Twenty-two years of Japanese institutional forecasts

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Twenty-two Years of the Japanese Institutional Forecasts

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This paper evaluates accuracy and rationality of real GDP forecasts made by 38 Japanese private institutions over the past 22 years. It finds that about 80% of current-year forecasts and year-ahead forecasts made by them pass various tests for rationality. Moreover, the encompassing test reveals the following results. (a) All of these forecasts outperform the naïve forecasts. (b) About half of their current-year forecasts are inferior to the corresponding forecast of VAR, VECM, or the Japanese government. (c) Almost all of their year-ahead forecasts are significantly superior to the corresponding forecast of VAR or the Japanese government, but one third of them are significantly inferior to VECM forecast. (d) The consensus forecast outperforms typical institution's forecast.

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1. Introduction

Accuracy of real GDP forecasts is crucial to those who look real GDP as a guide to what is happening to the economy. Numerous studies have investigated their accuracy and rationality, but the results are somewhat mixed. [1] Almost all of these studies, however, employ the data of pre-1995. Since forecasting technology has improved in 1990s, recent forecasts would be more accurate and more consistent with the rational expectations hypothesis. This paper examines the real GDP forecasts of 38 Japanese private institutions for the time period 1980 to 2001, and finds that about 80% of their forecasts pass various tests for rationality. Furthermore, it investigates accuracy of these forecasts relative to naïve forecasts, VAR, VECM, and the Japanese government.

2. Data

We use the forecast data of Japanese institutions in "Monthly Statistics (Tokei Geppo)" published by Toyo Keizai Inc. from 1980 to 2001. [2] In every December, institution i releases forecasts of the Japanese real GDP growth rate for the ongoing fiscal year (April to March) and for the next fiscal year. We call the former $f_{t,t}^{i}$ and the latter $f_{t,t+1}^{i}$. We exclude institutions that participate in less than 15 surveys, leaving 38 institutions. The average number of observations per institution is 19.52 for current-year forecast ($f_{t,t}^{i}$) and 19.11 for year-ahead forecast ($f_{t,t+1}^{i}$). As for the actual growth rate g_{t}, revised data introduces a systematic bias because the extent of revision is unpredictable for the forecasters. Hence we use the initial announcement of the Japanese government usually released in June. [3]

3. Benchmark forecasts

We consider the following six forecasts as a benchmark. [4]

(a) 'Same-change as last year' forecast ($f_{t,t}^{Same}$ and $f_{t,t+1}^{Same}$)

$$f_{t,t}^{Same} \equiv f_{t,t+1}^{Same} \equiv g_{t-1}$$

Note that forecasters do not know g_{t} when they release $f_{t,t+1}^{i}$. This "naïve" forecast might be optimal if g_{t} would follow a random walk process.

(b) Trend forecast ($f_{t,t}^{Trend}$ and $f_{t,t+1}^{Trend}$)

$$f_{t,t}^{Trend} \equiv \frac{1}{10} \sum_{i=1}^{10} g_{t-i} \text{ , and}$$

$$f_{t,t+1}^{Trend} \equiv \frac{1}{10} \sum_{i=1}^{9} g_{t-i} + \frac{1}{10} f_{t,t}^{Trend} = \frac{11}{100} \sum_{i=1}^{9} g_{t-i} + \frac{g_{t-10}}{100} .$$

Trend forecasts assume instant mean reversion.

(c) Vector autoregression (VAR) forecast ($f_{t,t}^{VAR}$ and $f_{t,t+1}^{VAR}$)

We construct a VAR model with four lags and a constant term consists of four variables: real GNP, GNP deflator, real private final consumption expenditure, and the call money rate. We focus on pseudo out-of-sample forecasts in order to simulate how the VAR forecasts would have been computed in real time. More precisely, to calculate the VAR forecasts of year t, we first estimate the model using real-time quarterly data from 1953 through the second quarter of fiscal year t (i.e. July-September of year t). Then the estimated coefficients are used to generate a two-quarter-ahead forecast, $f_{t,t}^{VAR}$, and a six-quarter-ahead forecast, $f_{t,t+1}^{VAR}$. The important point is that each institution could compute these VAR forecasts by itself before it released own forecast in December.

(d) Vector error correction model ($f_{t,t}^{VECM}$ and $f_{t,t+1}^{VECM}$)

We use cointegrating vectors estimated in the Johansen (1991) test procedure to construct a vector error correction model (VECM). The VECM forecasts are generated by the same way as the VAR forecasts.

(e) Government forecast ($f_{t,t}^{Gov}$ and $f_{t,t+1}^{Gov}$)

The Japanese government releases its growth forecasts in every late December.

(f) Mean forecasts of private institutions ($f_{t,t}^{Mean}$ and $f_{t,t+1}^{Mean}$):

$$f_{t,t}^{Mean} \equiv \text{avg}\left(f_{t,t}^{i}\right) \text{ and } f_{t,t+1}^{Mean} \equiv \text{avg}\left(f_{t,t+1}^{i}\right).$$

4. Tests for rationality

4-1. Test for unbiasedness

A forecast is unbiased if its average deviation from the outcome is zero. Holden and Peel (1990) suggest a simple regression of the forecast error on a constant term as the

test for unbiasedness. Define $FE_{t,t}^i \equiv f_{t,t}^i - g_t$ and $FE_{t,t+1}^i \equiv f_{t,t+1}^i - g_{t+1}$.[5] We estimate

$$FE_{t,t}^i = \alpha^i + u_t^i \qquad\qquad (1)$$

and $FE_{t,t+1}^i = \alpha^i + u_t^i$. $\qquad\qquad (2)$

The null hypothesis is $\alpha^i = 0$. We also check serial correlation in u_t^i, since a forecast can be improved if there is serial correlation in the error term.

As for regression (2), $FE_{t,t+1}^i$ might exhibit a first-order moving average error, since forecasters do not know the actual growth rate of the ongoing fiscal year (g_t) when they release $f_{t,t+1}^i$. Then OLS estimate of α^i is consistent but OLS estimate of standard error might be biased downward. Namely OLS estimations might incorrectly reject the rational expectations hypothesis. For this reason we calculate the asymptotic variance-covariance matrix estimates of Hansen and Hodrick (1980) if first order error correlation is detected in regression (2).

Table 1 summarizes the results. The first row shows the result of current-year forecasts. The second row shows that of year-ahead forecasts. The first column indicates the number of institutions for which the null of no bias and no serial correlation are not rejected at the 0.10 significance (More precisely, the null hypotheses for regression (2) are no bias and no serial correlation of second or higher order). We check serial correlation in u_t^i up to fourth order by the Ljung-Box Q-statistic. The second column indicates the number of institutions for which either the null of no bias or the null of no serial correlation is rejected at the 0.10 significance.

Table 1 demonstrates that almost all institutions pass the test for unbiasedness and test for no autocorrelation in residuals. [6] The estimation problem of the variance-covariance matrix is negligible, since first order error correlation is detected (at the 0.10 significance) in only two institutions. Accordingly we will use OLS estimates of the variance-covariance matrix hereafter.

4-2. Tests for efficiency
A forecast is efficient if its forecast error is not related to information available when the forecast was made. Let X_t^i be the information forecaster i knows at year t. Then the

regressions

$$FE_{t,t}^i = \alpha^i + \beta^i \cdot X_t^i + u_t^i \qquad (3)$$

$$\text{and} \quad FE_{t,t+1}^i = \alpha^i + \beta^i \cdot X_t^i + u_t^i \qquad (4)$$

can be used for the test of efficiency. The null hypothesis is $\alpha^i = \beta^i = 0$. We substitute $f_{t,t}^i$, $f_{t,t}^{Same}$, $f_{t,t}^{Trend}$, and $f_{t,t}^{VAR}$ for X_t^i: each forecaster should know own forecast ($f_{t,t}^i$), the latest realization ($f_{t,t}^{Same}$), the trend ($f_{t,t}^{Trend}$), and the past statistical relationships between basic economic variables ($f_{t,t}^{VAR}$).

Table 2 reports the results of regression (3) and (4). The first column shows the number of institutions for which the null of $\alpha^i = 0$, $\beta^i = 0$, and $\alpha^i = \beta^i = 0$ are not rejected at the 0.10 significance. It indicates that 32 or more institutions (out of 38 institutions) pass each test.[7] Furthermore, about 80% of individual institutions pass all tests: $FE_{t,t}^i$ is not correlated with either $f_{t,t}^i$, $f_{t,t}^{Same}$, $f_{t,t}^{Trend}$, or $f_{t,t}^{VAR}$ for 31 institutions, and $FE_{t,t+1}^i$ is not correlated with either $f_{t,t+1}^i$, $f_{t,t+1}^{Same}$, $f_{t,t+1}^{Trend}$, or $f_{t,t+1}^{VAR}$ for 29 institutions. This percentage is quite close to Zarnowitz (1985), which finds 80% of participants in NBER-ASA economic survey pass tests for efficiency.

4-3. Tests for martingale

Batchelor and Dua (1991, p.695) argue that, if a forecaster is rational, his forecast revision must be uncorrelated with variables known at the time of the earlier forecast. They propose the following regression as the martingale test:

$$f_{t+1,t+1}^i - f_{t,t+1}^i = \alpha^i + \beta^i \cdot X_t^i + u_t^i. \qquad (5)$$

We substitute $f_{t,t+1}^i$, $f_{t,t+1}^{Same}$, $f_{t,t+1}^{Trend}$, and $f_{t,t+1}^{VAR}$ for X_t^i and estimate (5).

Table 3 shows that 30 out of 38 institutions pass all tests. This result is noteworthy, since Batchelor and Dua find that only 7 out of 19 Blue Chip forecasters pass them.

5. Relative accuracy

As a further test of efficiency, this section employs the encompassing test and measures forecast accuracy of individual institutions relative to the benchmark forecasts.[8] We

evaluate two forecasting systems, f^1 and f^2, in the following regressions:

$$g_t - f_{t,t}^2 = \delta\left(f_{t,t}^1 - f_{t,t}^2\right) + u_t \tag{6}$$

$$\text{and} \quad g_{t+1} - f_{t,t+1}^2 = \delta\left(f_{t,t+1}^1 - f_{t,t+1}^2\right) + u_t . \tag{7}$$

If δ is significantly larger than zero, it indicates that f^1 provides some information concerning g_t, which information is excluded from f^2. In this case f^1 is said to "encompass" f^2. Similarly, if δ is significantly smaller than unity, f^2 is said to encompass f^1. If $\delta = 0$ ($\delta = 1$), then f^1 (f^2) provides no additional information useful in forecasting g_t given f^2 (f^1).[9] Ericsson (1992, p.483) shows that "forecast encompassing" is the sufficient condition of root-mean-square-error (RMSE) dominance.

Table 4 presents the results of (6).[10] We estimated six regressions for each of 38 institutions, substituting $f_{t,t}^i$ for f^1 and benchmark forecasts for f^2. The first (second) column shows the number of institutions for which the null of $\delta \leq 0$ is rejected at the 0.025 (0.05) significance by the one-tailed test. The third column shows the number of institutions for which the null of $\delta \geq 1$ is rejected at the 0.025 significance by the one-tailed test.

The first and the second rows of Table 4 show that $f_{t,t}^i$ encompasses $f_{t,t}^{Same}$ and $f_{t,t}^{Trend}$ for every institution. It indicates that every institution efficiently utilizes information in the naïve forecasts, and its RMSE is significantly smaller than that of naïve forecasts. In the third row, $f_{t,t}^i$ encompasses $f_{t,t}^{VAR}$ at the 0.05 significance for only 12 institutions. It indicates that only one third of 38 institutions efficiently utilize information in the VAR forecast, and the rest fail to exploit past statistical relationships between basic economic variables. The fourth row shows almost the same result for $f_{t,t}^{VECM}$.[11] These results are remarkable because the institutional forecasters could use better information than the VAR models: they could observe the economic trend in October and November of year *t*, while the VAR models could not.

The fifth row shows that $f_{t,t}^i$ encompasses (is encompassed by) $f_{t,t}^{Gov}$ for 13 (19) institutions at the 0.05 significance, indicating that the government forecast is slightly

better than private institutions. This result might reflect the fact that the majority of private institutions release forecasts by mid-December while the government releases forecasts in late December. The sixth row shows that the consensus (i.e. mean) forecast is significantly better than individual forecasts: $f_{t,t}^{i}$ encompasses $f_{t,t}^{Mean}$ for only two institutions, and is encompassed by $f_{t,t}^{Mean}$ for 20 institutions (at the 0.05 significance).

Table 5 presents the results of (7), i.e. year-ahead forecasts. $f_{t,t+1}^{i}$ encompasses naïve forecasts for every institution, and it encompasses $f_{t,t+1}^{VAR}$ at the 0.05 significance for 34 institutions. It indicates that, in contrast to the current-year forecasts, almost every $f_{t,t+1}^{i}$ incorporates information in the VAR forecast. On the other hand, $f_{t,t+1}^{i}$ is encompassed by $f_{t,t+1}^{VECM}$ at the 0.05 significance for 11 institutions: they are inferior to VECM in spite of the above-mentioned informational advantage. [12]

The most notable result is the fifth row: $f_{t,t+1}^{i}$ encompasses $f_{t,t+1}^{Gov}$ for 35 institutions and no institution is encompassed by $f_{t,t+1}^{Gov}$. The year-ahead forecast of the Japanese government contains no additional information given that of private institutions, and is much *less* accurate than that of private institutions. Romer and Romer (2000) find that Federal Reserve forecasts of growth rate and inflation possess valuable information not contained in the commercial forecasts. Our finding is in a striking contrast to theirs.

Zarnowitz and Braun (1993) investigate NBER-ASA survey GDP forecasts from 1968 to 1990. They find that two-quarter-ahead Bayesian VAR forecast is inferior to 75% of individual forecasts, but that five-quarter-ahead BVAR forecast is superior to 75% of individual forecasts. On the other hand, Anderson et al. (2002) compare various year-ahead forecasts of real GDP and CPI for 1990-1998, and find that, based on RMSE, VECM forecast is inferior to federal policymakers or other institutional forecasters. Our result for current-year forecast differs from them in that VAR forecast is superior to more than half of institutional forecasters. Our result for year-ahead forecast is similar to Zarnowitz and Braun in that we find only two out of thirty-eight institutions are significantly better than VECM forecast.

6. Conclusions

This paper is the first attempt to investigate accuracy and efficiency of Japanese private forecasters. It evaluates real GDP forecasts of 38 Japanese private institutions form 1980 to 2001. Each institution releases a four-months-ahead forecast for the ongoing fiscal year and a 16-months-ahead forecast for the next fiscal year in every December. Section 4 finds that about 80% of their forecasts pass various tests for rationality. Section 5 estimated the encompassing test, and four key findings emerge. First, all of their forecasts outperform the naïve 'same change as last year' forecast and the naïve trend forecast. Secondly, about half of their current-year forecasts are inferior to VAR, VECM, or the government forecast. Thirdly, almost all of their year-ahead forecasts are better than VAR or the Japanese government, but one third of them are inferior to the VECM forecast. Fourthly, the consensus forecast outperforms the typical institution's forecast.

To sum up, growth rate forecasts made by Japanese private institutions are found to be consistent with rational expectations hypothesis. Since past literature that uses the data of pre-1995 has obtained mixed results on this issue, our result may reflect recent progress of forecasting technology.

Notes

1. Batchelor and Dua (1991), Jansen and Kishan (1996), Joutz and Stekler (2000), and Ashiya (2002c) detect some bias. On the other hand, Zarnowitz (1985), Artis (1996), Pons (1999, 2000), Öller and Barot (2000), and Kreinin (2000) do not. See also Fildes and Stekler (2002) and references therein for the related literature.

2. Ashiya (2002a, b, 2003) also uses the data from "Monthly Statistics (Tokei Geppo)".

3. See Keane and Runkle (1990) and Stark and Croushore (2002). We obtain the same results by using the revised data of g_t released in June of year $t+2$.

4. Ashiya (2002c) also uses these forecasts as a benchmark.

5. Average forecast error of typical forecaster is about 0.5 percentage points for current-year forecast ($f_{t,t}^i$) and 1.3 percentage points for year-ahead forecast ($f_{t,t+1}^i$). See Ashiya (2002d) for the details.

6. Ashiya (2002d) finds that the consensus (i.e. mean) forecasts ($f_{t,t}^{Mean}$ and $f_{t,t+1}^{Mean}$) are not biased.

7. Ashiya (2002d) finds that the consensus forecasts ($f_{t,t}^{Mean}$ and $f_{t,t+1}^{Mean}$) use available information efficiently.

8. See Chong and Hendry (1986), Mizon and Richard (1986), Ericsson (1992), and Jansen and Kishan (1996).

9. When $\delta < 0$ ($\delta > 1$), f^1 (f^2) is so inaccurate that the minimum squared error composite requires "short selling" of it (Cooper and Nelson, 1975, p.8).

10. We also conducted the generalized encompassing test $g_t = \alpha + \delta_1 \cdot f_{t,t}^1 + \delta_2 \cdot f_{t,t}^2 + u_t$, and obtained similar results. See Ashiya (2002d) for the details.

11. Ashiya (2002d) finds that the consensus forecast for the current year ($f_{t,t}^{Mean}$) encompasses all of naïve forecasts, VAR forecast, VECM forecast, and the government forecast.

12. Ashiya (2002d) finds that the consensus forecast for the next year ($f_{t,t+1}^{Mean}$) encompasses naïve forecasts, VAR forecast, and the government forecast, but that it does not encompass VECM forecast.

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Table 1: Test for unbiasedness

Model: (1) $FE_{t,t}^{i} = \alpha^{i} + u_{t}^{i}$

(2) $FE_{t,t+1}^{i} = \alpha^{i} + u_{t}^{i}$

Eq.	Pass [a]	Fail
(1)	37	1
(2)	35 [b]	3

Notes

a: The number of institutions for which the null of no bias and no serial correlation are not rejected at the 0.10 significance.

b: Among them, forecast errors of two institutions have first-order serial correlation at the 0.10 significance.

Table 2: Test for efficiency

Model: (3) $FE_{t,t}^i = \alpha^i + \beta^i \cdot X_t^i + u_t^i$

X_t^i	Pass[a]	Fail
$f_{t,t}^i$	36	2
$f_{t,t}^{Same}$	37	1
$f_{t,t}^{Trend}$	32	6
$f_{t,t}^{VAR}$	37	1

* 31 institutions pass all tests.

Model: (4) $FE_{t,t+1}^i = \alpha^i + \beta^i \cdot X_t^i + u_t^i$

X_t^i	Pass[a]	Fail
$f_{t,t+1}^i$	35	3
$f_{t,t+1}^{Same}$	36	2
$f_{t,t+1}^{Trend}$	33	5
$f_{t,t+1}^{VAR}$	34	4

* 29 institutions pass all tests.

Notes

a: The number of institutions for which the null of $\alpha^i = 0$, $\beta^i = 0$, and $\alpha^i = \beta^i = 0$ are not rejected at the 0.10 significance.

Table 3: Test for martingale

Model: (5) $f^i_{t+1,t+1} - f^i_{t,t+1} = \alpha^i + \beta^i \cdot X^i_t + u^i_t$

X^i_t	Pass[a]	Fail
$f^i_{t,t+1}$	38	0
$f^{Same}_{t,t+1}$	33	5
$f^{Trend}_{t,t+1}$	37	1
$f^{VAR}_{t,t+1}$	34	4

* 30 institutions pass all tests.

Notes

a: The number of institutions for which the null of $\alpha^i = 0$, $\beta^i = 0$, and $\alpha^i = \beta^i = 0$ are not rejected at the 0.10 significance.

Table 4: Encompassing test for current-year forecasts

Model: (6) $g_t - f_{t,t}^2 = \delta\left(f_{t,t}^1 - f_{t,t}^2\right) + u_t$

$\left(f^1, f^2\right)$	$H_0 : \delta \leq 0$		$H_0 : \delta \geq 1$	
	$p < 0.025$ [a]	$p < 0.05$ [b]	$p < 0.025$ [a]	$p < 0.05$ [b]
$\left(f_{t,t}^i, f_{t,t}^{Same}\right)$	38	38	0	0
$\left(f_{t,t}^i, f_{t,t}^{Trend}\right)$	38	38	0	0
$\left(f_{t,t}^i, f_{t,t}^{VAR}\right)$	7	12	14	20
$\left(f_{t,t}^i, f_{t,t}^{VECM}\right)$	7	11	13	19
$\left(f_{t,t}^i, f_{t,t}^{Gov}\right)$	8	13	14	19
$\left(f_{t,t}^i, f_{t,t}^{Mean}\right)$	1	2	15	20

Notes
a: The number of institutions for which the null is rejected at the 0.025 significance (by the one-tailed test).
b: The number of institutions for which the null is rejected at the 0.05 significance (by the one-tailed test).

Table 5: Encompassing test for year-ahead forecasts

Model: (7) $g_{t+1} - f_{t,t+1}^2 = \delta\left(f_{t,t+1}^1 - f_{t,t+1}^2\right) + u_t$

$\left(f^1, f^2\right)$	$H_0 : \delta \leq 0$		$H_0 : \delta \geq 1$	
	$p < 0.025$ [a]	$p < 0.05$ [b]	$p < 0.025$ [a]	$p < 0.05$ [b]
$\left(f_{t,t+1}^i, f_{t,t+1}^{Same}\right)$	38	38	0	0
$\left(f_{t,t+1}^i, f_{t,t+1}^{Trend}\right)$	38	38	0	0
$\left(f_{t,t+1}^i, f_{t,t+1}^{VAR}\right)$	18	34	0	1
$\left(f_{t,t+1}^i, f_{t,t+1}^{VECM}\right)$	1	2	1	11
$\left(f_{t,t+1}^i, f_{t,t+1}^{Gov}\right)$	31	35	0	0
$\left(f_{t,t+1}^i, f_{t,t+1}^{Mean}\right)$	1	1	5	8

Notes

a: The number of institutions for which the null is rejected at the 0.025 significance (by the one-tailed test).

b: The number of institutions for which the null is rejected at the 0.05 significance (by the one-tailed test).