FOREIGN EXCHANGE RATE EXPECTATIONS:
MICRO SURVEY DATA

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ABSTRACT

This paper analyzes the panel data of bi-weekly surveys, conducted by the Japan Center for International Finance, on the yen/dollar exchange rate expectations of forty-four institutions for two years. There are four major findings in this paper. First, market participants are found to be heterogeneous. There are significant "individual effects" in their expectation formation. Second, the individual effects have a characteristics of "wishful expectations": exporters expect yen depreciation (relative to others), and importers expect yen appreciation (relative to others). Third, many institutions are found to violate the rational expectations hypothesis. Fourth, forecasts with long horizons showed less yen appreciation than those with short horizons. Cross-equation constraints implied by the consistency of the forecast term structure are strongly rejected in the data.

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1. Introduction

As rational expectations have become a popular benchmark for thinking about financial and macroeconomic hypotheses, many economists have become more interested in directly measuring the expectations of market participants. Although survey data for many domestic variables, including interest rates and inflation rates, have been frequently analyzed by many investigators (see, for example, Mishkin (1983; ch. 4)), it is only recently that survey data on foreign exchange rates have become available and been analyzed. Dominguez (1986) and Frankel and Froot (1987a,b) have exploited the survey data made available by the Money Market Service (MMS), the Amex Bank Review and the Economist Financial Report.1

The surveys that were investigated by Dominguez, and by Frankel and Froot have had only their median responses reported. Heterogeneity among market participants, if it exists, has been aggregated out. If the market consists of homogeneous agents that share the same forecasting model with common beliefs (priors) and information, then the median response would sufficiently describe the market in terms of forecasts. However, if market participants differ in their forecasting characteristics, then focusing on the median misses the most interesting questions such as whether the differences persist or are temporary, whether the differences are correlated with the participant's traits, and whether a rationality hypothesis is more likely to be rejected in individual data. Only individual responses of survey data can answer these questions.

In this paper, I will use the survey data collected by the Japan Center for International Finance (JCIF) in Tokyo, which allows me to investigate the individual responses in the survey. In particular the JCIF data set has two distinct advantages over the data used by Dominguez, and by Frankel and
Froot. First, the JCIF data consist of individual responses with no missing observations. This is the first paper to study the individual responses of exchange rate expectations, although individual responses of inflation expectations were studied before by Figlewski and Wachtel (1981). Second, not only financial institutions but other companies as well are polled in the JCIF survey. Therefore, there is a chance to associate possible heterogeneity to the traits of the forecasters' industry.

There are four major findings in this paper. First, market participants are found to be heterogeneous. There are significant "individual effects" in their expectation formation. Second, the individual effects have characteristics of "wishful expectations": exporters expect a yen depreciation (relative to others), and importers expect a yen appreciation (relative to others). Third, many institutions are found to violate the rational expectations hypothesis. Most of them underestimated the degree of yen appreciation. Fourth, forecasts with long horizons showed less yen appreciation than ones with short horizons. Put differently, market participants appear to have a "bandwagon" expectation in the short-run, but a "stabilizing" one in the long-run. The "twist" in forecast term structure could be "consistent" (in the sense of Froot and Ito (1988)), if an iterated substitution of a short-term forecast yields a long-term forecast. However, cross-equation constraints implied by the consistency are strongly rejected.

2. Data Summary

2.A. The Data Description

The JCIF has conducted telephone surveys twice a month, in the middle and at the end of the month, on Wednesdays, since May 1985. Forecasts of the yen/dollar exchange rate for the one-, three- and six-month horizons are
obtained from foreign exchange experts in 44 companies, including 15 banks and brokers, 4 securities companies, 6 trading companies, 9 export-oriented companies, 5 life insurance companies, and 5 import-oriented industries. Each respondent is asked to give a point forecast, for each horizon. In this paper, I assume that reported forecasts are the subjective means of respondents. We do not have any data on the subjective variance or range. The survey is meticulously arranged so that all 44 companies on the permanent list respond every week.

When a data set is analyzed as panel data, the mean across individuals and the mean across time should not be confused. In the following, the mean across forty-four individuals at a time will be referred to as the (cross-section, total) average; the mean across individuals at a time in an industry group will be referred to as the group average. The mean across time of an individual, of a group, or of the "average" will be referred to as the (time) mean of the individual, of the group, or of the average, respectively.

The JCIF calculates the total average, the standard deviation, the maximum, and the minimum of the forty-four responses and also the industry group averages and the group standard deviations. On the day after the survey, the JCIF informs its subscribers, including those who are polled, of the summary statistics. The total average is also released to the press and other media.

I will use, in addition to the panel data of the forty-four companies, the public information part of the survey, the cross-section average (AVE) and the group averages for the different industries: banks (BAN), securities companies (SEC), trading companies (TRA), companies in the export industries (EXP), insurance companies (INS), and companies in the import industries
The unit is yen per one U.S. dollar, so that a negative movement indicates a yen "appreciation." The spot exchange rate, \( s(t) \), is measured at the closing quote in Tokyo on Wednesday of the survey week.

2.B Overview

Table 1 shows the time means of (unconditional) expected changes (in percent) from the spot rate at the time of survey for the cross-section total average, the group averages, and (in a separate distribution table) for each individual. For the purposes of discussion, the actual (ex post) changes of the spot exchange rate (ACT) for each horizon are reported in the same table. For each horizon and each individual or group, subtracting the actual changes from the forecasts produces the forecast errors.

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Insert TABLE 1 about here
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In the one-month horizon, the (total) average on a typical week showed an expected 1.4 percent yen appreciation. The group averages ranged from a 0.8 percent to a 2 percent appreciation. Relative to the total average, the export industry was the most biased toward a yen depreciation, and the trading companies and the import industries were the most biased toward a yen appreciation. Looking into individual data, one extreme predicted a 1.4 percent depreciation of the yen, while the other extreme predicted a 3.1 percent of appreciation. The distribution of individual forecasts has a nice unimodal distribution. The average expected appreciation of the yen in the three-month horizon was 1.4 percent, about the same as in the one-month horizon. (Note that no adjustment is made with respect to the length of horizon.)

As in the one-month horizon, the export industry shows a yen
depreciation bias (from the total average), and the trading companies show a yen appreciation bias in the three-month horizon. A wide disagreement among individuals begins to appear in the three-month forecasts. It becomes a bimodal distribution: one group believes that the yen depreciates from the one-month to three-month in the forecast horizon, while the other believes that the yen continues to appreciate.

For the six-month horizon, the total average shows that the market expects the yen to return to nearly the prevailing level at the time of forecast. This is a sharp turnaround from the forecast of a 1.4 percent yen appreciation in three months. In fact, each of the group averages indicates that the group anticipates less yen appreciation in the six-month horizon than in either the one- or the three-month horizons.

The findings of this subsection can be summarized and related to the contents of the rest of this paper. First, the findings are highly suggestive of heterogeneous market participants. A rigorous analysis and interpretation of the heterogeneity will be provided in Section 3. Second, large forecast errors were recorded during the intermittent waves of yen appreciation after September 1985. Econometric tests on various forms of the rational expectation hypothesis will be conducted in Section 4. Third, the total average and most of the group averages have a "twist" in their forecasts a yen appreciation in the short-horizon and a yen depreciation in the long-horizon. Section 5 investigates whether such twists in expectations are internally consistent.

3. Wishful Expectations and Heterogeneity

3.A. Econometric Issue -- a special case of panel data

Recall that our micro survey data set consists of forty-four individuals and fifty-one observations. Suppose that an individual forecast
formation at time t consists of a common structural part based on public information, $f(I(t))$ and an individual effect, $g_j$. For a given forecast horizon, $k$ (suppressed notation), the expected exchange rate for individual $j$, $j = 1, \ldots, J$ (where in this paper $J=44$) is

$$s^e_j(t) = f(I(t)) + g_j + u_j(t)$$

(3.1)

where $s^e_j(t)$ is a $k$-step ahead forecast of the spot exchange rate at time $t$, by individual $j$; $u_j(t)$ is a pure random disturbance (with respect to $j$ and $t$) representing, for example, a measurement or a rounding error. The cross-section average of individual forecasts, $s^e_{AVE}(t)$ is defined as

$$s^e_{AVE}(t) = f(I(t)) + g_{AVE} + u_{AVE}(t)$$

(3.2)

where $x_{AVE}(t) = (\Sigma x_j(t))/J$; $x = s^e$, $g$, and $u$. Assume $f(I(t))$ contains a constant term so that normalization, $g_{AVE} = 0$, is possible. Then subtracting each side of (3.2) from the corresponding side of (3.1), we obtain

$$s^e_j(t) - s^e_{AVE}(t) = g_j + (u_j(t) - u_{AVE}(t))$$

(3.3)

The estimator of the individual effect, $g_j$ can be obtained by regressing the lefthand side of (3.3) on a constant over the sample period (across time). This procedure is simple and robust. It is unnecessary for the econometrician to know the exact structure of $f(I(t))$ as long as it is common to everybody for every survey date.

If the difference in the individual effects of two individuals is to be estimated, a similar method can be employed.

$$s^e_j(t) - s^e_h(t) = g_j - g_h + (u_j(t) - u_h(t)), \; h \neq j.$$
A (composite) disturbance term in equation (3.3) and (3.4) has mean zero and no serial correlations if \( u_j(t) \) is serially and cross-sectionally uncorrelated and \( f(I(t)) \) is exactly common to all individuals.

If the difference in individual beliefs extends to "idiosyncratic" coefficients on publicly available information in the structural part, \( f(I(t)) \), the above procedure needs to be modified, but is still applicable. Suppose, for example, that the forecast is in an extrapolative form:

\[
 s^e_j(t) - s(t) = a_j + b_{1j}(s(t-1)-s(t)) + b_{2j}(s(t-2)-s(t-1)) + u_j(t) \tag{3.5}
\]

where \( g_j \) is the difference in \( a_j \). Then the idiosyncratic individual coefficients can be estimated by regressing the following equations, for all \( j \):

\[
 s^e_j(t) - s^e_{AVE}(t) = a_j - a_{AVE} + \{b_{1j} - b_{1AVE}\}(s(t-1)-s(t))
 + \{b_{2j} - b_{2AVE}\}(s(t-2)-s(t-1)) + u_j(t) - u_{AVE} \tag{3.6}
\]

The above procedure parallels the technique in the panel data analysis, although, in the usual examples of the panel data analysis, the right-hand-side variables take different values for different individuals. Instead, it is reasonable here to assume that the structural part and the values of regressors (i.e., the past values of the exchange rates) in exchange rate forecasts are identical for all individuals, but with possibly different coefficients.

3.B Heterogeneous Participants in the Tokyo Market

In search of hard evidence for (or against) heterogeneity among market participants, I estimate forty-four individual effects, \( g_j \), and "group effects." In detecting the "group effect," a group average forecast calculated by the JCIF is treated as an individual \( j \), then the total average (or another group average) is subtracted.³
The individual (or group) effect $g_j$, estimated using equation (3.3), are reported in Table 2.  

Insert Table 2 about here

From panel 2.A., we learn that for any horizon, group effects are significant for the export industry, with a depreciation bias, and for the trading companies, with an appreciation bias. A significant appreciation bias was also detected for the import industry for the one-month horizon, for the insurance industry for the 3-month horizon, and for the banking sector for the six-month horizon.

The distinctive effect of exporters in contrast to importers or to trading companies can be highlighted by measuring the difference in individual effects directly, as in equation (3.4). (This is not reported here, see Ito (1988).) Exporters have a depreciation bias in their expectation formation compared to importers and trading companies for any horizon. Panel 2.B shows that, for any horizon, about half of the forty-four individuals have a significant bias in their forecasts. The deviations are sometimes very large.

One might object to a formulation of the individual effects in the form of biases in the constant term. They could have different models. Since it is not likely that the JCIF or the econometrician could persuade each forecaster to justify the forecast with a model every week, we have to guess the form, assuming that each market participant has a common autoregressive forecasting model, but with different coefficients on the lag terms (possibly because of differences in their prior beliefs). As discussed above, idiosyncratic coefficients can be estimated from equation (3.6). The results are shown in Table 3.
Table 3 once again shows that exporters and trading companies are significantly heterogeneous for each of the three horizons. However, the differences come from the biases in the individual (constant term) effects, not from the idiosyncratic coefficients of the lagged variables. Importers for the one-month horizon and banks for the six-month horizon also show the individual (constant) effect, as in Table 2.A, but fail to show the idiosyncratic coefficients on the lagged variables. Therefore, the heterogeneity is more like a constant bias rather than the differences in reacting to the recent changes in the exchange rate. Table 2 and Table 3 show solid evidence for heterogeneous expectation formations among market participants.

3.C Discussion: Heterogeneity and Rational Expectations

Most of the modern theory of finance and macroeconomics assumes the existence of a representative agent whose decision is an aggregate of market participants. In fact, the hypothesis of rational expectations would require that market participants be homogeneous in their formation of expectations, since the true stochastic process is unique. Therefore, findings of heterogeneity in this section cast some doubts on the homogeneous agent framework commonly used in finance and macroeconomics.

One might argue that if agents have private information which econometricians do not observe, the existence of individual effects may not be inconsistent with rational expectations. However, important news and variables in the foreign exchange market are generally common knowledge. In fact, even if the individual information sets are different, the difference in expectations conditional on a common (i.e., intersection of) information set should be unbiased. The constant term, which detects individual effects,
is certainly contained in the common information set. Thus, the finding of significant individual biases rejects rational expectations.  

Put differently, under the assumption of rational expectation but private information, the forecast differences across individuals, i.e., the dependent variables in equation (3.3) and (3.4), must be serially uncorrelated, contrary to our findings, provided that lagged group average forecasts are part of the common information set (which is the case in the JCIF survey as explained in Section 2.A).

One possible explanation of heterogeneity consistent with rational expectations would be a slow learning process due to a strongly biased prior. However, one has to model a learning process to assert this. Then, we would be able to discuss how biases can be related to individual priors and learning processes. This is beyond the scope of this paper.

3.D Discussion: Wishful Expectations

Having established heterogeneity, a discussion of why certain market participants have depreciation or appreciation biases is in order. From Table 2, we notice some regularity in the group effects: in the one-month ahead forecasts, exporters have a depreciation bias, while importers have an appreciation bias. The exporters' forecasts show a continuing deviation from the mean, significantly biased toward a yen depreciation, as the forecast horizon lengthens. In the three-month and six-month ahead predictions, trading companies, as opposed to importers, show a bias toward appreciation.

Exporters tend to be long in dollars and importers short in dollars. It is difficult to completely cover the exposure to the foreign exchange risk, since the forward markets exist only up to a one-year horizon, and timings of trade and financial transactions cannot be matched exactly.
Therefore, exporters wish that the yen will depreciate in the future, enabling their profit margins to increase and their products to compete better in the foreign markets. (This argument rests on an assumption of incomplete "pass-through," which is documented, for example, by Krugmen (1987) and Ohno (1988).) Their responses, being biased toward a yen depreciation relative to the average, seem to agree with their wishes.

On the contrary, importers' responses reflect their wish for a stronger yen so that their import costs will decrease given incomplete path-through. Note that the group effect of trading companies behaves like that of import industries. One might think that the change in the exchange rate may be neutral for trading companies, since they are just intermediaries of imports and exports. However, the leading Japanese trading companies handle more imports than exports. In 1983, the revenues of the leading nine trading companies were derived from export-oriented activities for 20.0%, import-oriented activities for 23.6%, domestic activities for 40.3%, and trade between foreign countries for 16.1% (Shinohara (1986; p. 164)).

Hence, the findings show that market participants apparently form "wishful expectations." (A "Chicago test" for the validity of survey data would be to check whether money is where the mouth is. But the result here shows that people "put the mouth where money is." This "wishful expectation" (or an "optimist" view in Hey's (1984) sense) may be a reflection of nonrational honest mistakes in expectation formation. A straightforward interpretation would be for respondents to mix wishful thinking with objective forecasts. However, there are a few deeper explanations of wishful expectations.

The Japanese manufacturing and trading companies usually set an in-house exchange rate for internal accounting, and the rate can be used for
coordinating the sales department with the other departments. It is possible that these in-house rates are heterogeneous, and moreover are slightly biased so that the sales department is encouraged. The survey responses from these companies may be influenced by the biased in-house exchange rate, although the respondent is not from the sales department.

If the announcement of the JCIF survey is very influential on the market, the respondent may be induced to try manipulating the announced survey result by answering with biased forecasts. Exporters respond to the JCIF by announcing a depreciated rate, but only slightly depreciated so as to avoid obvious detection, in the hope that the survey mean is biased toward depreciation. Exporters hope that the mean expectation with an "unexpected" depreciating bias could cause others to start selling yen, thus creating a self-fulfilling prophecy; if importers understand that exporters have incentives to lie, then importers would counter by manipulating their announcements; and vice versa. Thus, as a Nash equilibrium, the mean may not be biased after all, although exporters and importers are biased.

Despite its appeal to economists who are trained to seriously think about expectation and manipulation, this story of a manipulative motive has a few shortcomings. First, the size of survey, i.e., forty-four respondents, is large enough that a manipulation by one respondent is insignificant unless the bias is large enough to be easily detected by the JCIF. Second, if other participants understand that exporters and importers have incentives to lie, then they would not take the JCIF survey seriously, thereby removing the incentive to lie. It may be the case that market participants are simply naive in forming wishful expectations.
4. Rationality of Expectations

4.A Tests of Unbiasedness and Orthogonality

In this section, I will apply standard tests of rational expectations to this survey data. First, if the forecasts are rational, the forecast errors should be random. In other words, survey forecasts should be unbiased. Second, given rational expectations, forecast errors should be uncorrelated with (orthogonal to) any information available at the time the forecast is made. Otherwise, the variable correlated with the \textit{ex post} error could have been exploited to make a better forecast.

Under the null hypothesis of rational expectations, the realized spot rate is the sum of a forecast and a forecast error:

\[ s(t+k) = s^e(t,k) - h(t,k) \]  \hspace{1cm} (4.1)

where \( h(t,k) \) is the mean zero forecast error, uncorrelated with any variables available at \( t \). It is well known that forecast errors, \( h(t,k) \), would be serially correlated if the forecast horizon is longer than the observational frequency, i.e., \( k > 2 \). Therefore, rational expectations imply that \( a=0 \) and \( b=1 \) in the following regression:

\[ s(t+k) - s(t) = a + b(s^e(t,k)-s(t)) + u(t) \]  \hspace{1cm} (4.2)

The test statistics are calculated using the Generalized Method of Moments to take care of the serial correlations of \( u(t) \). Results of this unbiasedness test are reported in Table 4, panel A.

\[ \text{INSERT TABLE 4 ABOUT HERE} \]

Unbiasedness is rejected for trading companies and insurance companies of the one-month horizon, for securities and import companies of the three-month horizon, and for all groups but banks and import industries for the
six-month horizon. These rejections are evidence for rejecting a rational expectation hypothesis, in that market participants had unbiased forecasts. We would miss some rejections if we were only to look at the average of the forty-four participants, since for the one-month and three-month horizons, rejections by some groups are not detected in the average for all participants.

The second implication of rational expectations is the orthogonality: Under the null hypothesis, forecast errors, \( s^e(t,k) - s(t+k) \), are uncorrelated with any information, \( z(t) \), at time \( t \). In the literature, the past forecast errors \( s^e(t-k,k) - s(t) \); the forward premium, \( f(t,k) - s(t) \); or the recent actual change \( s(t-k) - s(t) \) have been popular candidates for variables in the information set. I will follow the standard procedure by regressing the ex post forecast errors on these candidate variables:

\[
s^e(t,k) - s(t+k) = a + b(z(t)-s(t)) + e(t) \tag{4.3}
\]

where \( z(t) = s^e(t-k,k), f(t,k), s(t-k) \). Rational expectations (orthogonality) is a null hypothesis of \( a=b=0 \). Results of the estimation of equation (4.3), with \( z(t) = s(t-k) \), and the test of null hypothesis is reported in Table 4, panel B. (Results for other cases of \( z(t) \) are essentially the same and not reported here. See Ito (1988).) There are only a few instances of rejections of the one-month and three-month horizons. However, for the six-month horizon, the rejection is unanimous. This is consistent with the results of unbiasedness tests. So far, there is little evidence rejecting the rational expectation hypothesis for the shorter horizons.

Variables in the information set are not restricted to those tested above. When the second lagged term is added, the number of rejection cases
increases dramatically. The results of estimating the following equation are reported in Table 4, panel C:

\[ s^e(t,k)-s(t+k) = a + b_1(s(t-k)-s(t)) + b_2(s(t-k-1)-s(t-1)) + e(t) \]  \hspace{1cm} (4.4)

Table 4.C shows rejections for most groups in all horizons. Even if the orthogonality test is conducted at the individual level, about three-quarters of the individuals are judged to be irrational.

4.8 Discussion: Peso problem and bubbles

Failing the rationality test in small samples may not imply that expectations are formed irrationally, due to the often invoked caveats of peso problems and bubbles. \(^\text{10}\) (See Obstfeld (1987) and Evans (1986) and references thereof for discussions of these issues.) When conditional forecasts were formed rationally taking into account a small probability of 'crash,' but when the crash did not occur in the (small) sample, the forecast errors ex post are biased. This is known as the peso problem. The sample size of this study is admittedly small (about two years), and this could be a reason for a rejection of rationality.

However, the sample period for this study includes a volatile period after the Plaza Agreement of September 1985. (See Ito (1987) for news analysis of the exchange rate volatility after the Plaza Agreement.) The process of the sharp yen appreciation after the Plaza agreement can be regarded as a long-awaited "crash" of the dollar value. However, market expectations underestimated the magnitude of this crash. \(^\text{11}\)

In summary, this section shows that most of the market participants violate necessary conditions of the rational expectations hypothesis, however, these results should be interpreted with caution, because they could be a case of a peso problem.
5. Expectational Twist

5.A Introduction to Twist and Consistency

In this section, the consistency of expectation formation of short- vs. long-term expectations, as discussed in Froot and Ito (1988), is explored. Frankel and Froot (1987b) showed that the short-term expectations are of the bandwagon type, while the long-term expectations show some regressive characteristics. Thus, I will first replicate their regressions, and then raise the question of how to interpret a "twist" found in the data.

However, Frankel and Froot (1987b) ignored the consistency issue of short- and long-term expectations formation: If expectations formation is internally consistent, a long-term forecast should be identical to the results of sequential substitutions of short-term forecasts, given a function of expectations formation. The consistency becomes a testable hypothesis in the form of cross-equation constraints on the coefficients of the short- and long-term forecast equations. This consistency problem is parallel to the cross-equation constraints implied in the context of the interest rate term structure (Sargent (1979)) and in the context of uncovered interest parity (Ito (1988) and Ito and Quah (1989)). Froot and Ito (1988) have applied the test of consistency to the data collected by Money Market Service (MMS) for one-week and one-month ahead forecasts and the *Economist Financial Report* for three-, six- and twelve-month forecasts. They also used the averages from the JCIF data. In this paper, the same test is applied to the group means of the JCIF data, where one-, three- and six-month forecasts are available.

5.B An Example of Extrapolative expectation with One Lag

First, let us consider, following Frankel and Froot (1987b), the extrapolative expectation with one lag:

\[ s^e(t,k) - s(t) = a + b(s(t-1)-s(t)) + e(t) \]  \hspace{1cm} (5.1).

- 16 -
In (5.1), \( b < 0 \) implies a (destabilizing) bandwagon effect while \( b > 0 \) implies a stabilizing expectation formation. Results are reported in Table 5, which shows that the one percent yen appreciation would make the average individual expect a further 0.01 percent appreciation in one month. However, the Table also implies that the shock would make the same individual form an expectation of a 0.13 percent depreciation in three months and a 0.22 percent depreciation in six months. Although different groups have different biases, the pattern of coefficients,

\[
b(\text{one month}) < b(\text{three month}) < b(\text{six month})
\]
is almost unanimously observed. Hence, we may draw a conclusion, similar to that of Frankel and Froot (1987b), that the long-term expectation is more stabilizing than the short-term expectation.

\begin{table}
\centering
\caption{Table 5 about here}
\end{table}

It is easy to show that so long as the extrapolative expectation with one lag is assumed, a twist, i.e. an appreciation in the short run and a depreciation in the long run, in expectation is impossible. Put differently, the assumed formulation is not rich enough for the observed twist to be consistent.

5.C Consistency Tests

Next, we adopt a distributed lag expectation formulation with more than two lags, a formulation rich enough to produce a twist in expectation. Consider estimating the following \( k \)-month \((k=1,3,6)\) expectation formations:

\[
s^e(t,k) = d_k + (1+a_k)s(t) + b_k s(t-1) + c_k s(t-2) + u_k(t) \tag{5.2}
\]

where \( u_k(t) \) are independent, random variables representing observation errors. After substitution, using the iterated projection (see Froot and Ito
(1988)), the consistency restrictions as cross-equation constraints are derived (see Table 6).

Each of two sets of cross-equation restrictions, one-month vs. three month, and three-month vs. six-month, is tested separately, and the results are reported in Table 6. The consistency is overwhelmingly rejected in this formulation, too.

5.D Discussion: Inconsistency

I hasten to add a caveat. If we misspecify the expectation formation, then the results in this section are not valid. For example, if a policy switch, such as a monetary tightening, is expected to occur around the second month from the point of forecasting, it is "consistent" to have a twist, although the test in this paper would not capture it.

One might think that people use different economic variables for forecasting the future spot rate with different horizons. For example, chart (technical) analysis, which is a special case of (univariate) distributed lag expectation formations, is used for the short-term horizon, but other factors come into consideration for the long-term horizon. A list of other factors includes trade balances, inflation rate differentials, interest rate differentials, fiscal deficits and policy switches. However, if these factors are relevant in the long-run, they should be relevant in the short-run, although the effect may be small in the short-run.13

6. Concluding Remarks

In this paper, newly-available survey data on the expected exchange rate in the Tokyo market were used to test several hypotheses regarding expectation formations. The JCIF data set is better than the data sets
previously used by Frankel and Froot (1987a,b), in that the survey includes the expectations of different industries, not only of banks and financial institutions but also of exporters and importers. Moreover, individual responses can be used to avoid the aggregation problem altogether.

Following are the major findings of this paper: First, market participants are heterogeneous, with constant-term biases in their expectation formations. Second, "wishful expectations" were found: exporters (importers) are biased toward yen depreciation (appreciation) relative to others. Third, when the usual rationality tests were applied, among different groups, the unbiasedness of expectation was rejected in a few instances for shorter horizons and unanimously rejected in the six-month horizon. Orthogonality was soundly rejected. We may conclude that we have strong evidence against rational expectation formation in the Tokyo foreign exchange market. Fourth, consistency is overwhelmingly rejected, given that the expectation formation is a distributed lag structure with two lags.

The present paper suggests that it is important to consider a model with heterogeneous agents for the international financial market. I hope that this paper stimulates the research in this direction.
FOOTNOTES

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1. Dominguez (1986) used the Money Market Service (MMS) data from 1983 to 1985 to test a rational expectations hypothesis. Unbiasedness and the independence of forecast errors from the forward premium were tested. She found that survey forecasts were no better than the spot rate in predictive power and that rationality was in general rejected. In addition to the MMS data, Frankel and Froot (1987a,b) exploited the survey data collected by Amex Financial Service, and the Economist, which have longer sample periods and different forecast horizons. They found that expectations do respond to exchange rate changes. Moreover, short-term forecasts are more "destabilizing" than long-term forecasts; that is, the response to the degree of forecasted appreciation in response to appreciation is larger in the short-term horizon than in the long-term.
2 The first few surveys were conducted not on Wednesdays but on the middle and last business days of the month. However, the survey date was fixed on Wednesday after the fourth observation. A twice-a-month survey means that observations are usually biweekly, with a couple of exceptions in a year. That is, there are 24, instead of 26, observations in the JCIF data in 52 weeks. It is unfortunate that the interval is not fixed. In the following, I disregard the problem arising from a mix of two and three week intervals. The survey started with 42 companies and expanded to the current 44 after the fourth survey in July 1985.

3 Since the micro panel data set was made available on the condition that the anonymity of the source should be honored, it is impossible to aggregate the individuals into groups.

4 For some cases, an allowance had to be made for AR(1) serial correlation in \( u_j(t) - u_{\text{AVE}}(t) \), or in \( u_j(t) - u_{\text{AVE}}(t) \), contrary to the assumptions mentioned earlier. This may be due to either serial correlation in \( u_j \) or to deviations in \( f(I(t)) \) among individuals. However, many of rejection cases (i.e., confirming heterogeneity) are found without AR(1) disturbances.

5 I owe the observation in the paragraph to an anonymous referee. There have been some investigations examining whether diverse expectations can be rational depending upon agents' information sets (see, for example, Feldman (1987), Marcet and Sargent (1989) and Frydman (1982, 1987).)

6 One might think that intelligent persons like professional traders and dealers can separate wishful thinking from scientific forecasts. However, there is some evidence in the psychology literature, kindly suggested by Kenneth J. Arrow, that wishful thinking is rather common in social cognition.
and views of the self.

"Theories of the causal attribution process, prediction, judgments of covariation, and other tasks of social inference incorporated the assumptions of the naive scientist as normative guidelines with which actual behavior could be compared. It rapidly became evident, however, that the social perceiver's actual inferential work and decision making looked little like these normative models. Rather, information processing is full of incomplete data gathering, shortcuts, errors, and biases. In particular, prior expectations and self-serving interpretations weigh heavily into the social judgement process." (Taylor and Brown (1988), with an emphasis added).

7 One might think that there may be self-selection among entrepreneurs and dealers: Those who are optimistic about the yen appreciation (depreciation) develop import (export, resp.) business. However, the JCIF polls include only leading companies, so that it is difficult to imagine that they change their types of business due to exchange rate expectations. Those who are in charge of foreign exchange expectations and trades in those companies are usually in-house staff, who are subject to a lifetime employment practice. It is hardly the case in Japan that foreign exchange professionals hop companies according to their biases in expectations.

8 For the aspects of econometrics, see Mishkin (1983). The same procedure has been applied to the MMS data by Dominguez (1986). In this paper, I assume that reported forecasts in the survey are the subjective means of respondents. However, if agents were reporting the medians of a skewed subjective distribution, then the results of rationality tests could be affected.

9 However, Muth (1961) originally interpreted rational expectations as applying only to aggregate expectations.
If the forward rate is used in place of expectation of survey data, as is the case in papers other than ones with survey data, risk aversion is another source of bias in forecast errors.

In that sense it may seem inappropriate to invoke the peso problem explanation in the usual sense for this period. The biased forecast errors due to the underestimation of the magnitude of a crash could be called the "Plaza problem." Both "peso problems," which arise when an infrequent crash did happen, and "Plaza problems," which occur when an infrequent crash did happen, are small sample problems. Moreover, the latter is a special case of peso problems: A policy switch, including interventions, could halt a dollar decline and reverse the movement with a small probability. That did not happen in the small sample.

Frankel and Froot (1987b) showed, using the MMS, the Economist, and the AMEX data sets, that short- and long-term expectations seem to have different characteristics. The data set with the short-term horizon yields the estimates indicating a bandwagon type (extrapolative) effect, while the data set with the long-term horizon yields results with a more regressive nature. However, the direct comparison of the short-term and long-term horizons is limited in their study, due to the spread of horizons across different data sets and different sample periods.

Suppose that uncovered interest parity (no risk premium) holds. An interest rate differential of six percent implies that the exchange rate changes by approximately three percent in six months, a significant and easily detectable change. However, it predicts only a 0.5 percent change in one month, a change which is small and may escape detection.


References page 1
References


TABLE 1: Unconditional Expected Change

Time mean of $s_j^0(t,k) - s(t)$

Mean of the (unconditional) expected change (in %)
Not annualized or adjusted for $k$.
May 1985 - June 1987, number of observations = 51

<table>
<thead>
<tr>
<th>Horizon</th>
<th>1 MONTH</th>
<th>3 MONTH</th>
<th>6 MONTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVE</td>
<td>-1.420</td>
<td>-1.431</td>
<td>-0.044</td>
</tr>
<tr>
<td>BAN</td>
<td>-1.404</td>
<td>-1.658</td>
<td>-0.957</td>
</tr>
<tr>
<td>SEC</td>
<td>-1.097</td>
<td>-0.834</td>
<td>+0.621</td>
</tr>
<tr>
<td>TRA</td>
<td>-1.956</td>
<td>-2.453</td>
<td>-0.948</td>
</tr>
<tr>
<td>EXP</td>
<td>-0.775</td>
<td>-0.137</td>
<td>+1.736</td>
</tr>
<tr>
<td>INS</td>
<td>-1.746</td>
<td>-2.309</td>
<td>+0.302</td>
</tr>
<tr>
<td>IMP</td>
<td>-1.937</td>
<td>-1.536</td>
<td>-0.430</td>
</tr>
<tr>
<td>ACT</td>
<td>-2.064</td>
<td>-5.970</td>
<td>-11.987</td>
</tr>
</tbody>
</table>

Distribution among individual respondents of the time mean of forecasted changes in the exchange rate over the specified horizon

<table>
<thead>
<tr>
<th>HORIZON</th>
<th>1 respondent</th>
<th>3 respondent</th>
<th>6 respondent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 MONTH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 MONTH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 MONTH</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2: Wishful Expectations

(a) Group Deviations from the Total Average, for each horizon,

<table>
<thead>
<tr>
<th>HORIZON</th>
<th>1 month</th>
<th>3 month</th>
<th>6 month</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
<td>DW or RHO</td>
<td>a</td>
</tr>
<tr>
<td>BAN</td>
<td>0.017</td>
<td>0.284</td>
<td>-0.228</td>
</tr>
<tr>
<td>t-stat</td>
<td>(0.25)</td>
<td>(2.04)</td>
<td>(-1.28)</td>
</tr>
<tr>
<td>SEC</td>
<td>0.305</td>
<td>0.438</td>
<td>0.561</td>
</tr>
<tr>
<td>t-stat</td>
<td>(1.25)</td>
<td>(3.38)</td>
<td>(1.62)</td>
</tr>
<tr>
<td>TRA</td>
<td>-0.536</td>
<td>DW=2.13</td>
<td>-1.022</td>
</tr>
<tr>
<td>t-stat</td>
<td>(-4.98)*</td>
<td>(-7.56)*</td>
<td>(-2.57)*</td>
</tr>
<tr>
<td>EXP</td>
<td>0.645</td>
<td>DW=2.07</td>
<td>1.294</td>
</tr>
<tr>
<td>t-stat</td>
<td>(8.55)*</td>
<td>(12.68)*</td>
<td>(6.11)*</td>
</tr>
<tr>
<td>INS</td>
<td>-0.326</td>
<td>0.474</td>
<td>-0.815</td>
</tr>
<tr>
<td>t-stat</td>
<td>(-1.54)</td>
<td>(3.72)</td>
<td>(-1.93)*</td>
</tr>
<tr>
<td>IMP</td>
<td>-0.517</td>
<td>DW=1.47</td>
<td>-0.079</td>
</tr>
<tr>
<td>t-stat</td>
<td>(-3.76)*</td>
<td>(-0.29)</td>
<td>(2.17)</td>
</tr>
</tbody>
</table>

* shows the "heterogeneous" group at the level of 1%.

(B) Distribution of individual effects

\[
\begin{align*}
\% & = \text{significant individual effects;} & \% & = \text{insignificant individual effects.} \\
\text{HORIZON} & & & \\
\% & & & \\
+5.0 & & & \\
0.0 & & & \\
-5.5 & & & \\
\end{align*}
\]
Table 3: Idiosyncratic effects
Extrapolative form

\[ s^E_j(t) - s^E_{AVE}(t) = a_j - a_{AVE} + \{b^1_j - b^1_{AVE}\}(s(t-1) - s(t)) + \{b^2_j - b^2_{AVE}\}(s(t-2) - s(t-1)) + u_j(t) - u_{AVE} \]

H0: No idiosyncratic coefficient effects, \( b = 0 \)
(allowing for individual effect of a constant bias)

H1: No idiosyncratic coefficient or individual (constant) effect, \( a = b = 0 \)

<table>
<thead>
<tr>
<th>Lag length</th>
<th>1 lag ((b^2 = 0))</th>
<th>2 lag</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H0</td>
<td>H1</td>
</tr>
<tr>
<td>BAN F-stat</td>
<td>.122</td>
<td>.103</td>
</tr>
<tr>
<td>signif</td>
<td>.729</td>
<td>.903</td>
</tr>
<tr>
<td>SEC F-stat</td>
<td>.815</td>
<td>1.37</td>
</tr>
<tr>
<td>TRA F-stat</td>
<td>.461</td>
<td>21.0</td>
</tr>
<tr>
<td>signif</td>
<td>.500</td>
<td>.000*</td>
</tr>
<tr>
<td>EXP F-stat</td>
<td>4.28</td>
<td>40.5</td>
</tr>
<tr>
<td>signif</td>
<td>.044</td>
<td>.000*</td>
</tr>
<tr>
<td>INS F-stat</td>
<td>.429</td>
<td>2.12</td>
</tr>
<tr>
<td>signif</td>
<td>.516</td>
<td>.132</td>
</tr>
<tr>
<td>IMP F-stat</td>
<td>3.68</td>
<td>7.70</td>
</tr>
<tr>
<td>signif</td>
<td>.061</td>
<td>.001*</td>
</tr>
</tbody>
</table>
Table 4: Tests of Rational Expectations

(A) Unbiasedness:

(i) Estimates and standard errors of a and b; Chisq and signif. for AVE

<table>
<thead>
<tr>
<th></th>
<th>1 MONTH</th>
<th></th>
<th>3 MONTH</th>
<th></th>
<th>6 MONTH</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>b</td>
<td>CHISQ</td>
<td>a</td>
<td>b</td>
<td>CHISQ</td>
<td>a</td>
</tr>
<tr>
<td>-0.028</td>
<td>-0.485</td>
<td>2.59</td>
<td>-0.043</td>
<td>1.167</td>
<td>5.21</td>
<td>-0.119</td>
</tr>
<tr>
<td>(0.017)</td>
<td>(0.969)</td>
<td>0.274</td>
<td>(0.034)</td>
<td>(1.167)</td>
<td>0.074</td>
<td>(0.041)</td>
</tr>
</tbody>
</table>

(ii) Number of cases in the group data,

<table>
<thead>
<tr>
<th></th>
<th>1 month</th>
<th></th>
<th>3 month</th>
<th></th>
<th>6 month</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fail to reject H (at 1%)</td>
<td>4</td>
<td></td>
<td>4</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Reject H (at 1%)</td>
<td>2 (TRA, INS)</td>
<td>2 (SEC, IMP)</td>
<td>4 (SEC, TRA EXP, INS)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(B) Orthogonality, past exchange rate movement, with 1 lag

(i) Estimates and standard errors of a and b; Chisq and signif. for AVE

<table>
<thead>
<tr>
<th></th>
<th>1 MONTH</th>
<th></th>
<th>3 MONTH</th>
<th></th>
<th>6 MONTH</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>b</td>
<td>CHISQ</td>
<td>a</td>
<td>b</td>
<td>CHISQ</td>
<td>a</td>
</tr>
<tr>
<td>0.004</td>
<td>0.166</td>
<td>3.883</td>
<td>0.042</td>
<td>0.306</td>
<td>9.504</td>
<td>0.114</td>
</tr>
<tr>
<td>(0.010)</td>
<td>(0.203)</td>
<td>0.144</td>
<td>(0.025)</td>
<td>(0.225)</td>
<td>0.009</td>
<td>(0.036)</td>
</tr>
</tbody>
</table>

(ii) Number of cases in Group data and Micro data

<table>
<thead>
<tr>
<th></th>
<th>Group Data</th>
<th></th>
<th>Micro Data</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 month</td>
<td>3 month</td>
<td>6 month</td>
<td>1 month</td>
<td>3 month</td>
</tr>
<tr>
<td>Fail to reject H</td>
<td>5</td>
<td>3</td>
<td>0</td>
<td>37</td>
<td>26</td>
</tr>
<tr>
<td>Reject H (at 1%)</td>
<td>1 (EXP)</td>
<td>3 (SEC, EXP, IMP)</td>
<td>6</td>
<td>7</td>
<td>18</td>
</tr>
</tbody>
</table>

(C) Orthogonality, past exchange rate movement, with 2 lags

(i) Estimates and standard errors of a and b; Chisq and signif. for AVE

<table>
<thead>
<tr>
<th></th>
<th>1 MONTH</th>
<th></th>
<th>3 MONTH</th>
<th></th>
<th>6 MONTH</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>b</td>
<td>c</td>
<td>CHISQ</td>
<td>a</td>
<td>b</td>
<td>c</td>
</tr>
<tr>
<td>0.007</td>
<td>.247</td>
<td>-.323</td>
<td>38.29</td>
<td>.043</td>
<td>.330</td>
<td>-.095</td>
</tr>
<tr>
<td>(.011)</td>
<td>(.185)</td>
<td>(.207)</td>
<td>(.000)</td>
<td>(.025)</td>
<td>(.220)</td>
<td>(.093)</td>
</tr>
</tbody>
</table>

(ii) Number of cases in Group data and Micro data

<table>
<thead>
<tr>
<th></th>
<th>Group Data</th>
<th></th>
<th>Micro Data</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 month</td>
<td>3 month</td>
<td>6 month</td>
<td>1 month</td>
<td>3 month</td>
</tr>
<tr>
<td>Fail to reject H</td>
<td>0</td>
<td>2 (BAN, TRA)</td>
<td>1 (BAN)</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td>Reject H (at 1%)</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>33</td>
<td>22</td>
</tr>
</tbody>
</table>

Tables - 4 -
Table 5: Expectation Formation

Extrapolative expectation with one lag

\[ s_j(t,k) - s(t) = a + b(s(t-1) - s(t)) + \epsilon(t) \]

Cases: 
- \( b < 0 \) belief in a bandwagon effect
- \( b = 0 \) belief in constant appreciation
- \( b > 0 \) distributed lag form

H: \( a = b = 0 \) belief in random walk

Estimates of \( a \) and \( b \) and their (standard errors)

<table>
<thead>
<tr>
<th>HORIZON (k)</th>
<th>1 MONTH</th>
<th>3 MONTH</th>
<th>6 MONTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>b</td>
<td>CHISQ</td>
<td>a</td>
</tr>
<tr>
<td>AVE</td>
<td>-.015</td>
<td>-.011</td>
<td>49.42</td>
</tr>
<tr>
<td></td>
<td>(.002)</td>
<td>(.035)</td>
<td>.000</td>
</tr>
<tr>
<td>BAN</td>
<td>-.014</td>
<td>-.008</td>
<td>62.85</td>
</tr>
<tr>
<td></td>
<td>(.001)</td>
<td>(.044)</td>
<td>.000</td>
</tr>
<tr>
<td>SEC</td>
<td>-.011</td>
<td>-.058</td>
<td>8.05</td>
</tr>
<tr>
<td></td>
<td>(.003)</td>
<td>(.061)</td>
<td>.001</td>
</tr>
<tr>
<td>TRA</td>
<td>-.020</td>
<td>-.029</td>
<td>69.67</td>
</tr>
<tr>
<td></td>
<td>(.002)</td>
<td>(.068)</td>
<td>.000</td>
</tr>
<tr>
<td>EXP</td>
<td>-.009</td>
<td>.061</td>
<td>18.82</td>
</tr>
<tr>
<td></td>
<td>(.001)</td>
<td>(.039)</td>
<td>.000</td>
</tr>
<tr>
<td>INS</td>
<td>-.018</td>
<td>.015</td>
<td>17.20</td>
</tr>
<tr>
<td></td>
<td>(.003)</td>
<td>(.067)</td>
<td>.000</td>
</tr>
<tr>
<td>IMP</td>
<td>-.018</td>
<td>-.134</td>
<td>28.43</td>
</tr>
<tr>
<td></td>
<td>(.003)</td>
<td>(.075)</td>
<td>.000</td>
</tr>
</tbody>
</table>

Number of Cases In Micro Data,

<table>
<thead>
<tr>
<th>Horizon</th>
<th>1 month</th>
<th>3 month</th>
<th>6 month</th>
</tr>
</thead>
<tbody>
<tr>
<td>b &gt;&gt; 0</td>
<td>sig.</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>b &gt; 0</td>
<td>insig.</td>
<td>18</td>
<td>29</td>
</tr>
<tr>
<td>b &lt; 0</td>
<td>insig.</td>
<td>20</td>
<td>7</td>
</tr>
<tr>
<td>b &lt;&lt; 0</td>
<td>sig.</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 6: Consistency Tests

**One-month vs. three-month expectations**

\[ s_j(t,1) - s(t) = d_1 + a_1s(t) + b_1s(t-1) + c_1s(t-2) \]
\[ s_j(t,3) - s(t) = d_3 + a_3s(t) + b_3s(t-1) + c_3s(t-2) \]

**H: Consistency restrictions:**

\[ d_3 = (2 + a_1 + b_1 + (1 + a_1)^2) d_1 \]
\[ a_3 = c_1 - 1 + (2(1 + a_1)b_1 + (1 + a_1)^3) \]
\[ b_3 = ((1 + a_1)c_1 + (b_1^2) + b_1((1 + a_1)^2)) \]
\[ c_3 = (c_1((1 + a_1)^2) + (b_1c_1) \]

<table>
<thead>
<tr>
<th>1 MONTH (OLS)</th>
<th>3 MONTH (GMM)</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>d_1</td>
<td>a_1</td>
<td>b_1</td>
</tr>
<tr>
<td>AVE</td>
<td>-.0261</td>
<td>.0003</td>
</tr>
<tr>
<td></td>
<td>(.0050)</td>
<td>(.0001)</td>
</tr>
</tbody>
</table>

In the Group data, H is rejected in all 6 groups.

In Micro Data, H is rejected in 42 out of 44 individuals.

**Three-month vs. Twelve-month expectations**

\[ s_j(t,3) - s(t) = d_3 + a_3s(t) + b_3s(t-3) + c_3s(t-6) \]
\[ s_j(t,6) - s(t) = d_6 + a_6s(t) + b_6s(t-3) + c_6s(t-6) \]

**H Consistency Restrictions:**

\[ d_6 = (2 + a_3)d_3 \]
\[ a_6 = (1 + a_3)^2 + b_3 - 1 \]
\[ b_6 = (1 + a_3)b_3 + c_3 \]
\[ c_6 = (1 + a_3)c_3 \]

<table>
<thead>
<tr>
<th>3 MONTH (OLS)</th>
<th>6 MONTH (GMM)</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td>AVE</td>
<td>.0218</td>
<td>-.0009</td>
</tr>
<tr>
<td></td>
<td>(.0220)</td>
<td>(.0003)</td>
</tr>
</tbody>
</table>

In Group data, H is rejected for all 6 groups.

In Micro Data, H is rejected for 42 out of 44 individuals.

Tables - 6 -