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Predicting the direction of change in aggregate demand growth and its components

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Abstract

In this study, we set up a framework to generate the forecasts of growth in aggregate demand and its components using real-time data. In general, these forecasts (for 1983-2008) accurately predict directional change under symmetric loss and are thus of value to a user who assigns similar cost (loss) to incorrect upward and downward predictions. Our model is simple yet useful, especially to economically-rational agents who tend to balance the predictive benefit of a forecast against the cost of gathering and processing information. We conclude by suggesting that the success of our model may have to do with the stationary behavior of the series as well as monetary policy that aims to achieve sustainable growth with stable prices.

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1. Introduction

Growth in aggregate demand and its components are among the economic indicators closely monitored by market participants and policymakers to assess the future state of the economy. In particular, one is interested to know whether future growth in spending will be higher or lower. This paper sets up a forecasting framework to predict the direction of change in aggregate demand, consumption, investment, government spending, export, and import growth. Within this framework, we employ a naïve approach to generate the forecasts using real-time data. In general, our findings indicate that the forecasts for 1983-2008 accurately predict the direction of change. Our model, which displays reasonable predictive power, is simple but useful, especially to economically-rational agents who tend to balance the predictive benefit of a forecast against the cost of gathering and processing information. Thus, this study provides further evidence in support of the notion that, for many economic (and financial) indicators, a naïve forecast can contain useful predictive information (Diebold and Lopez, 1996).

The emphasis on directional forecasting in this study follows the recent literature on evaluating the directional accuracy of various macroeconomic and financial forecasts. Examples include: Lietch and Tanner (1991); Kolb and Stekler (1996); Ash, Smyth and Heravi (1998); Joutz and Stekler (2000); Pons (2000); Greer (2003); and Baghestani and Kherfi (2008).[1] In addition to examining directional accuracy, however, we explore whether a forecast implies symmetric or asymmetric loss (Dua and Smyth, 1993). After all, whether a forecast is of value to a user depends on his/her loss structure. A symmetric loss structure, while appropriate in many decision environments, may not be relevant in some others. As noted by Diebold (2007, p. 186), "Bias is optimal under asymmetric loss because we gain on average by pushing the forecasts in the direction such that we make relatively few errors of the more costly sign." Our forecasts of growth in aggregate demand, consumption, investment, export, and import, while directionally accurate, imply symmetric loss and are thus useful to a user who assigns similar cost (loss) to incorrect upward and downward predictions. In general, however, our forecasts of growth in government spending are directionally accurate under asymmetric loss. These forecasts, as we shall see, are generally more (less) accurate in predicting the downward (upward) moves. Accordingly, the forecasts of growth in government spending are useful to a user who assigns more (less) cost to incorrect downward (upward) predictions.

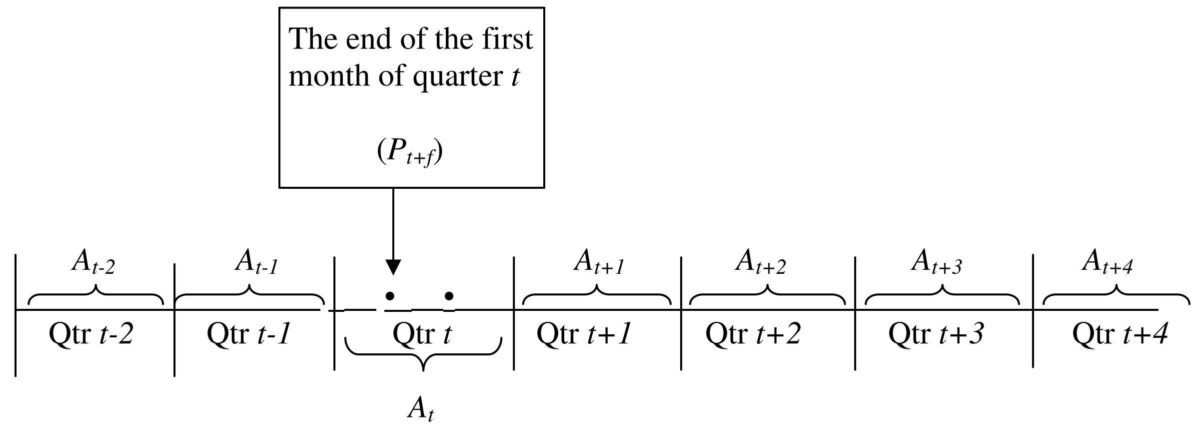
This study is organized as follows: Section 2 describes our forecasting framework. Section 3 presents the empirical results. Section 4 concludes this study.

2. The forecasting framework

The initial release of the data on aggregate demand and its components for each quarter occurs roughly 30 days after the end of the quarter, the second release (the first revised data) occurs roughly 60 days after the end of the quarter, and the third release (the second revised data) occurs roughly 90 days after the end of the quarter. For the fourth quarter of 2005, for instance, the first release was on January 30, 2006, the second on March 1, 2006, and the third on March 31, 2006. In light of this information, Figure 1 presents the timeline of the forecasts.

[1] Pesaran and Timmermann (2004, p. 414) also note that directional forecast accuracy has now become an increasingly popular metric in evaluating forecasting performance.

Figure 1. Timeline of the forecasts



The actual growth rates for the respective quarters are denoted by A_{t-2}, A_{t-1}, A_t, A_{t+1}, …, and A_{t+4}. With the forecast horizon f = 0, 1, 2, 3, and 4, P_{t+f} is the forecast of A_{t+f} made at the end of the first month of quarter t. In what follows, we refer to P_t, P_{t+1}, P_{t+2}, P_{t+3}, and P_{t+4} as the current-quarter, one-, two-, three-, and four-quarter-ahead forecasts, respectively.

For the purpose of our study, we define the actual change by ΔA_{t+f} (= $A_{t+f} - A_{t-1}$), where A_{t+f} and A_{t-1} are measured, respectively, by the second revised and initial data. We also define the predicted change by ΔP_{t+f} (= $P_{t+f} - A_{t-1}$) and set the forecast P_{t+f} equal to A_{t-2} which is measured by the second revised data available at the end of the first month of quarter t. Accordingly, our forecasting model is

$$A_{t+f} = A_{t-2} + u_{t+f},$$

where, again, the forecast horizon f = 0, 1, 2, 3, and 4, and u_{t+f} is an error term. The forecasts examined here are made in the first quarter of 1983 through the fourth quarter of 2007. Therefore, the sample periods for the current-quarter, one-, two-, three-, and four-quarter-ahead forecasts are, respectively, 1983.1-2007.4, 1983.2-2008.1, 1983.3-2008.2, 1983.4-2008.3, and 1984.1-2008.4 (with 100 observations for each forecast horizon). Table I reports some descriptive statistics for 1983.1-2008.4. As indicated by the maximum and minimum values, growth in aggregate demand and its components are erratic to varying degrees. For instance, growth in consumer spending on durable goods, business and residential investment, exports, and imports are highly volatile. In comparison, growth in aggregate demand, total consumption, consumer spending on non-durables and services are among the less volatile indicators. The last column of Table I reports the shares of alternative spending in aggregate demand.[2] As can be seen, consumer spending on services (40.1%) and on non-durable goods (20.6%) have the largest shares in aggregate demand (and in total consumption). Consumer spending on durable goods

[2] Aggregate demand is measured by real GNP (real GDP) before (after) 1992. Real-time (the initial as well as second revised) data on all variables (in levels) are available on the Federal Reserve Bank of Philadelphia website. We calculate the annualized quarterly percentage rate of growth (in GDP, for example) using the formula: Growth=100.(((GDP÷GDP(-1))^4)-1)

(7.8%), business investment (9.9%), and residential investment (4.6%) are, however, among the components with lower shares in aggregate demand.

Table I. Descriptive statistics: 1983.1-2008.4

	Growth rate (%)			Share in GDP (%)
	Mean	Maximum	Minimum	
Aggregate demand (real GDP)	2.9	10.1	-6.3	--
Total consumption spending	3.1	10.0	-4.3	68.5
Durable goods	6.4	44.6	-22.1	7.8
Non-durable goods	2.3	10.2	-9.4	20.6
Services	3.0	6.4	-0.1	40.1
Business investment	6.2	27.3	-21.7	9.9
Residential investment	3.1	78.6	-25.3	4.6
Government spending	2.0	18.6	-12.3	19.6
Exports	5.9	25.7	-23.6	9.1
Imports	8.2	55.4	-28.3	11.7

Note: Growth rates are in annualized quarterly percentage changes.

3. Empirical results

In investigating directional accuracy, Table II presents the two-by-two contingency table which classifies the actual and forecast data for each quarter by whether the change in actual growth is (+) or (–) and by whether the forecast correctly or incorrectly predicts the sign (Dua and Smyth, 1993). The sign (+) indicates an upward move in the actual ($A_{t+f} > A_{t-1}$) or forecast ($P_{t+f} > A_{t-1}$) series, and the sign (–) indicates a downward move in the actual ($A_{t+f} < A_{t-1}$) or forecast ($P_{t+f} < A_{t-1}$) series.

Table II. Contingency table

	Actual directional change	
	Upward	Downward
Correct directional predictions	n_1: ΔA_{t+f} (+) & ΔP_{t+f} (+)	n_2: ΔA_{t+f} (–) & ΔP_{t+f} (–)
Incorrect directional predictions	n_3: ΔA_{t+f} (+) & ΔP_{t+f} (–)	n_4: ΔA_{t+f} (–) & ΔP_{t+f} (+)

Notes: A_{t+f} is the actual growth rate in quarter $t+f$, and P_{t+f} is the forecast of A_{t+f} made at the end of the first month of quarter t (f is the forecast horizon). $\Delta A_{t+f} = (A_{t+f} - A_{t-1})$ is the actual change and $\Delta P_{t+f} = (P_{t+f} - A_{t-1})$ is the predicted change; A_{t-1} is the growth rate in quarter $t-1$ known at the time of the forecast. For some series, either the actual or predicted change is zero in a few quarters. We include these no-change observations with the downward predictions. n_1 and n_2 (n_3 and n_4) are the numbers of correct (incorrect) sign forecasts.

As noted, n_1 and n_2 (n_3 and n_4) are the numbers of correct (incorrect) sign forecasts. Accordingly, the overall directional forecast accuracy rate is $\pi_{All} = (n_1 + n_2)/n$, where n is the sample size. The proportion of correctly predicted upward moves is $\pi_{Up} = n_1/(n_1 + n_3)$, and the proportion of correctly predicted downward moves is $\pi_{Down} = n_2/(n_2 + n_4)$.

Table III reports the related statistics for growth in aggregate demand in rows 1-5 for, respectively, the current-quarter, one-, two-, three-, and four-quarter ahead forecasts. As can be seen, the overall directional accuracy rates (π_{All}), ranging from 60 to 70%, are reasonably high. In examining the null hypothesis of no association between the actual and predicted directional changes, we use Fisher's exact test (superscript "a" indicates that the p-value of this test is below 0.10). As shown by superscript "a" in Table III, we reject the null hypothesis of independence for every forecast in rows 1-5, indicating that the forecasts of growth in aggregate demand are all directionally accurate. These forecasts are also equally accurate in predicting the upward and downward moves. For instance, π_{Up} ranges from 59 to 67%, and π_{Down} ranges from 61 to 74%.

Table III. Directional forecast accuracy test results: Growth in aggregate demand

Row		Correct		Incorrect					
no.	f	n_1	n_2	n_3	n_4	π_{All}	π_{Up}	π_{Down}	p-value
1	0	38	32	19	11	0.70[a]	0.67	0.74	0.402
2	1	31	35	16	18	0.66[a]	0.66	0.66	0.993
3	2	31	31	20	18	0.62[a]	0.61	0.63	0.798
4	3	30	30	21	19	0.60[a]	0.59	0.61	0.806
5	4	27	35	16	22	0.62[a]	0.63	0.61	0.887

Notes: $\pi_{All} = (n_1 + n_2)/n$ is the overall directional accuracy rate; n (= 100) is the sample size. $\pi_{Up} = n_1/(n_1 + n_3)$ is the proportion of correctly predicted upward moves and $\pi_{Down} = n_2/(n_2 + n_4)$ is the proportion of correctly predicted downward moves. Superscript "a" indicates that the p-value (of Fisher's exact test statistic) is below 0.10, leading to the rejection of the null hypothesis of no association between the actual and predicted directional changes. For every forecast, the last column reports the p-value (of the chi-square statistic) for testing the null hypothesis of no asymmetry: the proportion of incorrectly predicted upward moves ($1 - \pi_{Up}$) equals the proportion of incorrectly predicted downward moves ($1 - \pi_{Down}$).

In line with Dua and Smyth (1993), we utilize the chi-square test described in Berenson, Levine, and Rindskopf (1988, sec. 11.4.1) to test the null hypothesis of no asymmetry that the proportion of incorrectly predicted upward moves ($1 - \pi_{Up}$) equals the proportion of incorrectly predicted downward moves ($1 - \pi_{Down}$). The p-value of this test (reported in the last column of Table III) is greater than 0.10 for every forecast in rows 1-5, indicating that we cannot reject the null hypothesis of no asymmetry and thus the forecasts of growth in aggregate demand are useful to a user who assigns similar cost (loss) to incorrect upward and downward predictions.

The same is true for the forecasts of growth in total consumption in rows 1-5 of Table IV as well as the forecasts of growth in consumer spending on durable goods, non-durable goods, and services in rows 6-10, 11-15, and 16-20, respectively. For instance, the overall directional accuracy rate (π_{All}) ranges from 59 to 78% and, as shown by superscript "a", the null hypothesis of independence is rejected, indicating that every forecast in rows 1-20 is directionally accurate. With π_{Up} (π_{Down}) ranging from 55 to 77% (from 63 to 80%), these forecasts are also equally accurate in predicting the upward and downward moves. That is, we cannot reject the null hypothesis of no asymmetry for every forecast in rows 1-20, since the corresponding *p*-value (reported in the last column of Table IV) is greater than 0.10.

Table IV. Directional forecast accuracy test results

Row		Correct		Incorrect					
no.	f	n_1	n_2	n_3	n_4	π_{All}	π_{Up}	π_{Down}	*p*-value
Growth in total consumption									
1	0	37	34	18	11	0.71[a]	0.67	0.75	0.364
2	1	32	36	16	16	0.68[a]	0.67	0.69	0.784
3	2	32	37	15	16	0.69[a]	0.68	0.70	0.852
4	3	32	36	16	16	0.68[a]	0.67	0.69	0.784
5	4	27	38	14	21	0.65[a]	0.66	0.64	0.881
Growth in consumer spending on durable goods									
6	0	38	35	16	11	0.73[a]	0.70	0.76	0.521
7	1	39	39	12	10	0.78[a]	0.76	0.80	0.706
8	2	30	37	15	18	0.67[a]	0.67	0.67	0.949
9	3	34	41	10	15	0.75[a]	0.77	0.73	0.642
10	4	33	36	15	16	0.69[a]	0.69	0.69	0.959
Growth in consumer spending on non-durable goods									
11	0	30	30	23	17	0.60[a]	0.57	0.64	0.462
12	1	30	34	19	17	0.64[a]	0.61	0.67	0.571
13	2	35	35	18	12	0.70[a]	0.66	0.74	0.358
14	3	27	32	22	19	0.59[a]	0.55	0.63	0.437
15	4	28	34	19	19	0.62[a]	0.60	0.64	0.638
Growth in consumer spending on services									
16	0	36	36	16	12	0.72[a]	0.69	0.75	0.521
17	1	37	35	17	11	0.72[a]	0.68	0.76	0.401
18	2	29	35	17	19	0.64[a]	0.63	0.65	0.854
19	3	30	32	20	18	0.62[a]	0.60	0.64	0.680
20	4	36	37	15	12	0.73[a]	0.71	0.75	0.579

Notes: See the notes in Tables II and III.

For the forecasts of growth in business investment in rows 1-5 of Table V, the overall directional accuracy rate (π_{All}) ranges from 58 to 66%. In addition to being directionally accurate, these forecasts are equally accurate in predicting the upward and downward moves. That is, π_{Up} (π_{Down}) ranges from 57 to 64% (from 60 to 69%) and we cannot reject the null hypothesis of no asymmetry since the corresponding *p*-values in the last column are all greater than 0.10. For growth in residential investment, the current-quarter forecast in row 6 of Table V produces an overall directional accuracy rate (π_{All}) of 54% and fails to be directionally accurate. The one- through four-quarter-ahead forecasts in rows 7-10 are, however, directionally accurate under symmetric loss. For these forecasts, π_{All} ranges from 59 to 63% and π_{Up} (π_{Down}) ranges from 58 to 62% (from 59 to 64%).

Table V. Directional forecast accuracy test results

Row no.	f	Correct n_1	n_2	Incorrect n_3	n_4	π_{All}	π_{Up}	π_{Down}	p-value
Growth in business investment									
1	0	33	31	20	16	0.64[a]	0.62	0.66	0.701
2	1	35	31	20	14	0.66[a]	0.64	0.69	0.581
3	2	32	33	18	17	0.65[a]	0.64	0.66	0.834
4	3	32	29	21	18	0.61[a]	0.60	0.62	0.892
5	4	30	28	23	19	0.58[a]	0.57	0.60	0.764
Growth in residential investment									
6	0	24	30	22	24	0.54	0.52	0.56	0.735
7	1	29	34	18	19	0.63[a]	0.62	0.64	0.800
8	2	27	34	17	22	0.61[a]	0.61	0.61	0.947
9	3	26	33	19	22	0.59[a]	0.58	0.60	0.822
10	4	24	35	17	24	0.59[a]	0.58	0.59	0.937
Growth in government spending									
11	0	34	36	20	10	0.70[a]	0.63	0.78	0.096
12	1	30	38	18	14	0.68[a]	0.62	0.73	0.257
13	2	30	35	21	14	0.65[a]	0.59	0.71	0.186
14	3	35	40	16	9	0.75[a]	0.69	0.82	0.133
15	4	32	35	21	12	0.67[a]	0.60	0.74	0.135

Notes: See the notes in Tables II and III.

As shown by superscript "a", the forecasts of growth in government spending in rows 11-15 of Table V are directionally accurate with reasonably high overall directional accuracy rates (π_{All}) ranging from 65 to 75%. With π_{Up} (π_{Down}) ranging from 59 to 69% (from 71 to 82%), these forecasts tend to be more (less) accurate in predicting the downward (upward) moves. In line with this observation, the corresponding p-values for the null hypothesis of no asymmetry (reported in the last column) are generally around the 10% level of significance. Accordingly, it may be more convincing to argue that the forecasts of growth in government spending imply asymmetric loss and are thus useful to a user who assigns more (less) cost to incorrect downward (upward) predictions.

For the forecasts of growth in exports in rows 1-5 of Table VI, the overall directional accuracy rate (π_{All}) ranges from 61 to 68%. Again, these forecasts are directionally accurate under symmetric loss. For instance, with π_{Up} (π_{Down}) ranging from 61 to 69% (from 60 to 67%), the forecasts of growth in exports are equally accurate in predicting the upward and downward moves. The same is true for the forecasts of growth in imports in rows 6-10 of Table VI. That is, for these forecasts, the overall directional accuracy rate (π_{All}) ranges from 63 to 75% and, as indicated by superscript "a", they are directionally accurate. With π_{Up} (π_{Down}) ranging from 67 to 79% (from 60 to 71%), the forecasts of growth in imports are also equally accurate in predicting the upward and downward moves (i.e., we cannot reject the null hypothesis of no asymmetry since the corresponding *p*-values in the last column are all above 0.10).

Table VI. Directional forecast accuracy test results

Row no.	f	Correct n_1	n_2	Incorrect n_3	n_4	π_{All}	π_{Up}	π_{Down}	*p*-value
Growth in exports									
1	0	36	27	21	16	0.63[a]	0.63	0.63	0.970
2	1	36	32	16	16	0.68[a]	0.69	0.67	0.784
3	2	35	29	19	17	0.64[a]	0.65	0.63	0.854
4	3	35	26	22	17	0.61[a]	0.61	0.60	0.924
5	4	37	31	17	15	0.68[a]	0.68	0.67	0.904
Growth in imports									
6	0	32	31	16	21	0.63[a]	0.67	0.60	0.466
7	1	39	34	13	14	0.73[a]	0.75	0.71	0.639
8	2	36	34	13	17	0.70[a]	0.73	0.67	0.458
9	3	31	33	14	22	0.64[a]	0.69	0.60	0.357
10	4	38	37	10	15	0.75[a]	0.79	0.71	0.355
Inflation									
11	0	30	31	16	23	0.61[a]	0.65	0.57	0.424
12	1	35	34	13	18	0.69[a]	0.73	0.65	0.416
13	2	34	32	15	19	0.66[a]	0.69	0.63	0.483
14	3	30	33	14	23	0.63[a]	0.68	0.59	0.341
15	4	31	29	18	22	0.60[a]	0.63	0.57	0.513

Notes: See the notes in Tables II and III.

To augment these findings, we further report the related statistics for the GNP/GDP deflator inflation forecasts in rows 11-15 of Table VI. As indicated, these forecasts are directionally accurate with the overall directional accuracy rates (π_{All}) ranging from 60 to 69%. In addition, π_{Up} (π_{Down}) ranges from 63 to 73% (from 57 to 65%) with the corresponding *p*-values for testing the null hypothesis of no asymmetry (in the last column) well above 0.10. Accordingly, the inflation forecasts are equally accurate in predicting the upward and downward moves and are thus useful to a user who assigns similar cost (loss) to incorrect upward and downward predictions.

Finally, we ask whether our results hold for a more recent period. In answering, Table VII reports the overall directional accuracy rates (π_{All}) for the forecasts made in the first quarter of

1993 through the fourth quarter of 2007. For this shorter period, the samples for the current-quarter, one-, two-, three-, and four-quarter-ahead forecasts are, respectively, 1993.1-2007.4, 1993.2-2008.1, 1993.3-2008.2, 1993.4-2008.3, and 1994.1-2008.4 (with 60 observations for each forecast horizon). For comparison, we also report in parentheses the corresponding overall directional accuracy rates (π_{All}) for the full period of 1983.1-2007.4. As can be seen, the overall directional accuracy rates for the two samples are very comparable. However, unlike for 1983.1-2007.4, the three- and four-quarter-ahead forecasts of growth in business (residential) investment for 1993.1-2007.4, with their respective overall directional accuracy rates of 57% and 53% (55% and 57%), fail to be directionally accurate.[3] This suggests that one should be cautious in using our model for predicting the direction of change in business and residential investment growth at the three- and four-quarter-ahead forecast horizons.[4]

Table VII. Overall directional accuracy rates (in percentages)

	Forecast horizon (f)				
	0	1	2	3	4
Growth in:					
Aggregate demand	67 (70)	67 (66)	63 (62)	60 (60)	67 (62)
Total consumption	70 (71)	72 (68)	63 (69)	72 (68)	68 (65)
Durable goods	75 (73)	82 (78)	70 (67)	75 (75)	70 (69)
Non-durable goods	62 (60)	63 (64)	70 (70)	58 (59)	62 (62)
Services	67 (72)	77 (72)	63 (64)	62 (62)	72 (73)
Business investment	62 (64)	63 (66)	62 (65)	57 (61)	53 (58)
Residential investment	55 (54)	68 (63)	65 (61)	55 (59)	57 (59)
Government spending	65 (70)	70 (68)	60 (65)	80 (75)	63 (67)
Exports	67 (63)	68 (68)	68 (64)	62 (61)	77 (68)
Imports	65 (63)	73 (73)	72 (70)	63 (64)	78 (75)
Inflation	60 (61)	73 (69)	62 (66)	68 (63)	60 (60)

Notes: Numbers with no parentheses are the overall directional accuracy rates (π_{All}) for the forecasts made in 1993.1-2007.4. Numbers in parentheses are π_{All} for the forecasts made in 1983.1-2007.4.

[3] The *p*-values of Fisher's exact test statistics for these forecasts (ranging from 0.18 to 0.40) are all above 0.10.

[4] The same should be said for the current-quarter forecast of growth in residential investment which fails to be directionally accurate for both the periods of 1983.1-2007.4 and 1993.1-2007.4.

4. Conclusions

Diebold and Lopez (1996), among others, note that for many economic and financial indicators, a naïve forecast can contain useful predictive information. With this in mind, this study takes a naïve forecasting approach to predict the direction of change in aggregate demand growth and its components for 1983-2008. This framework, while simple, displays reasonable directional predictive power and thus is useful, especially to economically-rational agents who tend to balance the predictive benefit of a forecast against the cost of gathering and processing information. More specifically, the forecasts of growth in aggregate demand, consumption, investment, exports, and imports are equally accurate in predicting the upward and downward moves, implying symmetric loss. Accordingly, these forecasts are useful to a user who assigns similar cost (loss) to incorrect upward and downward predictions. However, the forecasts of growth in government spending, while directionally accurate, tend to be more (less) accurate in predicting the downward (upward) moves. As a result, these forecasts are useful to a user who assigns more (less) cost to incorrect downward (upward) predictions.

We suggest that our model's success may have to do with the stationary behavior of the series as well as monetary policy that aims to achieve sustainable growth with stable prices.[5] Specifically, when growth in quarter *t-1* happens to be above growth in quarter *t-2* ($A_{t-2} < A_{t-1}$), the stationary behavior of the series raises the likelihood for future growth to be less than growth in quarter *t-1* ($A_{t+f} < A_{t-1}$). Similarly, when growth in quarter *t-1* happens to be below growth in quarter *t-2* ($A_{t-2} > A_{t-1}$), the stationary behavior of the series raises the likelihood for future growth to be more than growth in quarter *t-1* ($A_{t+f} > A_{t-1}$). Given that our forecast of A_{t+f} is equal to A_{t-2} (i.e., $P_{t+f} = A_{t-2}$), the statistically significant directional association between the actual change ($A_{t+f} - A_{t-1}$) and predicted change ($P_{t+f} - A_{t-1}$) may not be surprising.[6] Another point to keep in mind is the Federal Reserve's dual mandate of promoting sustainable growth and maintaining low inflation. More specifically, the goal of monetary policy is to stabilize the economy in the short-run by smoothing out the peaks and valleys in output around its maximum sustainable (long-run) level. During a recession, for instance, the Fed lowers interest rates to stimulate private demand for goods and services and thus push output back toward its long-run level. This action, however, is temporary since persistent attempts to expand output above its long-run level will create capacity constraints and thus lead to higher and higher inflation. High inflation results in increased inflation uncertainty which, in turn, can hinder economic growth by complicating private saving and investment decisions. Accordingly, when growth in quarter *t-1* happens to be above (below) growth in quarter *t-2*, the likelihood for future growth to be less (more) than growth in quarter *t-1* increases due to monetary policy. Again, for growth in aggregate demand

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[5] Based on the augmented Dickey-Fuller (ADF) tests (Dickey and Fuller, 1981) with the unit root critical values from MacKinnon (1991), our findings (not reported here) indicate that the growth series examined here are all stationary.

[6] A theoretical explanation for the stationary behavior of growth in aggregate demand may be that increases in growth lead to "bottlenecks," like pressures on capacity limits in some areas or difficulties in maintaining productivity increases as expansion proceeds, while decreases in growth should slow down as demand for essential goods and services do not keep falling off as rapidly as demand for discretionary purchases do.

and its components as well as inflation, the statistically significant directional association between the actual change ($A_{t+f} - A_{t-1}$) and predicted change ($P_{t+f} - A_{t-1}$) may not be surprising.

References

Ash, J.C.K., D.J. Smyth, and S.M. Heravi (1998) "Are OECD forecasts rational and useful? A directional analysis" *International Journal of Forecasting* **14**, 381–91.

Baghestani, H. and S. Kherfi (2008) "How well do U.S. consumers predict the direction of change in interest rates?" *Quarterly Review of Economics and Finance* **48**, 725-32.

Berenson, M.L., D.M. Levine, and D. Rindskopf (1988) *Applied Statistics: A First Course*. Prentice Hall: New York.

Dickey, D.A. and W.A. Fuller (1981) "Likelihood ratio statistics for autoregressive time series with a unit root" *Econometrica* **49**, 1057-72.

Diebold, F.X. (2007) *Elements of Forecasting*. Fourth edition. Thomson South-Western: Ohio.

Diebold, F.X., and J.A. Lopez (1996) "Forecast evaluation and combination" in *Handbook of Statistics* (**14**) by G.S. Maddala and C.R. Rao, Eds., North–Holland: Amsterdam, 241-68.

Dua, P. and D.J. Smyth (1993) "Survey evidence on excessive public pessimism about the future behavior of unemployment" *Public Opinion Quarterly* **57**, 566-74.

Greer, M. (2003) "Directional accuracy tests of long-term interest rate forecasts." *International Journal of Forecasting* **19**, 291-98.

Joutz, F. and H.O. Stekler (2000) "An evaluation of the predictions of the Federal Reserve" *International Journal of Forecasting* **20**, 411-25.

Kolb, R.A. and H.O. Stekler (1996). "How well do analysts forecast interest rates?" *Journal of Forecasting* **15**, 385-94.

Leitch, G. and J.E. Tanner (1991) "Economic forecast evaluation: Profits versus the conventional error measures" *American Economic Review* **81**, 580–90.

MacKinnon, J.G. (1991) "Critical values for cointegration tests" in *Long-run Economic Relationships* by R.F. Engle and C.W.J. Granger, Eds., Oxford University Press: Oxford, 267-76.

Pesaran, M.H. and A. Timmermann (2004) "How costly is it to ignore breaks when forecasting the direction of a time series? " *International Journal of Forecasting* **16**, 17-38.

Pons, J. (2000) "The accuracy of IMF and OECD forecasts for G7 countries" *Journal of Forecasting* **19**, 53–63.