3 | 1146.1 | -2.316 | 1092.8 | -6.863 | 1092.5 | -6.890 |

1) {[Var(Spot-Only) – Var(Term-Only)]/Var(Spot-Only)} x 100
2) {[Var(Spot-Only) – Var(Selective (1))]/Var(Spot-Only)} x 100
3) {[Var(Spot-Only) – Var(Selective (2))]/Var(Spot-Only)} x 100

Table 2 presents the maximum percent reduction in variance by hedging period for the out-of-sample period. The spot-only or no-hedging type produces the standard deviations of 98.1 KRW/USD regardless of hedging periods. The term-only type shows no reduction in the variances of effective exchange rate flows except for the hedging period of 1 to 2 months. The selective hedging (1) type yields about 3 to 56 percent reduction in the variances. The selective hedging (2) type exhibits about zero to 56 percent reduction in the variances. Comparing the selective hedging (1) with (2) types, the former shows better results than the latter regardless of hedging periods. The variations in the variance reduction between the selective hedging (1) and (2) types turn out to be less than 3 percent.

Table 2. Maximum percent reduction in variance by hedging period

| Hedging Period (week) | Spot-Only | Term-Only | % Change[1)] | Selective Hedging (1) | % Change[2)] | Selective Hedging (2) | % Change[3)] |
|---|---|---|---|---|---|---|---|
| 4 | 98.1 | 96.7 | -2.933 | 96.3 | -3.667 | 97.9 | -0.485 |
| 8 | 98.1 | 97.3 | -1.596 | 96.4 | -3.423 | 97.6 | -0.994 |
| 13 | 98.1 | 98.7 | 1.164 | 88.5 | -18.615 | 89.0 | -17.669 |
| 17 | 98.1 | 99.6 | 3.008 | 82.4 | -29.395 | 82.9 | -28.544 |
| 21 | 98.1 | 100.5 | 4.824 | 78.5 | -36.035 | 78.7 | -35.660 |
| 26 | 98.1 | 103.5 | 11.198 | 72.6 | -45.279 | 73.1 | -44.476 |
| 30 | 98.1 | 106.0 | 16.749 | 66.9 | -53.577 | 67.5 | -52.708 |
| 34 | 98.1 | 109.8 | 25.327 | 64.8 | -56.417 | 65.1 | -55.941 |
| 39 | 98.1 | 114.4 | 35.986 | 66.6 | -53.882 | 66.9 | -53.480 |
| 43 | 98.1 | 118.2 | 45.210 | 68.2 | -51.641 | 68.4 | -51.363 |
| 47 | 98.1 | 122.2 | 55.057 | 70.3 | -48.624 | 70.5 | -48.309 |
| 52 | 98.1 | 127.0 | 67.484 | 73.2 | -44.280 | 73.3 | -44.203 |

1) {[Var(Spot-Only) – Var(Term-Only)]/Var(Spot-Only)} x 100
2) {[Var(Spot-Only) – Var(Selective (1))]/Var(Spot-Only)} x 100
3) {[Var(Spot-Only) – Var(Selective (2))]/Var(Spot-Only)} x 100

Table 3 summarizes the combinations of long- and short-term MA factors (denoted as $k$ in eq. (1)) that generate the maximum percent reduction in the averages and the variances of effective exchange flows by hedging period. For example, the selective hedging (1) type would pro-

duce the maximum reduction in average with the long-term MA = 39 weeks (9 months) and short-term MA = 8 weeks (2 months) for the 26-week (6-month) hedging period. The combinations of MA factors differ by hedging type and period. This result implies that the combination of MA factors would influence the predictability of price trends. In turn, the predictability based on the moving averages would have a crucial impact on the hedging results in terms of the reduction in the averages and the variances of exchange rate flows. Therefore, one needs to find an optimal and ex ante combination of MA factors to forecast future price trends and thus make the signals for taking position in spot or term contracts.

Table 3. Moving average factors for maximum percent reduction in average and variance by hedging period

| Hedging | Average | | | | Variance | | | |
|---|---|---|---|---|---|---|---|---|
| Period | Selective (1) | | Selective (2) | | Selective (1) | | Selective (2) | |
| (week) | L-MA | S-MA | L-MA | S-MA | L-MA | S-MA | L-MA | S-MA |
| 4 | 39 | 26 | 39 | 26 | 43 | 26 | 43 | 26 |
| 8 | 39 | 8 | 39 | 8 | 39 | 8 | 39 | 8 |
| 13 | 39 | 8 | 39 | 8 | 39 | 8 | 39 | 8 |
| 17 | 39 | 8 | 39 | 8 | 39 | 8 | 39 | 8 |
| 21 | 39 | 8 | 39 | 8 | 39 | 8 | 39 | 8 |
| 26 | 39 | 8 | 39 | 8 | 39 | 8 | 39 | 8 |
| 30 | 39 | 8 | 39 | 8 | 39 | 8 | 39 | 8 |
| 34 | 39 | 8 | 39 | 8 | 39 | 8 | 39 | 8 |
| 39 | 56 | 8 | 56 | 8 | 56 | 8 | 56 | 8 |
| 43 | 60 | 8 | 60 | 8 | 56 | 13 | 56 | 13 |
| 47 | 65 | 13 | 65 | 13 | 65 | 13 | 65 | 13 |
| 52 | 73 | 8 | 73 | 8 | 73 | 8 | 73 | 8 |

# 5 Conclusions

This study tries to examine the hedging performances of selective hedging strategies available to Korean importers facing exchange rate

risks. For this purpose, a simple forecasting rule is introduced using moving averages. The effective exchange rate flows are generated depending on the pricing signals of whether to take spot or term positions. The percent reductions in averages and variances are calculated by different hedging type and period. The sample data is the spot and the futures exchange rates of KRW/USD and covers the period of January 2002 to March 2013. The empirical analysis is performed by an ex ante simulation procedure.

According to the empirical results, the term-only type and the selective hedging strategies produce about 2 to 6 percent reduction in the averages of effective exchange rate flows compared to the spot-only or no-hedging type. However, the maximum percent reductions in variances by these hedging types become prominent. That is, the reduction rates amount to a maximum of 56 percent depending on the hedging period. In order to examine the sensitivity of hedging performances to the key elements in the simulation process, this study uses various combinations of moving average factors and hedging periods. The variant quantitative results imply that one needs to consider the important information depending on the combinations of moving averages and hedging periods in forecasting future price trends. This would improve the predictability of future spot prices and thus the performances of selective hedging strategies.

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