Does information asymmetry really explain the extrapolative expectation of foreign investors?

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Abstract

It is often argued that foreign investors in a domestic market have an extrapolative expectation because of their informational disadvantages. More precisely, the claim is that foreign investors, absent other sources of information, revise their expectation about the future price of a domestic stock more in line with its current price change. In this paper, we analytically show that a temporary component in stock price makes it possible that *better informed* or *long-term* investors are more extrapolative and that their greater response to a given price change is in fact *short-lived*. We empirically confirm these and other implications of our analysis using the quote data for the futures contracts written on a broad-based Korean stock market index. Specifically, we find that compared with domestic investors, foreign investors show a greater reaction to price changes only at a short measurement interval and that their performance is better than that of domestic investors particularly for a longer investment horizon.

Keywords: foreign investors; extrapolative expectations; temporary component in stock price; stock index futures

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1. Introduction

One of the most stylized facts about foreign investors in a domestic market is that foreigners purchase (sell) domestic stocks following a positive (negative) return on those stocks (e.g., Tesar and Werner 1994, 1995; Bohn and Tesar 1996; Brennan and Cao 1997; Choe, Kho, and Stulz 1999; Grinblatt and Keloharju 2000; Froot, O'Connell, and Seasholes 2001). Often called a positive feedback trading, this behavior has been understood mostly in the context of information asymmetries between domestic and foreign investors (e.g., Brennan and Cao 1997). More precisely, the explanation has been that since foreign investors do not have as much private information as domestic investors, a given price change in a domestic stock (which is public information) renders foreigners revise their expectation about its future price more than domestic investors; consequently, foreigners trade more in line with the current price change. In short, the positive feedback trading of foreign investors—it is argued—is a reflection of their extrapolative expectation about domestic stocks, which is a rational response to a given price change as a less-informed investor.

In this paper, we examine whether foreign investors have an extrapolative expectation and, if so, it is indeed attributable to their informational disadvantages. This inquiry is motivated by the mixed empirical results on the information asymmetry between domestic and foreign investors (e.g., Grinblatt and Keloharju 2000; Seasholes 2000; Choe, Kho, and Stulz 2005) and by the absence of direct evidence on the expectations of foreign investors about domestic stocks.[1] This investigation is also warranted by the fact that the purchase (sale) of domestic stocks following their positive (negative) return is attributable to factors other than an extrapolative expectation, such as the portfolio insurance strategy or the contrarian strategy of the counterparty investors.

[1] An important exception is Brennan et al. (2005). However, their evidence is based on survey data. As detailed shortly, our evidence is based on quotes for futures contracts written on domestic stocks, which is a more direct measure of an investor's expectation.

There are two unique features in our investigation. First, by postulating the stock price (in natural log) as the sum of a temporary and a permanent component, we show that it is possible for *better-informed* or *long-term* investors to revise their expectation more in line with the current price change. Second, in testing this and other empirical implications of our analysis—all of which are not readily available in the conventional approach to the extrapolative expectation—, we directly measure the investor's expectation via her quotes for a futures contract written on a broad-based domestic stock market index.

Let us first summarize our analysis of an extrapolative expectation and its empirical implications. The key notion here is the fact that an innovation in the permanent component has a larger impact on the future price than an innovation in the temporary component. (See Section 2 for details.) Consequently, with heterogeneity among investor in terms of their weighting between the two components, a temporary mispricing will render a better-informed investor who focuses on the permanent component revise his expectation about future price more in line with the current price change. Similarly, with a time-varying element in efficient pricing, it will be a long-term investor who attaches a greater weight on the permanent component and thus revises the expectation more in line with the current price change. In this setup, the only sensible scenario of less-informed investors being more extrapolative is that the temporary component is mispricing and the less-informed investors mistakenly react to it, while responding to the permanent component as much as the better-informed investors do.

The immediate empirical implication arising from our analysis, regardless of whether it is a better-informed or a less-informed investor who is more extrapolative, is that the differing reactions to the current price change among investors are short-lived. The reason is obvious: changes in stock price at a longer interval are more likely to be triggered by an innovation in the permanent component rather than by changes in the temporary component, since the latter arises and then dissipates during the interval.

Another empirical implication concerns the manner in which the differing reactions to the current price change become less pronounced at a longer measurement interval. If the better-informed or long-term investors at a shorter interval are more responsive to the current price change by focusing more on the permanent component, then other investors will eventually catch up at a longer interval during which the role of a temporary component is limited. In contrast, if the less-informed investors are more extrapolative at a short interval due to their erroneous response to temporary mispricing, then the convergence among investors at a longer interval is predicted to occur as those extrapolative investors become less responsive to price changes.

The same logic leads us to another empirical implication that helps gauge the importance of recognizing a temporary component in understanding the investor's response to price changes. Note that the temporary component, by nature, will cause the changes in expectation measured at a short interval to be serially negatively correlated. As a result, the variance of the expectation changes will not increase linearly with the length of the interval. We predict that these patterns not only exist but also manifest themselves particularly with those investors who assign a greater weight on the temporary component.

The final empirical prediction allows us to determine whether it is a better-informed (long-term) investor or a less-informed investor who is more extrapolative. If it is the better-informed or long-term, then they will perform better than others, especially over a longer horizon. If, on the other hand, it is the less-informed ones, then the performance of these extrapolative investors should be worse that that of less extrapolative investors.

To test these empirical predictions, we use the futures quotes as a proxy for the future spot price expected by the quote submitter. This approach is on the grounds that the quote for a futures contract is the price at which the quote submitter is willing to trade the underlying asset at a

future date. That is, the quote reveals his expectation about the future spot price.[2] Specifically, we use the quote data for a broad-based index for the Korean stock market, namely, KOSPI 200. This index futures market is one of the most liquid ones in the world. More importantly, this market is uniquely characterized by the heavy participation of individual investors. Consequently, our experimental setting enables us to analyze all three key players in the spot market—namely, domestic individuals, domestic institutions, and foreign investors.

For the period from December 2005 to December 2006, we find strong empirical support for all of our predictions. Specifically, by regressing the 5-minute quote changes on the contemporaneous changes in spot price, we find that foreigners revise their expectation the most in response to a given price change. Domestic individual investors are at the other extreme, with domestic institutional investors in the middle. With daily-frequency data, however, this cross-investor difference disappears. What is more, their reactions to price changes become similar as the less responsive investors at the 5-minute interval revise their expectations more in line with price changes at daily frequency. We also find that the quote changes are more negatively auto-correlated for domestic individuals, confirming that they are the ones who pay attention to the temporary component in stock price. Finally, we find that the performance of domestic individuals is the worst as the investment horizon lengthens. Conversely, foreign investors perform better for a longer investment horizon.

Interestingly, the positive relation of foreign equity capital flows to domestic stock returns is observed at various frequencies. (See the references at the beginning of this introduction.) Then, how are our results reconciled with those flow-based results? Note first that the contemporaneous relationship between the two is open to several alternative explanations. For example, it could be that foreigners create a price pressure in the direction that they trade. Another possibility is that

[2] We are aware that the futures price and thus the quote are only a biased predictor of the future spot price of the underlying asset (see, e.g., Fama 1984). We discuss this issue in Section 2. In addition, the investor may want to buy (sell) the asset at a lower (higher) price than at the price he believes to prevail in the future. For this reason, we use the average of the bid and ask quotes.

foreigners buy (sell) in advance of a price appreciation (decline), but the low frequency of data makes this lagged relationship appear to be a concurrent one. Yet, even for a lagged relationship detected with sufficiently high-frequency data (e.g., Froot, O'Connell, and Seasholes 2001), one could legitimately argue that it is the domestic contrarians who are actually driving the positive relation of foreign equity capital flows to domestic stock returns. To sum, the positive relationship between foreign equity capital flows and domestic stock returns at various frequencies does not necessarily mean that the extrapolative expectation of foreign investors persists over those horizons. As a matter of fact, some recent studies control for the persistence of foreign equity capital flows and find that their relation to domestic stock returns is rather short-lived (e.g., Griffin, Nardari, and Stulz 2004). This is exactly what we predict.

This paper proceeds as follows. In the next section, we detail our approach to an extrapolative expectation based on a temporary and a permanent component, and develop its empirical predictions. Section 3 describes the sample and data, and Section 4 reports the empirical results. Section 5 concludes the paper.

2. Hypothesis development

In this section, we first show that a temporary component in stock price causes an investor to be extrapolative even if he is *not* informationally disadvantaged. In other words, the link between the expected future price of a stock and its current price change does *not* necessarily stem from an informational disadvantage. We then discuss how the quotes for a futures contract written on the stock help us detect its future spot price expected by the quote submitter. Finally, we develop several testing hypotheses.

2.1. A simple approach to an extrapolative expectation

We begin with the following model for stock price (in logarithm).

$$P_t = P_t^* + u_t \,, \qquad (1)$$

where $P_t^* = \mu + P_{t-1}^* + \varepsilon_t$ and $u_t = \alpha \times u_{t-1} + v_t$. The former represents a permanent component in stock price (with a long-run growth rate of μ), whereas the latter stands for a temporary component. Their innovations, ε_t and v_t, are assumed to be uncorrelated with each other and to follow *iid* N(0, σ_ε^2) and *iid* N(0, σ_v^2), respectively. It is also assumed that $|\alpha|<1$, since the temporary component cannot grow for ever, by definition.

The above model is suggested by Summers (1986) in the name of a "fad" model. However, the existence of a temporary component is also consistent with efficient pricing with a time-varying expected return (Fama and French 1988). This ambivalence of the model is in fact useful, since we can show that the results from the model are robust to alternative interpretations of the temporary component. We thus remain agnostic about its sources.

With the above model, it is easy to show that a one-unit increase in ε_t results in the following impact on the next-period price.

$$\frac{\partial P_{t+1}}{\partial \varepsilon_t} = 1 \,, \qquad (2)$$

On the other hand, the impact on the next-period price of a one-unit increase in v_t is as follows.

$$\frac{\partial P_{t+1}}{\partial v_t} = \alpha \ \,, \qquad (3)$$

Since $|\alpha|<1$, the effect on the next-period price of a shock to the permanent component is greater than that of a shock to the temporary component. Using this observation and with investor heterogeneity in terms of the weighting between the temporary and permanent components (since an investor's informational disadvantage is defined only when compared with others), below we show that the informational advantage does not necessarily result in an extrapolative expectation.

Suppose that some investors respond solely to the innovations in the permanent component, whereas others pay attention to the innovations in the temporary component alone. Or

equivalently, suppose that some investors perceive a given change in the stock price to be an innovation in the permanent component, whereas others take it for an innovation in the temporary component.[3] In such cases, a given change in the price will render the former group of investors revise their expectation about future price more than the latter group—i.e., the former will be more extrapolative. Does this mean that the former group of investors is informationally disadvantaged? If the temporary component is to be mispricing, then those extrapolative investors are in fact *better informed* because they are not responding to temporary mispricing. If, on the other hand, the temporary component is thought of as a time-varying element in efficient pricing, then those extrapolative investors are a *long-term investor* who does not respond to the temporary component because it dissipates during their holding period.

What if investors are allowed to respond to both components? To allow for heterogeneity among investors, we posit two groups of investors. Specifically, investor group i assigns w_i to the permanent component and $(1-w_i)$ to the temporary component. Similarly, investor group j applies w_j and $(1-w_j)$ to the two components, respectively. The adding-up constraint (i.e., $w_i + (1-w_i) = 1$) serves a purpose here by allowing a better-informed (long-term) investor to be less responsive to mispricing (transient shocks). With $w_i > w_j$, investor group i will be more extrapolative, since its response, $[w_i + (1-w_i)*\alpha]$, is greater than $[w_j + (1-w_j)*\alpha]$ for investor group j. Note that the extrapolative response of group i is, again, attributable to its informational advantage or to the longer investment horizon.

Alternatively, we can relax the adding-up constraint, so that the responses to the two components are not correlated with each other. Of all the resultant possibilities, the only sensible scenario of a less-informed investor being more extrapolative is that the temporary component is mispricing and the less-informed investor responds to it more than better informed investors do,

[3] This is similar to the presumption in, for example, Harrison and Kreps (1978) and Barberis, Shleifer, and Vishny (1998), in the sense that investors are "positive" about what they believe.

while reacting to the permanent component correctly (i.e., as much as the better-informed investors do).[4]

In a nutshell, an extrapolative expectation due to an informational disadvantage is not a robust result. Rather, the opposite seems to be more plausible. Then, how do Brennan and Cao (1997) obtain their result that an informational disadvantage results in an extrapolative expectation? In their model, each investor receives a private signal about the future payoffs of an asset, which is similar in contents but different in precision. By definition, better-informed investors receive a more precise signal, and thus their demand for the asset is more pronounced (in either direction) than that of less-informed investors. The model is of a noisy rational expectations, so the price of an asset changes in accordance with (albeit imperfectly) changes in its economic fundamentals. Consequently, better-informed investors are expected to trade more in line with the current price change.

However, the less-informed investors will not keep yielding the opportunity to react to new information to the better-informed. Those lost opportunities will cumulate over time and, at some point, the less-informed investors will be better off acting on their own noisy signal. Brennan and Cao assume that this "cumulative" effect dominates the "marginal" (i.e., current-time) effect, thereby making the demand of the less-informed investors stronger than that of the better-informed investors. Again, combined with the partially revealing asset price, it will be the *less-informed* investors who trade are more in line with the current price change; hence, the conclusion that the less-informed investor are more extrapolative.

In our setup, the result of Brennan and Cao can be rephrased as the less-informed investors being so anxious about the lack of information that they mistake temporary mispricing for valid information and thus respond to it. Note that Brennan and Cao's approach to an extrapolative

[4] In this scenario, the permanent component represents economic fundamentals, so it is difficult to imagine that a less-informed investor responds to it more than a better-informed investor. Note that a general overreaction of the less-informed investor is subsumed by the scenario in the text: he responds more to the temporary component, which is mispricing.

expectation is rather indirect. More precisely, to examine the international equity capital flows in the asymmetric information framework, the authors focus on the expected trades conditional on a certain price change. On the contrary, our approach speaks directly to the expected future price of an asset given its current price change.

2.2. Measuring expected future spot price via quotes for futures contract

To make our approach operational, we should be able to measure the future spot price of an asset expected by an investor. We do this by using the quotes for futures contracts written on the asset. By definition, the quote for a futures contract written on an asset is the price at which the quote submitter is willing to trade the asset at a future date. Of course, the quote will not precisely represent the submitter's expectation about the future spot price of the asset, since the actual spot price in the future can be different from the expected value even if the expectation is unbiased. That is, a risk premium will create a wedge between the futures quote and the expected future spot price.[5] Similar to Fama (1984), we thus express the futures quote as follows.

$$Q_t^i = E_t^i\left(P_{t+j}\right) - RP_{t,t+j}^i , \qquad (4)$$

where Q_t is the time-t quote for a futures contract written on an asset, $E_t(\cdot)$ is the time-t expectations operator, P_t is the time-t spot price for the asset, and $RP_{t,t+j}$ is the risk premium for the asset from t to $t+j$. Note that the superscript i indicates that it is a subjective estimate for investor i. Note also that the negative sign in front of the risk premium implies that the futures contract has a positive beta; if not, the premium will take a negative value and correct the equation automatically.[6]

[5] Additionally, the investor may want to buy (sell) the asset at a lower (higher) price than what he believes to prevail in the future. However, this deviation becomes irrelevant once we use the average of the bid and ask quotes.

[6] Prior studies have shown that hedging pressure is not an important determinant of the risk premium for financial futures, because the underlying assets are easily marketable. Instead, those studies show that the premium is determined by the systematic risk. See, for example, Black (1976) or Bessembinder (1992). For

In this paper, we use the futures contracts written on a broad-based index for a particular stock market, namely, Korea. Given its extremely high trading volume, it is not unreasonable to assume that j is in the very near future, at most a day. For such an interval, the risk premium will be negligible and allow us to use the following:

$$\partial Q_t^i \approx \partial E_t^i\left(P_{t+j}\right). \tag{5}$$

Our empirical strategy is thus to use changes in the futures quotes as a proxy for changes in the expected future spot price. Similarly, we can obtain the following:

$$\frac{\partial Q_t^i}{\partial P_t} \approx \frac{\partial E_t^i\left(P_{t+j}\right)}{\partial P_t}. \tag{6}$$

According equations (2) and (3), the right-hand side of eq. (6) is either 1, or α, or some combination of the two, depending on how the investor weights between the temporary and permanent components in response to a given price change. It thus follows that the expectation revision by an investor in response to price changes can be directly measured by regressing changes in the futures quotes on the contemporaneous changes in the spot price.

2.3. Hypotheses

Testing hypotheses are now developed. One unique feature of our approach is its recognition of a temporary component in stock price. Recall that in our setup, an extrapolative expectation—or equivalently, a greater response to changes in price—always involves a temporary component. That is, some investors are more extrapolative than others as former responds to the temporary component less than the latter. As the measurement interval for price changes lengthens, however, the role of the temporary component becomes limited, since they arise and then dissipate during the interval. Consequently, we have the following hypothesis.

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commodity futures contracts, however, both hedging pressure and systematic risks affect the risk premium. See, for example, Hirshleifer (1988).

H1. Differing reactions to a given price change between investors will be less (more) pronounced with a longer (shorter) measurement interval.

Note that *H1* is not inconsistent with Brennan and Cao (1997), although they do not explicitly make this prediction. In their model, however, an extrapolative expectation arises when the less-informed investors react to temporary mispricing more than other investors do. Hence, their model would predict that *H1* finds empirical support as those less-informed (i.e., more responsive) investors become less so over a longer horizon. In stark contrast, our approach predicts a convergence among investors via the initially less responsive investors becoming more responsive at a longer interval. Hence, we have the second hypothesis.

H2. The convergence among investors with a longer measurement interval will occur as those investors who are less responsive with a shorter interval become more responsive with a longer interval.

Our approach also offers a prediction about an unconditional characteristic of an investor's expectation. A temporary component, by definition, arises and then disappears. Thus, the investors who respond to it will revise their expectation such that those revisions are serially negatively correlated. It will also be the case that the variance of those revisions measured at a short interval will be larger than the one for a longer interval, after controlling for the difference in interval length. To sum, we have the following hypothesis.

H3. The quote changes measured at a short interval will be serially negatively correlated, and the variance of those changes will increase less than linearly with the length of the interval. Further,

those two patterns will be more pronounced with investors focusing more on a temporary component than on a permanent component in stock price.

If some investors are better informed than others, then the performance of the former must be better than that of the latter. Consequently, an investigation into investor performance will determine whether the extrapolative investors (identified at a shorter interval) are better or less informed. To this end, we borrow the notion of Barclays and Warner (1993) and calculate the ratio of: the price contribution of a certain investor group over a certain period to the total spot price change during the same period. By construction, the numerator of the ratio is positive when the trade is a buy, and negative when the trade is a sell. Consequently, the ratio tells us whether a particular investor group trades in the same direction as the price change.

Over a short period, this ratio may convey a wrong impression, because the investor group can create a price pressure though its own trading. It is also possible that these investors are actually trading with contrarians who have superior information. As the ratio is calculated over a longer horizon, however, these concerns are minimized. As a matter of fact, this performance measure is useful for the very reason that it can point to different investor groups for different horizons. We thus have the following prediction.

H4. If the extrapolative investors, identified at a short interval, are better-informed or long-term investors, then their price contribution measure will be greater than that of other investors, especially over a longer horizon.

3. Sample and data

Our data are from Korea. Specifically, we use the quote data for futures contracts written on an index comprising 200 largest stocks in the Korean stock market (KOSPI 200). The data spans

the period from December 2005 to December 2006, during which we have detailed information about the entire quotes for all futures contracts written on KOSPI 200, including the type of the submitting investor and the submission time. Using this information we categorize investors into three groups: domestic individuals, domestic institutions, and foreign investors.

The Korean index futures market opens at 9:00am with a beginning price determined by a batch auction prior to the opening (8:00am–9:00am). Afterwards, quotes are matched in a continuous-auction market until 3:05pm. A 10-minute batch auction then follows to collect quotes from investors and determine the closing price. Then, the market closes at 3:15pm. The spot (i.e., stock) market, on the other hand, closes at 3:00pm, with the last 10 minutes (i.e., 2:50pm–3:00pm) set aside for the closing batch auction. The extra 15 minutes for the futures market are to allow investors to rebalance their positions in response to the closing spot price.

Our empirical analysis uses changes in quotes either at 5-minute or at daily frequency. changes or daily-frequency changes. To measure the quote changes, we use the quotes submitted during the continuous-auction period and, to avoid using fake or noisy quotes, we limit ourselves to the price-setting quotes. These are the quotes that initiate a trade and thus reveal the valuation of the quote submitter. For each of the 5-minute interval, we separately identify the last buy-side and sell-side price-setting quotes, and then calculate their average. Log changes in those quotes are then used for the 5-minute interval analysis. For the daily-frequency analysis, we cumulate the 5-minute changes during the day.

We measure changes in spot price in a similar fashion and use them in the regression analysis. However, to ensure that the intraday lead-lag relationship between the two markets does not affect our results, we conduct a robust check that utilizes changes in futures price in place of spot price changes.

4. Empirical results

4.1. Summary statistics

We begin by reporting summary statistics for the 5-minute log changes in spot price and in futures quotes (top panel of Table 1). As shown in the mean and median columns, the typical 5-minute change is zero both for the spot price and for the futures quote. This observation lends support to our presumption of zero risk premium at this frequency. The quotes are, however, a lot more volatile compared to the spot price. In particular, the quotes of domestic individuals are noticeable volatile ranging from –10.91% to +10.97%. In contrast, the quotes of the other two investor groups do not exceed 7% in either direction. Consistent with this observation, the standard deviation of the quote changes is the greatest for domestic individuals (0.69%), with foreign investors at the other extreme (0.24%) and domestic institutions in the middle (0.37%).

The second panel of Table 1 shows summary statistics for daily log changes in spot price and in futures quotes. As mentioned earlier, we cumulate the 5-minute changes during the day (i.e., during the continuous-auction period) to obtain the daily-frequency changes in those variables. The mean and median changes are still very small, again pointing to negligible risk premium during this measurement interval. However, the volatility shrinks noticeably. Simple calculations show that the variance ratio is always below unity. For example, the ratio for the spot price changes is 0.88 / (0.11*$\sqrt{69}$), or 0.96, thereby attesting to the existence of a temporary component. What is more dramatic is the variance ratio for the quote changes. Specifically, the ratio for domestic individuals is as small as 0.18, which is in sharp contrast with foreign investors whose variance ratio is 0.48. (Again, domestic institutions are in the middle.)

As an aside, note that domestic institutions have a smaller number of quote revisions. It is because their quotes are concentrated on the nearest-term contract until it matures, whereas we switch to the next-nearest contract at the beginning of the maturity month. This switching is a convention in the literature.

In a nutshell, the summary statistics suggest that domestic individuals are focused more on a temporary component in stock price compared with other investors. They also suggest that foreign investors pay the least attention to such a transient component. Consequently, our analysis would predict that it is foreigners who are most extrapolative and, at the same time, their greater extrapolation is only short-lived. The next sub-section will test these and other empirical implications.

4.2. Regression of log changes in futures quotes on log changes in spot price – Tests of H1 and H2

For each investor group, we estimate the following equation:

$$\Delta quote_{i,t} = \alpha_i + \beta_i \Delta spot_t + \varepsilon_{i,t}, \qquad (7)$$

where $\Delta quote$ and $\Delta spot$ are, respectively, the log changes in the futures quote and in the spot price. Subscript i stands for investor group i, which is domestic individuals, foreigners, or domestic institutions.

The first panel of Table 2 reports the results based on the quote/price changes at 5-minute interval. To produce the tabulated results, we first estimate eq. (7) every day and then average the resultant regression results (i.e., coefficients and R-squared) across the sample period. Consistent with our prediction, foreign investors are found to be most extrapolative. Their regression coefficient is, on average, 0.649, and is about 1.3 times more responsive to a given price change than domestic individuals whose coefficient is 0.486. In an unreported result, we tested for difference by pooling the regressions with dummy variables for each investor group and their interactive terms with the spot price change. The t-statistic for the difference in coefficient between foreigners and domestic individuals is 2.00.

The bottom panel shows the results based on daily changes in quote/price. It is striking that at this longer measurement interval, the differing reactions to a given price change across investors

disappear completely. Specifically, the coefficient for domestic individuals is now 1.027 and is hence comparable to the coefficient for foreigners, which is 1.045. Moreover, foreigners are no longer the most extrapolative investor group, as the coefficient for domestic institutions is 1.051. However, all three coefficients are indistinguishable both statistically and economically.

In short, the results in Table 2 confirm our hypothesis that those investors who pay more attention to a permanent component are most extrapolative, but they are so only at a shorter measurement interval (*H1*). Furthermore, a closer examination of those results also verifies our second hypothesis. To wit, it states that the convergence among investors with a longer measurement interval will occur as the initially less responsive investors catch up, rather than the initially more responsive investors slow down. Changes in the regression coefficients across the two panels in Table 2 are consistent with this prediction.

4.3. Robustness checks for tests of H1 and H2

A concern about the results in Table 2 is that the spot price lags the futures price during the day for such reasons as stale price (see, e.g., Chan 1992). To address this concern, we replace the spot price with the futures price as in Bessembinder et al. (1995) and others. Table 3 shows that the results remain the same qualitatively. Specifically, foreign investors are most extrapolative at the 5-minute interval but become similar to other investors at daily frequency. More importantly, the convergence is attributable mostly to domestic individuals who show a dramatic increase in the regression coefficient, from 0.670 to 0.940. Again, this confirms both *H1* and *H2*. The coefficient for foreigners, on the contrary, experiences little change, from 0.855 to 0.996.

To further ensure that our results are not spurious, we limit ourselves to the trading days during which at least 50 valid 5-minute quote changes are available. This limitation will enhance the precision of the coefficients estimated within a day and thus their averages that are reported in the tables. As shown in Table 4, the results again remain unchanged qualitatively. The only

noteworthy change is that the coefficient for domestic individuals increase somewhat but that for domestic institutions declines. Still, foreigners are found to be most extrapolative at 5-minute interval and their reaction is statistically significantly different from that of domestic investors. Of course, such differences disappear at daily frequency.

4.4. Serial correlation of intraday quote changes – Test of H3

We now examine the third empirical prediction, which is about the serial correlation of quote changes at a shorter interval. To this end, we first estimate the serial correlation within a day for each investor group, and average the estimates across the sample period. As shown in Figure 2, domestic individuals show a much negative serial correlation as compared with domestic institutions or foreign investors. More precisely, the first-lag autocorrelation coefficient for domestic individuals is -0.35, whereas foreign investors have a first-lag autocorrelation coefficient of -0.15. As in other preceding analyses, domestic institutions are in the middle with a coefficient of -0.20. Simple calculations using the associated standard errors show that the difference between domestic individuals and foreigners is statistically significant with a t-statistic of 13.37. Similarly, the t-statistic for the difference between domestic individuals and domestic institutions is 9.24.[7]

This result is consistent with our earlier observation in Table 1 that the variance of quote changes increases less than linearly with the length of the measurement interval and that this pattern is most pronounced with domestic individuals. This is a clear indication that they react more to a temporary component in stock price as compared with other investor groups.

4.5. Performance for various holding periods – Test of H4

[7] As in the preceding sub-section, we used the trading days during which at least 50 valid 5-minute quote changes are available. The results based on those days are virtually identical to the one reported in the text.

Thus far, we have utilized the price-setting quotes to test the empirical implications of our analysis. In fact, there quotes allow for another testing hypothesis. Recall that a price-setting quote is the one that initiates a trade and thus sets a new market price; hence, the term "price-setting" quote. Consequently, one can measure the price change caused by this quote. The market microstructure literature shows that a trade cannot affect the price consistently unless it contains some private information. It thus follows that the price change caused by a price-setting quote can help us understand how well-informed the quote submitter is. The more it moves the price, the more likely that the quote submitter has private information. This idea was first operationalized by Barclay and Warner (1992) in the name of a price contribution measure, and we apply their methodology to our data.

For a given period, the price contribution of a particular investor group is the price change caused by the group's price-setting quotes divided by the total contemporaneous spot price change. We calculate this measure for each of the three investors groups with a variety of holding periods. Specifically, we examine a one-day, one-week, one-month, one-contract, and the whole period contribution measures. Alternatively, we use the futures price in place of the spot price to ensure the robustness of our results.

Table 5 shows that the contribution of foreign investors becomes more pronounced especially for a longer holding period. This pattern is clearly in line with our prediction (*H4*) that the extrapolative investors are the ones who are either better-informed or have a longer investment horizon.

5. Conclusions

In this paper, we examine whether foreign investors have an extrapolative expectation and, if so, whether this behavior is attributable to their informational disadvantages. We first analytically show that a temporary component in stock price makes it possible that better informed or long-

term investors are more extrapolative and that such a greater response to a given price change is short-lived. We then empirically confirm these and other implications of our analysis using the quote data for the futures contracts written on a broad-based Korean stock market index. Our results thus force us to rethink the reason for the positive relation of foreign equity capital flows to domestic stock returns. Clearly, the extrapolative expectation will be in part responsible at a short interval. At a longer interval, however, there should be other explanations besides the extrapolative expectation of foreign investors.

More importantly, our results suggest that the positive relation of foreign equity capital flows to domestic stock returns is not evidence of the informational disadvantages of foreign investors in a domestic market. As our results draw on the market-level data, it is conceivable that the comparative advantage of foreign investors in terms of information differs between firm-specific and market-wide affairs. Perhaps this notion helps reconcile the mixed results in the literature. For example, with firm-level data from a market with a wide cross-section (e.g., with both very large and very small stocks), foreigners may well be found to have an informational disadvantage. However, at the market level or in a market dominated by a handful of large stocks, foreigners may be better informed than domestic investors.[8]

[8] This conjecture is also consistent with Albuquerque, Bauer, and Schneider (2009).

References

Albuquerque, R., Bauer, A., Schneider, G., 2009. Global private information in international equity markets. *Journal of Financial Economics*, forthcoming.

Bessembinder, H., 1992, Systematic risk, hedging pressure, and risk premiums in futures markets, *Review of Financial Studies* 5, 637-667.

Bessembinder, H., J. Coughenour, P. Seguin, and M. Smoller, 1995, Mean reversion in equilibrium asset prices: Evidence from the futures term structure, *Journal of Finance* 50, 361-375.

Bessembinder, H., J. Coughenour, P. Seguin, and M. Smoller, 1996, Is there a term structure of futures volatilities? Reevaluating the Samuelson hypothsis, Journal of Derivatives.

Biais, B., Hillion, P., Spatt, C., 1999. Price discovery and learning during the preopening period in the Paris Bourse. *Journal of Political Economy* 107, 1218-1248.

Black, F., 1976, The pricing of commodity contracts, *Journal of Financial Economics* 3, 167-179.

Bohn, H. and L. Tesar, 1996, U.S. equity investment in foreign markets: Portfolio rebalancing or return chasing?, *American Economic Review*, 77-81.

Brennan, M. and H. Cao, 1997, International portfolio flows, *Journal of Finance*, 1851-1880.

Brennan, M., Cao, H., Strong, N., Xu, X., 2005. The dynamics of international equity market expectations. *Journal of Financial Economics* 77, 257-288.

Chan, K., 1992. A further analysis of the lead-lag relationship between the cash market and stock index futures market. *Review of Financial Studies* 5, 123-152.

Choe, Hyuk, Bong-Chan Kho, and René M. Stulz, 1999, Do foreign investors destabilize stock markets? The Korean experience in 1997, *Journal of Financial Economics* 54, 227-264.

DeRoon, F., Nijman, T., Veld, C., 2000. Hedging pressure effects in futures markets. *Journal of Finance* 55, 1437-1456.

Eaves, J., Williams, J., 2007. Walrasian Tâtonnement auctions on the Tokyo Grain Exchange. *Review of Financial Studies* 20, 1183-1218.

Froot, K., P. O'Connell, and M. Seasholes, 2001, The portfolio flows of international investors, *Journal of Financial Economics* 59, 151-193.

Grinblatt, M. and M. Keloharju, 2000, The investment behavior and performance of various investor-types: A study of Finland's unique data set, *Journal of Financial Economics*, 43-67.

Hirshleifer, D., 1988, Residual risk, trading costs, and commodity futures risk premia, *Review of Financial Studies* 1, 173-193.

Hong, H., 2000. A model of returns and trading in futures markets. Journal of Finance 55, 959-988.

Kang, H., Lee, D., Park, K., 2009. Do different interpretations of the same information help explain the home bias? Unpublished working paper, Korea University Business School.

Griffin, J., Nardari, F., Stulz, R., 2004. Are daily cross-border equity flows pushed or pulled? *Review of Economics and Statistics* 86, 641-657.

Tesar, L. and I. Werner, 1995, Home bias and high turnover, *Journal of International Money and Finance*, 467-493.

Table 1. Summary statistics for log changes in spot price and futures quote

This table reports summary statistics for log changes in the spot price for the KOSPI 200 index and the quotes for its nearest-term futures contract, for period is from December 2005 to December 2006. We switch to the next-nearest contract at the beginning of the maturity month. In the "Daily changes" panel, "Spot price" is the cumulative 5-minute changes during the day. All numbers, except for the number of observations, are in percentage.

quotes during	type/ investor group	n	mean	median	std	min	max
5-minute changes	Spot price	18,411	0.00	0.00	0.11	-0.78	1.16
	individual	17,687	0.00	0.00	0.69	-10.91	10.97
	foreigner	18,167	0.00	0.00	0.24	-6.28	6.28
	institution	16,846	0.00	0.00	0.37	-6.20	6.01
Daily changes	Spot price	267	-0.05	0.01	0.88	-3.43	2.76
	individual	267	0.04	0.07	1.04	-3.72	4.89
	foreigner	267	-0.02	0.04	0.95	-3.69	2.87
	institution	262	-0.01	0.04	1.04	-5.08	5.26

Table 2. Regression of log change in futures quote on log change in spot price

This table reports the results from a regression of log changes in futures quotes on log changes in the spot price for the KOSPI 200 index. Estimation is conducted for each of the three investor groups for the period from December 2, 2005 to December 28, 2006. Intercept is in the regression, but is not reported. Standard errors are based on heteroscedasticity-consistent covariance estimator.

quotes during	investor group	coeff. for Δspot	standard error	R-squared	# of obs.
5-minute changes	individual	0.486	(0.081)	11.5%	267
	foreigner	0.649	(0.017)	29.3%	267
	institution	0.638	(0.058)	23.9%	262
Daily changes	individual	1.027	(0.023)	75.4%	267
	foreigner	1.045	(0.016)	94.8%	267
	institution	1.051	(0.029)	76.6%	262

Table 3. Regression of log change in futures quote on log change in futures price

This table reports the results from a regression of log changes in futures quotes on log changes in the futures price for the KOSPI 200 index. Estimation is conducted for each of the three investor groups for the period from December 2, 2005 to December 28, 2006. Intercept is in the regression, but is not reported. Standard errors are based on heteroscedasticity-consistent covariance estimator.

quotes during	investor group	coeff. for Δfutures	standard error	R-squared	# of obs.
5-minute changes	individual	0.670	(0.103)	15.8%	267
	foreigner	0.855	(0.012)	48.9%	267
	institution	0.730	(0.035)	38.2%	262
Daily changes	individual	0.940	(0.061)	39.1%	267
	foreigner	0.996	(0.006)	98.8%	267
	institution	0.990	(0.009)	97.0%	263

Table 4. Regression using data from days in which at least 50 5-minute quote changes are available

This table reports the results from a regression of log changes in futures quotes on log changes in the spot (futures) price for the KOSPI 200 index. Estimation is conducted for each of the three investor groups for the period from December 2, 2005 to December 28, 2006. Intercept is in the regression, but is not reported. Standard errors are based on heteroscedasticity-consistent covariance estimator.

quotes during	investor group	Independent variable:			
		Δspot		Δfutures	
		coeff. for Δspot	standard error	coeff. for Δfutures	standard error
5-minute changes	individual	0.534	(0.055)	0.732	(0.050)
	foreigner	0.648	(0.018)	0.854	(0.012)
	institution	0.530	(0.033)	0.706	(0.032)
Daily changes	individual	1.024	(0.025)	0.960	(0.063)
	foreigner	1.046	(0.016)	0.996	(0.006)
	institution	1.051	(0.030)	0.992	(0.009)

Table 5. Price contribution measure

This table reports the price contribution measure of Barclay and Warner (1992) by investor type. In the top panel, we use the total spot price change as the denominator, whereas the bottom panel sues the total futures price change in the denominator.

denominator	investor group	Holding period					
		One-day	One-week (M−F)	One-week (R−W)	One-month	Contract	Entire sample period
Δspot	individual	0.11	-35.17	5.81	-6.28	-20.71	-21.43
	foreigner	-0.21	50.12	-5.60	2.99	14.25	24.22
	institution	1.07	-14.74	1.36	3.75	5.22	-2.91
Δfutures	individual	-0.03	-0.63	15.46	-1.36	-8.77	-19.83
	foreigner	-0.44	3.45	-14.15	0.47	7.30	22.41
	institution	0.71	-2.30	0.21	1.86	1.38	-2.69

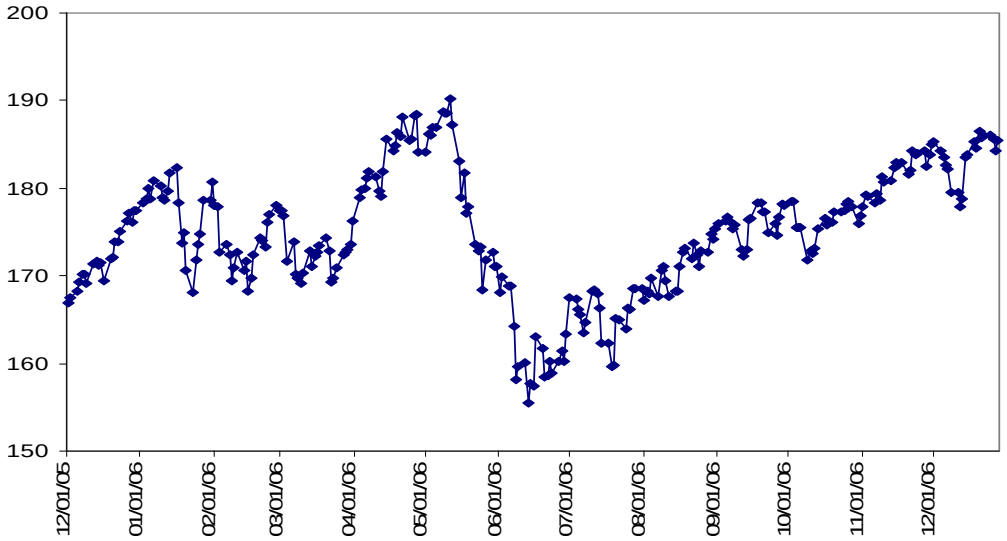

Figure 1. KOSPI 200 during the sample period

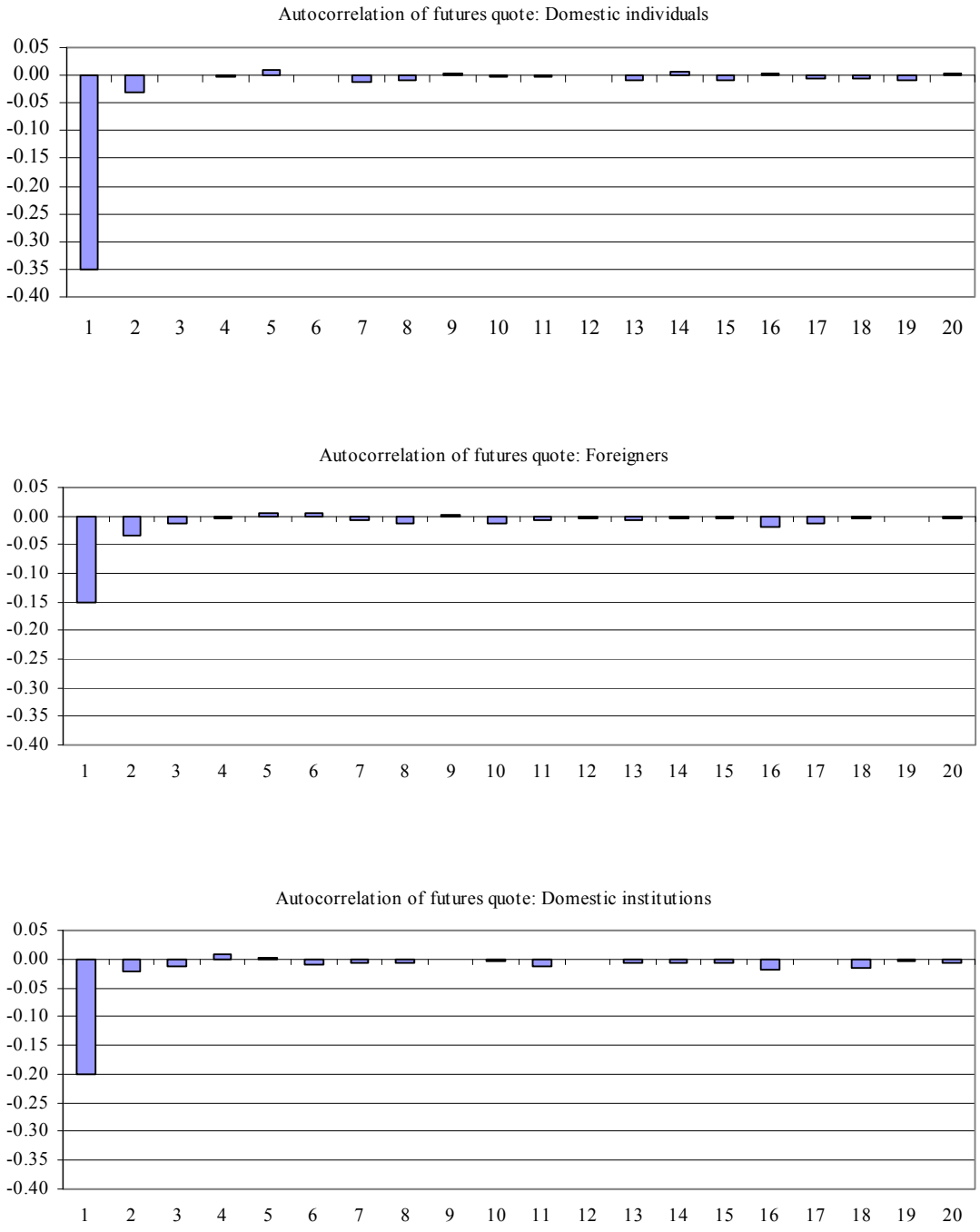

Figure 2. Intra-day autocorrelation of futures quotes – by investor group