AN EVALUATION OF GDP FORECASTS MADE BY JAPANESE INDIVIDUAL ECONOMISTS

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We evaluate the relative accuracy of real GDP forecasts made by 25 Japanese economists over the past 15 years. The encompassing test reveals the following results. (a) All of these forecasts outperform naïve forecasts. (b) Their current-year forecasts are inferior to the corresponding forecasts of VAR, VECM, or the Japanese government. (c) Their year-ahead forecasts are inferior to the corresponding forecast of VECM, although they are as accurate as VAR or the government forecast. (d) On the whole, their forecasts are significantly inferior to those of commercial institutions.

1. Introduction

Thirty years ago, the best strategy for improving economic forecasts was to build larger and more detailed models. It was difficult for individual economists at that time to compete with commercial institutions because they were handicapped by lack of money and other resources. The 1980s saw, however, the rapid spread of the vector autoregression (VAR) approach among economic forecasters. VAR models were simple to construct, easy to operate, and relatively accurate. Thus it is natural to think that individual economists from the late 1980s on would become more competent.

This paper follows the methodology of Ashiya (2005) and evaluates the performance of real GDP forecasts made by 25 Japanese individual forecasters for the time period 1987 to 2001. The encompassing test finds that individual economists are inferior to commercial institutions and a sophisticated VAR model that uses real-time data only. It indicates that individual economists in 1990s were still incompetent (as for the encompassing test and its application, see Cooper and Nelson (1975), Chong and Hendry (1986), Mizon and Richard (1986), Fair and Shiller (1990), Ericsson (1992), Jansen and Kishan (1996), Joutz and Stekler (2000), Romer and Romer (2000), and Batchelor (2001)).

The paper is organized as follows. Section 2 explains the data, and Section 3 introduces six benchmark forecasts. Section 4 reports forecast accuracy of individual economists. Section 5 evaluates relative accuracy, and Section 6 concludes the paper.

2. Data

We use the forecast data of Japanese economists and Japanese institutions in "Monthly Statistics (Tokei Geppo)" published by Toyo Keizai Inc. from 1987 to 2001 (Ashiya and Doi

(2001) and Ashiya (2003) also use this data). Every December, forecaster *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 $f^i_{t,t}$ and the latter $f^i_{t,t+1}$.

As for the individual forecasters, we exclude economists that participate in less than 12 surveys, leaving 25 economists. The average number of observations per economist is 12.40 for the current-year forecast ($f^i_{t,t}$) and 13.68 for the year-ahead forecast ($f^i_{t,t+1}$). As for the institutional forecasters, we pick up 36 institutions by the same criterion as the individual forecasters. The average number of observations per institution is 12.86 for $f^i_{t,t}$ and 14.69 for $f^i_{t,t+1}$. As for the actual growth rate g_t, Keane and Runkle (1990) argue that the revised data introduces a systematic bias because the extent of revision is unpredictable for the forecasters (see also Stark and Croushore (2002)). For this reason we use the initial announcement of the Japanese government usually released in June (we obtain the same results by using the revised data of g_t released in June of year $t + 2$).

3. Benchmark forecasts

This paper follows the methodology of Ashiya (2005) and introduces six benchmark forecasts.

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

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

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

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

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

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

Trend forecasts assume instant mean reversion.

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

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, $f^{VAR}_{t,t}$, and a six-quarter-ahead forecast, $f^{VAR}_{t,t+1}$. The important point is that each institution could compute these VAR forecasts by itself before it released its 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 in 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 annual growth forecasts in late December. (Ashiya (forthcoming-a) investigates accuracy and rationality of the government forecast in great detail.)

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

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

4. Forecasting accuracy

Table 1 presents the values of several traditional measures of forecast accuracy. The first row in Table 1 shows the summary statistics (average, standard deviation, minimum, and maximum) of mean absolute error (MAE). The average forecast error of a typical economist is about 0.7 percentage points for the current-year forecast ($f_{t,t}^{i}$) and 1.5 percentage points for the year-ahead forecast ($f_{t,t+1}^{i}$). The average forecast error of the best economist is about 0.53 percentage points for the current-year forecast and 1.24 percentage points for the year-ahead forecast. The second row shows the summary statistics of root mean square error (RMSE).

The third row of Table 1(a) shows the summary statistics of modified Theil's *U*, constructed as the ratio of the RMSE of each economist to the RMSE of the 'same change as last year' forecast ($f_{t,t}^{Same}$). Note that the 'no-change' forecast, which always predicts 0% growth, is not an appropriate basis for comparison, since real GDP seldom exhibits negative changes (Artis (1996) uses the same definition of Theil's U as ours). More specifically, define $T_{t,t}^{i}$ as the set of fiscal years economist i released $f_{t,t}^{i}$. Since g_{t-1} is the latest realization of the growth rate when $f_{t,t}^{i}$ is released, we use $f_{t,t}^{Same} \equiv g_{t-1}$ as the naïve alternative forecast. Then the Theil's *U* of economist *i* for the current-year forecast, $U_{t,t}^{i}$, is defined as

$$U_{t,t}^{i} \equiv \sqrt{\sum_{t\in T_{t,t}^{i}} (f_{t,t}^{i} - g_{t})^2} \Big/ \sqrt{\sum_{t\in T_{t,t}^{i}} (g_{t-1} - g_{t})^2}.$$

Similarly, the Theil's U of economist i for the year-ahead forecast, $U_{t,t+1}^{i}$, is defined as

$$U_{t,t+1}^{i} \equiv \sqrt{\sum_{t\in T_{t,t+1}} (f_{t,t+1}^{i} - g_{t+1})^2} \Big/ \sqrt{\sum_{t\in T_{t,t+1}} (g_{t-1} - g_{t+1})^2}.$$

Table 1 shows that Theil's *U* is definitely smaller than one for all economists. It demonstrates that the forecasts of economists are much more accurate than the naïve same change forecast.

Each economist can be arranged by the size of $U^i_{t,t}$ and $U^i_{t,t+1}$. The rank correlation coefficient between $U^i_{t,t}$ and $U^i_{t,t+1}$ is 0.550, which indicates that there is a positive correlation between the ability to forecast the ongoing year and the ability to forecast the next year.

Similarly, Table 2 shows the forecast performance of commercial institutions in the corresponding period. By comparing Table 1(a) and 2(a), we find that individual economists are inferior to commercial institutions for the current-year forecasts. As for the year-ahead forecasts, little difference is found in Table 1(b) and 2(b). The encompassing test in the next section, however, will show that actually there *is* a difference in accuracy between these two groups.

5. Relative accuracy

This section evaluates forecast accuracy of individual economists relative to commercial institutions and benchmark forecasts defined in Section 3. Tables 1 and 3 show mean absolute error (MAE) and root mean square error (RMSE) of individual economists and benchmark forecasts, but we cannot compare them directly because few economists have participated in every survey. Therefore we will evaluate relative accuracy by the encompassing test Chong and Hendry (1986) propose.

5.1 Methodology

The encompassing test evaluates two forecasting systems, f^1 and f^2, by the following regression:

$$g_t = \delta f^1_{t,t} + (1 - \delta) f^2_{t,t} + u_t.$$

If δ is positive and significantly different form zero, it indicates that f^1 provides some information concerning g_t, whose information is excluded from f^2. In this case f^1 is said to "encompass" f^2. Similarly, if $1 - \delta$ is positive and significantly different form zero, then f^2 is said to encompass f^1.

Ericsson (1992, p.485, l.1) argues, however, that "the forecast-encompassing test may have no power when the dependent variable is $I(1)$." Thus we follow Ericsson (1992) and Jansen and Kishan (1996) and estimate the transformed encompassing test

$$g_t - f^2_{t,t} = \delta(f^1_{t,t} - f^2_{t,t}) + u_t \tag{1}$$

$$\text{and } g_{t+1} - f^2_{t,t+1} = \delta(f^1_{t,t+1} - f^2_{t,t+1}) + u_t. \tag{2}$$

If δ is significantly larger than zero, then f^1 encompasses f^2. If δ is significantly smaller than unity, then f^2 encompasses 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). 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). Ericsson (1992, p.483) shows that "forecast encompassing" is the sufficient condition of RMSE dominance.

5.2 Comparison with benchmark forecasts

Table 4 presents the results of (1). We estimated six regressions for each of 25 economists, substituting $f^i_{t,t}$ for f^1 and benchmark forecasts for f^2. The first (second) column shows the number of economists for which the null of $\delta \le 0$ is rejected at the 0.025 (0.05) significance by the one-tailed test. The third (fourth) column shows the number of economists for which the null of $\delta \ge 1$ is rejected at the 0.025 (0.05) significance by the one-tailed test.

The first and the second rows of Table 4 show that $f^i_{t,t}$ encompasses $f^{Same}_{t,t}$ and $f^{Trend}_{t,t}$ for every economist. It indicates that every economist efficiently utilizes information in the naïve forecasts, and its RMSE is significantly smaller than that of the naïve forecasts. The third row shows that $f^i_{t,t}$ does not encompass $f^{VAR}_{t,t}$ for any economist, and that $f^i_{t,t}$ is encompassed by $f^{VAR}_{t,t}$ for 19 out of 25 economists (at the 0.05 significance). It indicates that 76% of the current-year forecasts made by the individual economists are significantly inferior to the VAR forecast, and these economists fail to exploit past statistical relationships between basic economic variables for their forecasts. We obtain almost the same result for $f^{VECM}_{t,t}$ (the fourth row). These results are remarkable because the economists must have had better information than the VAR models: they had observed the economic trend in October and November of year t, while the VAR models had not.

The fifth row shows that $f^i_{t,t}$ does not encompass $f^{Gov}_{t,t}$ for any economist, and that $f^i_{t,t}$ is encompassed by $f^{Gov}_{t,t}$ for all 25 economists (at the 0.05 significance). It indicates that the current-year forecast of the Japanese government is significantly better than that of every individual economist. This result might reflect the fact that every economist releases forecasts in early December while the government releases forecasts in late December. The sixth row shows that $f^i_{t,t}$ encompasses $f^{Mean}_{t,t}$ for only one economist, and $f^i_{t,t}$ is encompassed by $f^{Mean}_{t,t}$ for nine economists (at the 0.05 significance). It implies that the consensus (i.e. mean) forecast is better than individual forecasts, as past literature has noted (e.g., Clemen, 1989).

Table 5 presents the results of (2), i.e. the year-ahead forecasts. The first and the second rows show that $f^i_{t,t+1}$ encompasses the naïve forecasts for every economist. The third row shows a mixed result for $f^{VAR}_{t,t+1}$, but the fourth row shows that $f^i_{t,t+1}$is encompassed by $f^{VECM}_{t,t+1}$ at the 0.05 significance for 18 out of 25 economists. Namely 72% of the year-ahead forecasts made by the individual economists are significantly inferior to the mechanical VECM forecast in spite of the above-mentioned informational advantage. On the other hand, the fifth row shows that $f^i_{t,t+1}$ encompasses $f^{Gov}_{t,t+1}$ for seven economists and that only one economist is encompassed by $f^{Gov}_{t,t+1}$. That is, individual economists are at least as good as the Japanese government for the year-ahead forecast. The sixth row shows that the mean forecast is better than individual forecasts.

As for the US economy, Zarnowitz and Braun (1993) investigate NBER-ASA survey GDP forecasts from 1968 to 1990. They find that 75% of two-quarter-ahead individual forecasts are better than the corresponding Bayesian VAR forecast, but that 75% of five-quarter-ahead individual forecasts are inferior to the corresponding Bayesian VAR forecast. Anderson et al. (2002) compare various year-ahead forecasts of real GDP and CPI for 1990-1998, and find that, based on RMSE, federal policymakers and other institutional forecasters are superior to the VECM forecast.

5.3 Comparison with commercial institutions

The most comprehensive way to compare forecast accuracy between 25 economists and 36 institutions is to run 36 encompassing tests for each of the 25 economists, substituting institutional forecasts for f^2. However, this method is rather tedious, and the result obtained is hard to interpret. Accordingly, we measure their relative accuracy indirectly. First we estimate six regressions for each of 36 commercial institutions, substituting their forecasts for f^1 and benchmark forecasts for f^2. Then we compare the result with what we found in the analysis of individual economists.

Table 6 shows the result of the encompassing test for 36 institutions. By inspecting the sixth rows of this table and Table 4, we find definite evidence with respect to the forecast accuracy of individual economists relative to commercial institutions. As for the current-year forecast, the sixth row of Table 6 shows that no institution is encompassed by the mean forecast of the economists ($f_{t,t}^{Mean}$) and 16 out of 36 institutions encompass $f_{t,t}^{Mean}$. In contrast, Table 4 has shown that nine out of twenty-five economists are encompassed by $f_{t,t}^{Mean}$ and only one economist encompasses $f_{t,t}^{Mean}$. These results indicate that the commercial institutions are significantly superior to $f_{t,t}^{Mean}$, and $f_{t,t}^{Mean}$ in turn is superior to the individual economists. Therefore the current-year forecasts of the commercial institutions are significantly superior to those of individual economists.

As for the year-ahead forecasts, the sixth row of Table 7 shows that no institution is encompassed by $f_{t,t+1}^{Mean}$ and eight institutions encompass $f_{t,t+1}^{Mean}$. On the other hand, Table 5 has shown that ten economists are encompassed by $f_{t,t+1}^{Mean}$ and no economist encompasses $f_{t,t+1}^{Mean}$. Thus the year-ahead forecasts of the commercial institutions are also significantly superior to those of individual economists.

6. Conclusions

This paper investigates the relative accuracy of real GDP forecasts made by 25 Japanese economists over the past 15 years. Each economist releases every December a four-month-ahead forecast for the ongoing fiscal year and a 16-month-ahead forecast for the next fiscal year. Section 5 estimated the encompassing test, and three key findings emerge. First, all forecast series made by these economists outperform the naïve ‘same change as last year’ forecast and the naïve trend forecast. Second, their current-year forecasts are inferior to the corresponding forecasts of VAR, VECM, the Japanese government, and commercial institutions. Third, their year-ahead forecasts are inferior to the corresponding forecasts of VECM and commercial institutions, although they are as good as VAR forecast and the government forecast.

To sum up, the growth rate forecasts of the Japanese economists are so inaccurate that it is better to rely on a VECM forecast or forecasts of commercial institutions. Investigating their directional accuracy and their accuracy rankings (using the methodology of Ashiya (forthcoming b and c)) remains a task for future research.

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TABLE 1. Prediction performance of the economists

(a) Current-year forecasts

	Average	S.D.	Minimum	Maximum
MAE	0.696	0.125	0.525	0.985
RMSE	0.873	0.130	0.713	1.206
$U_{t,t}^{i}$	0.494	0.074	0.397	0.698

(b) Year-ahead forecasts

	Average	S.D.	Minimum	Maximum
MAE	1.476	0.139	1.242	1.758
RMSE	1.839	0.161	1.644	2.287
$U_{t,t+1}^{i}$	0.686	0.058	0.589	0.815

TABLE 2. Prediction performance of the institutions

(a) Current-year forecasts

	Average	S.D.	Minimum	Maximum
MAE	0.539	0.065	0.431	0.733
RMSE	0.691	0.072	0.574	0.889
$U_{t,t}^{i}$	0.398	0.040	0.332	0.497

(b) Year-ahead forecasts

	Average	S.D.	Minimum	Maximum
MAE	1.467	0.100	1.247	1.708
RMSE	1.796	0.108	1.530	2.035
$U_{t,t+1}^{i}$	0.678	0.042	0.582	0.774

TABLE 3. Prediction performance of the benchmark forecasts

(a) Current-year forecasts

	MAE	RMSE	$U_{t,t}^{i}$
$f_{t,t}^{Same}$	1.354	1.728	1.000
$f_{t,t}^{Trend}$	1.998	2.510	1.452
$f_{t,t}^{VAR}$	0.614	0.693	0.401
$f_{t,t}^{VECM}$	0.637	0.704	0.407
$f_{t,t}^{Gov}$	0.515	0.610	0.353
$f_{t,t}^{Mean}$	0.603	0.769	0.445

(b) Year-ahead forecasts

	MAE	RMSE	$U_{t,t+1}^{i}$
$f_{t,t+1}^{Same}$	2.107	2.597	1.000
$f_{t,t+1}^{Trend}$	1.923	2.512	0.967
$f_{t,t+1}^{VAR}$	1.342	1.781	0.686
$f_{t,t+1}^{VECM}$	1.340	1.577	0.607
$f_{t,t+1}^{Gov}$	1.433	1.856	0.715
$f_{t,t+1}^{Mean}$	1.385	1.710	0.659

TABLE 4. Encompassing test for the current-year forecasts (25 economists)

	$H_0 : \delta \leq 0$		$H_0 : \delta \geq 1$	
(f^1,f^2)	$p < 0.025$[a]	$p < 0.05$[b]	$p < 0.025$[a]	$p < 0.05$[b]
$(f_{t,t}^{i},f_{t,t}^{same})$	25	25	0	0
$(f_{t,t}^{i},f_{t,t}^{Trend})$	25	25	0	0
$(f_{t,t}^{i},f_{t,t}^{VAR})$	0	0	16	19
$(f_{t,t}^{i},f_{t,t}^{VECM})$	0	0	12	17
$(f_{t,t}^{i},f_{t,t}^{Gov})$	0	0	24	25
$(f_{t,t}^{i},f_{t,t}^{Mean})$	0	1	8	9

Notes

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

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

TABLE 5. Encompassing test for the year-ahead forecasts (25 economists)

	$H_0 : \delta \leq 0$		$H_0 : \delta \geq 1$	
(f^1,f^2)	$p < 0.025$[a]	$p < 0.05$[b]	$p < 0.025$[a]	$p < 0.05$[b]
$(f^i_{t,t+1},f^{same}_{t,t+1})$	25	25	0	0
$(f^i_{t,t+1},f^{Trend}_{t,t+1})$	25	25	0	0
$(f^i_{t,t+1},f^{VAR}_{t,t+1})$	2	5	0	4
$(f^i_{t,t+1},f^{VECM}_{t,t+1})$	0	0	13	18
$(f^i_{t,t+1},f^{Gov}_{t,t+1})$	5	7	1	1
$(f^i_{t,t+1},f^{Mean}_{t,t+1})$	0	0	6	10

Notes

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

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

TABLE 6. Encompassing test for the current-year forecasts (36 institutions)

	$H_0 : \delta \leq 0$		$H_0 : \delta \geq 1$	
(f^1,f^2)	$p < 0.025$[a]	$p < 0.05$[b]	$p < 0.025$[a]	$p < 0.05$[b]
$(f^i_{t,t},f^{same}_{t,t})$	36	36	0	0
$(f^i_{t,t},f^{Trend}_{t,t})$	36	36	0	0
$(f^i_{t,t},f^{VAR}_{t,t})$	2	7	2	7
$(f^i_{t,t},f^{VECM}_{t,t})$	2	8	2	4
$(f^i_{t,t},f^{Gov}_{t,t})$	0	0	14	20
$(f^i_{t,t},f^{Mean}_{t,t})$	14	16	0	0

Notes

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

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

TABLE 7. Encompassing test for the year-ahead forecasts (36 institutions)

	$H_0 : \delta \leq 0$		$H_0 : \delta \geq 1$	
(f^1,f^2)	$p < 0.025$[a]	$p < 0.05$[b]	$p < 0.025$[a]	$p < 0.05$[b]
$(f^i_{t,t+1},f^{same}_{t,t+1})$	36	36	0	0
$(f^i_{t,t+1},f^{Trend}_{t,t+1})$	36	36	0	0
$(f^i_{t,t+1},f^{VAR}_{t,t+1})$	5	11	0	0
$(f^i_{t,t+1},f^{VECM}_{t,t+1})$	1	1	1	2
$(f^i_{t,t+1},f^{Gov}_{t,t+1})$	9	23	0	0
$(f^i_{t,t+1},f^{Mean}_{t,t+1})$	6	8	0	0

Notes

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

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