

Explanations of the inconsistencies
in survey respondents' forecasts

Michael P. Clements
Department of Economics,
University of Warwick.

March 20, 2009

1 Introduction

Literature addresses the rationality of different types of forecasts: point forecasts, probability distributions, interval & quantiles, volatility, and probability forecasts.

Engelberg, Manski and Williams (2009) and Clements (2009) assess forecast rationality by considering the consistency of different types of forecasts

- the point forecasts and histograms of the respondents to the US Survey of Professional Forecasters

- histograms and forecast probabilities of declines in real output growth

Inconsistencies between the different types of forecasts: the point and probability forecasts indicate a rosier outlook than the histograms: the point forecasts of output growth and inflation are higher and lower, respectively, than implied by the histogram forecasts.

Directly reported probabilities of decline less than implied by histograms.

Explanations for the inconsistencies?

- degree of uncertainty and computational complexity (boundedly rational forecasters)
- delayed updating: sticky information. Costs to information acquisition and processing (boundedly rational forecasters)
- asymmetric loss (rational forecasters)
- possibility of strategic motives (signalling that well informed, attracting media attention, etc.).

2 Plan of talk

The US Survey of Professional Forecasters (SPF)

Evidence of inconsistencies

Possible explanations

Relative forecast accuracy of point forecasts and histogram means

Conclusions

3 SPF

Quarterly survey of professional macroeconomic forecasters that elicits information on the outlook for the US economy.

Respondents provide point forecasts for a number of macro variables

Also histograms for annual growth in the current survey year over the previous year, for output growth (GNP/GDP) and inflation (GNP/GDP deflator)

Began in 1968Q4.

Forecasts from 1968:4 to 2006:4 for inflation, and from 1981:3 onwards for output growth.

January 31, 2001

INSTRUCTIONS

Please return this survey to Dean Croushore, Research Department, Federal Reserve Bank of Philadelphia, Ten Independence Mall, Philadelphia, PA 19106 no later than February 12, 2001. Questions about the survey should be directed to Dean Croushore at (215) 574-3809. Questionnaires may be sent via fax at (215) 574-4364.

Recent data for the variables to be forecast are given on an attached sheet, with figures for the most recent quarter printed in the first column of the table on the next page (there are figures for the past year listed as well). If you use these figures in preparing your forecast, leave them as they are; otherwise cross them out and insert your own figures.

For monthly data, use quarterly averages.

For some variables, you may record your responses in growth rates or levels, but you must provide a level for 2000:Q4 for quarterly data and for 2000 annual data. These variables are denoted with the symbol "L / G"; circle the "L" if you forecast in levels, the "G" if you forecast in growth rates. Please be consistent--if you forecast in growth rates for quarterly data, also forecast in growth rates for annual data.

See the information in the write-up "Data Sources and Descriptions" for details on all the variables.

DATE ON WHICH THIS FORECAST WAS MADE _____

NAME _____

ADDRESS & PHONE _____

DEADLINE: FEBRUARY 12
Please fax by Feb. 12 or mail by Feb. 6
Fax to: (215) 574-4364

Section 1 U.S. Business Indicators		Quarterly Data						Annual Data		
		2000	2001				2002			
		Q4	Q1	Q2	Q3	Q4	Q1	2000	2001	2002
1. Gross Domestic Product	L / G	10125.0						9965.7		
2. GDP Chain-Weighted Price Index	L / G	107.77						106.99		
3. Corporate Profits After Taxes	L / G									
4. Civilian Unemployment Rate		4.0						4.0		
5. Industrial Production Index	L / G	148.0						147.0		
6. Housing Starts	L / G	1.558						1.594		
7. Consumer Price Index		2.7						3.4*		
8. Treasury Bill Rate, three-month		6.02						5.82		
9. AAA Corporate Bond Yield		7.40						7.62		
10. Treasury Bond Rate, 10-year		5.57						6.03		
Section 2 Real GDP and Its Components		CHAIN-WEIGHTED BASIS								
11. Gross Domestic Product	L / G	9401.5						9320.4		
12. Personal Consumption Expenditures	L / G	6374.6						6294.6		
13. Nonresidential Fixed Investment	L / G	1433.6						1412.5		
14. Residential Fixed Investment	L / G	360.0						366.6		
15. Federal Government C & GI	L / G	551.9						548.4		
16. State & Local Govt. C & GI	L / G	1037.1						1030.3		
17. Change in Private Inventories		67.1						63.7		
18. Net Exports of Goods and Services		-442.2						-412.5		

* Computed as a 4th-quarter-over-4th-quarter percent change. Annual growth-rate forecasts for variables other than the CPI should be computed with the year-over-year formula.

Section 3 - Probabilities of Changes in Real GDP and the GDP Price Index

Please indicate what probabilities you would attach to the various possible percentage changes this year and the next in chain-weighted real GDP and the chain-weighted real GDP price index (annual averages). The probabilities of these alternative forecasts should, of course, add up to 100, as indicated.

	Probability of indicated percent change in real (chain-weighted) GDP			Probability of indicated percent change in chain-weighted GDP price index	
	2000-2001	2001-2002		2000-2001	2001-2002
+6 percent or more			+8 percent or more		
+5.0 to +5.9 percent			+7.0 to +7.9 percent		
+4.0 to +4.9 percent			+6.0 to +6.9 percent		
+3.0 to +3.9 percent			+5.0 to +5.9 percent		
+2.0 to +2.9 percent			+4.0 to +4.9 percent		
+1.0 to +1.9 percent			+3.0 to +3.9 percent		
+0.0 to +0.9 percent			+2.0 to +2.9 percent		
-1.0 to -0.1 percent			+1.0 to +1.9 percent		
-2.0 to -1.1 percent			+0.0 to +0.9 percent		
Decline more than 2%			Will decline		
TOTAL	100	100	TOTAL	100	100

Section 4 - Probability of Decline in Real GDP (chain-weighted)

Indicate the probability you would attach to a decline in real GDP (chain-weighted basis, seasonally adjusted) in the next five quarters. Write in a figure that may range from 0 to 100 percent in each of the cells (100 percent means you think a decline in the given quarter is certain, 0 means you think there is no chance at all).

	Probability (out of 100) of decline in real GDP:
Q4 2000 to Q1 2001	
Q1 2001 to Q2 2001	
Q2 2001 to Q3 2001	
Q3 2001 to Q4 2001	
Q4 2001 to Q1 2002	

Section 5 - Long-Term Forecasts

What do you expect to be the annual average over the next 10 years of:

- a. The CPI inflation rate? _____
- b. Real GDP growth rate (chain-weighted basis)? _____
- c. Productivity growth (output per hour, chain-weighted)? _____
- d. Stock returns (S&P 500)? _____
- e. Bond returns (10-year Treasuries)? _____
- f. Bill returns (3-month T-bills)? _____

Section 6 - Special Question On The Federal Government Budget Surplus

Part A. Federal Budget Surplus. Please indicate your own forecast for federal government budget surpluses (use minuses for deficits) for fiscal year 2001 and the following five fiscal years. For comparison, we have listed the CBO's forecast for each fiscal year from its "The Budget and Economic Outlook: Fiscal Years 2002-2011," released on January 31. The baseline forecast presented here was constructed under the assumption that discretionary spending grows at the rate of inflation. The forecasts are in billions of dollars and include both on-budget and off-budget items (Social Security).

Fiscal year	CBO forecast	Your forecast
2001	281	_____
2002	313	_____
2003	359	_____
2004	397	_____
2005	433	_____
2006	505	_____

Part B. New Spending Initiatives. Is your budget surplus projection based on any new **spending** initiatives that CBO would not have included in the forecast given above? If so, please describe them and write down the dollar value (billions of dollars) of such initiatives in the space provided below ("+" = increased spending, "-" = decreased spending). The dollar value should be based on CBO's baseline projection for economic growth (CY 2001: 2.4 percent; CY 2002: 3.4 percent). *Please enter zeros if your forecast incorporates no new spending initiatives.*

Fiscal Yr	Description of New Spending Initiatives	Amount (bil \$)
2001		
2002		

Part C. New Tax Initiatives. Is your budget surplus projection based on any new **tax** initiatives that CBO would not have included in the forecast given above? If so, please describe them and write down the dollar value (billions of dollars) of such initiatives in the space provided below ("-" = tax cut, "+" = tax increase). The dollar value should be based on CBO's baseline projection for economic growth (CY 2001: 2.4 percent; CY 2002: 3.4 percent). *Please enter zeros if your forecast incorporates no new tax initiatives.*

Fiscal Yr	Description of New Tax Initiatives	Amount (bil \$)
2001		
2002		

Section 7 - Effect of New Spending & Tax Initiatives on Economic Growth.

Do you expect new tax and/or spending initiatives?

Yes

No

In the space provided below, please indicate the amount by which any new federal tax & spending initiatives are increasing (+) or decreasing (-) your current forecast for year-over-year growth in real GDP in 2001 and 2002 (calendar years). **Please enter zeros if you expect new initiatives but expect no effect on real GDP growth. Leave blank if you expect no new initiatives.**

Effect of New Federal Spending & Tax Initiatives
on Your Current Forecast for Year-Over-Year Growth
in Real GDP, in Percentage Points

2001 _____%

2002 _____%

Note: Please use a "+" sign to indicate an increase in your projected rate of growth and a "-" sign to indicate a decrease.

4 Evidence of inconsistencies

Use of a 'bounds approach' means don't need to make an assumption about the nature of the probability distributions underlying the histograms.

Can bound the value of the *mean* without using any more information than is recorded in the histogram.

Lower (upper) bound assumes all the probability lies at the lower (upper) limit of the histogram bin or interval.

Also bounds on *mode* and *median*.

Alternatively, moments can be calculated from histograms by assuming:

- probability mass is uniform within a bin - fitting parametric distributions such as the normal - or the unimodal generalized beta distribution.

Table 1: Bounds violations: mean, mode, median and conservative

Q	#	mean			median			mode			conservative		
		within	below	above	within	below	above	within	below	above	within	below	above
Output growth													
1	547	75.5	4.6	19.9	71.5	5.9	22.7	81.4	6.0	12.6	89.0	2.6	7.9
2	586	80.7	3.8	15.5	76.1	3.8	20.1	85.0	4.1	10.9	91.1	2.4	6.5
3	523	81.8	4.2	14.0	81.1	4.0	14.9	86.0	4.6	9.4	91.6	2.1	6.1
4	424	87.7	3.8	8.5	81.8	5.4	12.7	84.9	5.2	9.9	91.8	3.1	5.2
Inflation													
1	1045	72.0	21.4	6.6	69.2	17.5	13.3	75.2	14.9	9.9	83.9	11.2	4.6
2	1074	75.0	19.7	5.2	73.2	14.3	12.5	78.7	12.8	8.6	86.6	9.3	4.1
3	893	76.3	13.7	10.1	69.9	11.1	19.0	75.1	11.0	13.9	84.1	7.7	8.2
4	541	84.1	11.6	4.3	78.2	10.2	11.6	82.8	10.5	6.8	89.6	6.8	3.5

Output growth. The figures are based on surveys from 1981:3 to 2006:4. **Inflation.** Based on surveys 68:4 to 06:4.

5 Probability of decline forecasts and distributions

For Q4 surveys, we calculate the year-on-year rate of growth that equates the Q4 level of output with that of the preceding Q3 level.

From the histogram we calculate the probability that year-on-year output growth will not exceed this rate.

Similar issues in reading off probabilities from histograms as in calculating means.

Can also calculate bounds (avoids assn. about how mass distributed within the intervals). e.g.,

bin interval	[3, 4)	[4, 5)	[5, 6)
prob	0.1	0.5	0.4

Suppose output will decline if $y < 4.2$. Upper bound on the probability (when all mass in the [4, 5) interval is less than 4.2) is $0.1 + 0.5 = 0.6$. Lower bound is 0.1.

Table 2: Bounds on histogram probabilities of decline and directly-reported probabilities.

Survey quarter	# of forecasts	% within bounds	% below bounds	% above bounds
Q4	408	56.1	42.2	1.7

Method of reporting plays a role?

e.g., rounding of directly reported probabilities

6 Explanations

6.1 Degree of uncertainty and computational complexity

Consider a forecaster A who puts all mass in one bin.

Forecaster B attaches non-zero probabilities to all histogram bins.

Intuitively, A less likely to produce inconsistent point forecasts and histogram means than B.

Borne out by the evidence.

Because A less uncertain about the outlook than B?

Or because calculating mutually consistent forecasts computationally simpler for A.

Does not explain systematic tendency of point forecasts to be more upbeat.

6.2 Delayed updating

Forecasters react differently to the arrival of new information when they come to update point and histogram forecasts?

The costs of information acquisition and processing may differ for the two types of forecasts – the sticky-information model of Mankiw and Reis (2002), Mankiw, Reis and Wolfers (2003). If a histogram is more costly to produce, agents may not revise their histograms as frequently as their point forecasts.

Investigate possibility that point forecasts and histogram means are revised differently when new information arises.

Some evidence that histogram means are more ‘anchored’ to previous period’s forecast and react less to new information (the consensus forecast).

6.3 Asymmetric loss functions

Patton and Timmermann (2007) show that the optimal forecast is given by:

$$f_{t+h,t} = E_t(y_{t+h}) + \phi_h \cdot \sqrt{V_t(y_{t+h})}$$

where $E_t(y_{t+h}) \equiv E(y_{t+h} | \Omega_t)$, $V_t(y_{t+h}) \equiv Var(y_{t+h} | \Omega_t)$, with the data generating process $y_{t+h} | \Omega_t \sim D(E_t[y_{t+h}], V_t[y_{t+h}])$ for some constant distribution function D , and where ϕ_h is a constant that depends only on the form of D and the forecast loss function.

$\phi_h < 0$ when over-predictions are penalised more heavily than under-predictions, and vice versa.

So asymmetric loss suggests a role for forecast uncertainty as an explanation of the differences between point forecasts and conditional means.

Then for a rational forecaster:

$$\begin{aligned} E(y_{t+h} - f_{t+h,t} \mid \Omega_t) &= E\left(y_{t+h} - \left(E_t(y_{t+h}) + \phi_h \cdot \sqrt{V_t(y_{t+h})}\right) \mid \Omega_t\right) \\ &= -\phi_h \cdot \sqrt{V_t(y_{t+h})} \end{aligned}$$

Motivates the suggestion of Pesaran and Weale (2006) to test for rational expectations with asymmetric losses by running a regression such as:

$$e_{t+h,t} \equiv y_{t+h} - f_{t+h,t} = \tilde{\zeta}_1 \sqrt{V_t(y_{t+h})} + \tilde{\zeta}_2' \mathbf{Z}_t + \tilde{\epsilon}_{t+h} \quad (1)$$

where under the null we would expect to find $\tilde{\zeta}_2 = \mathbf{0}$, but $\tilde{\zeta}_1 \neq 0$ if loss is asymmetric.

Alternatively, can use:

$$E_t(y_{t+h}) - f_{t+h,t} = \zeta_1 \sqrt{V_t(y_{t+h})} + \zeta_2' \mathbf{Z}_t + \epsilon_{t+h} \quad (2)$$

which may be preferable in some circumstances (see Clements (2009)).

Estimate (2) by panel regressions.

– random-effects GLS estimator

For inflation, forecast standard deviation is positive, lagged inflation rate is negative for the Q1 survey forecasts

Output: forecast std dev negative (but not significant), lagged actual output significantly negative, for Q1 forecasts.

– random-coefficients estimator: parameter vector as a different realization of a stochastic process for each individual respondent.

Tests of parameter constancy reject, but results replicate those for random effects estimator

Table 3: Panel regressions explaining the discrepancy between the histogram mean and point forecasts, and the probability of the point forecast being more ‘optimistic’ than the bound on the histogram mean (‘random-effects logistic’)

		Random-effects GLS			Random-coefficients			Random-effects logistic		
		Coeff.	Std. Err	z	Coeff.	Std. Err	z	Coeff.	Std. Err	z
Inflation										
Q1	σ	.449	.119	3.77	.302	.192	1.58	1.73	.377	4.61
	Inf	-.048	.009	-5.48	-.059	.027	-2.15	-.277	.118	-2.33
	Con	-.007	.064	-0.10	.0811	.126	0.64	-2.48	.379	-6.55
		Wald p -value			Cconstancy; Wald p -value			Panel vs pooled; Wald p -value		
		0.000			0.006; 0.045			0.272; 0.000		
Q2	σ	.113	.109	1.04	.131	.200	0.66	1.49	.450	3.32
	Inf	-.015	.025	-0.60	-.041	.042	-0.98	-.123	.126	-0.98
	Con	.137	.077	1.77	.154	.137	1.12	-2.50	.497	-5.03
		Wald p -value			Constancy; Wald p -value			Panel vs pooled; Wald p -value		
		0.571			0.000; 0.609			0.007; 0.004		
Q3	σ	.255	.148	1.73	.099	.185	0.54	2.79	.615	4.53
	Inf	-.005	.030	-0.16	.005	.038	0.15	-.354	.163	-2.17
	Con	-.015	.089	-0.16	.003	.139	0.02	-2.89	.564	-5.12
		Wald p -value			Constancy; Wald p -value			Panel vs pooled; Wald p -value		
		0.142			0.000; 0.841			0.241; 0.000		
Q4	σ	.109	.067	1.62	.052	.384	0.14	1.29	.546	2.36
	Inf	-.032	.022	-1.49	-.060	.056	-1.07	-.288	.196	-1.47
	Con	.092	.061	1.52	.151	.216	0.70	-2.24	.456	-4.90
		Wald p -value			Constancy; Wald p -value			Panel vs pooled; Wald p -value		
		0.117			0.000; 0.543			1.00; 0.046		

The columns headed ‘ z ’ are the ‘t-statistics’, where z denotes that the small-sample distributions are unknown. The ‘Wald p -values’ are for the tests of the joint insignificance of the regressors other than the constant (‘Con’); where σ is the standard deviation of histogram; and Inf is the actual quarterly

Table 4: Panel regressions explaining the discrepancy between the histogram mean and point forecasts, and the probability of the point forecast being more ‘optimistic’ than the bound on the histogram mean (‘random-effects logistic’)

		Random-effects GLS			Random-coefficients			Random-effects logistic		
		Coeff.	Std. Err	z	Coeff.	Std. Err	z	Coeff.	Std. Err	z
Output growth										
Q1	σ	-.169	.122	-1.38	-.202	.184	-1.10	1.85	.544	3.40
	Out	-.067	.017	-4.02	-.058	.018	-3.16	.330	.091	3.61
	Con	.186	.115	1.62	.208	.153	1.36	-4.70	.786	-5.99
		Wald p -value			Constancy; Wald p -value			Panel vs pooled; Wald p -value		
		0.000			0.000; 0.007			0.000; 0.000		
Q2	σ	-.133	.103	-1.29	-.166	.188	-0.88	1.28	.586	2.18
	Out	-.047	.019	-2.41	-.044	.016	-2.81	.394	.110	3.57
	Con	.075	.120	0.63	.142	.138	1.03	-4.81	.818	-5.88
		Wald p -value			Constancy; Wald p -value			Panel vs pooled; Wald p -value		
		0.029			0.000; 0.017			0.000; 0.000		
Q3	σ	-.035	.073	-0.47	.156	.200	0.78	1.14	.646	1.76
	Out	-.057	.039	-1.44	-.037	.034	-1.09	.350	.118	2.98
	Con	.047	.124	0.38	-.098	.1149	-0.85	-3.97	.643	-6.18
		Wald p -value			Constancy; Wald p -value			Panel vs pooled; Wald p -value		
		0.347			0.000; 0.514			0.083; 0.004		
Q4	σ	-.121	.092	-1.31	.372	.215	1.73	-.163	1.028	-0.16
	Out	.016	.028	0.58	.014	.029	0.50	.073	.170	0.43
	Con	-.072	.142	-0.51	-.276	.157	-1.76	-3.46	.935	-3.70
		Wald p -value			Constancy; Wald p -value			Panel vs pooled; Wald p -value		
		0.105			0.000; 0.222			0.022; 0.902		

The columns headed ‘ z ’ are the ‘t-statistics’, where z denotes that the small-sample distributions are unknown. The ‘Wald p -values’ are for the tests of the joint insignificance of the regressors other than the constant (‘Con’); where σ is the standard deviation of histogram; and Out is the actual quarterly

– random-effects panel-logit estimator. Whether point is more optimistic than non-parametric bound.

Confirm the finding that the forecast standard deviation and the actual value in the previous period are significant for the Q1 forecasts for both variables.

The relevance of the forecast standard deviation suggests asymmetry, but the significance of the lagged actual value rejects rational behaviour by the forecaster for class of loss functions we have allowed.

7 Forecast accuracy

Forecast accuracy is distinct from consistency.

But is the ‘optimism’ of the point forecasts well founded?

What should be used as outturns to calculate forecast errors?

Use second data release (e.g., Romer and Romer (2000) and Patton and Timmermann (2007)).

Also consider pairs of inconsistent forecasts. Calculate histogram mean to minimize the squared forecast error, subject to it lying within the bounds. Gives ‘most-favourable scenario’ for the histograms. Even so, little evidence that histograms superior.

Table 5: Accuracy of point forecasts and histogram means, MSFE.

	No. of forecasts	Point forecast	Histogram mean	Histogram mean Normal approx.	Histogram mean 'bounds'
Inflation					
68:4 to 81:2					
All	1410	1.37	1.61	1.66	
point > bound	192	1.99	3.32	3.48	2.28
point < bound	285	1.72	2.08	2.07	1.30
81:3 to 91:4					
All	786	0.39	0.87	0.76	
point > bound	21	1.46	1.07	1.46	0.13
point < bound	100	0.95	3.53	3.01	1.18
92:1 to 06:4					
All	1507	0.12	0.27	0.25	
point > bound	28	0.11	0.42	0.50	0.07
point < bound	243	0.16	0.89	0.76	0.38
Output growth					
81:3 to 91:4					
All	607	0.58	1.08	1.08	
point > bound	43	0.69	4.27	4.12	1.82
point > bound	33	0.56	3.12	3.01	0.99
92:1 to 06:4					
All	1606	0.39	0.55	0.54	
point > bound	267	0.61	1.31	1.20	0.60
point < bound	54	0.40	0.52	0.61	0.18

The actual values used to calculate the forecast errors are the second-release real-time data.

8 Conclusions

Approximately 20% of first-quarter output growth and inflation forecasts more optimistic than histograms.

These inconsistencies are not attributable to a small number of errant respondents, and they can not be accounted for by a small number of surveys.

Degree of forecast uncertainty is systematically related to the tendency for the point forecasts to present a rosier outlook than the histograms.

Could be due to

- the shape of the underlying distribution function, - or computational complexity.

Hard to distinguish these two explanations.

Asymmetric loss also suggests that forecast uncertainty will affect the relationship between the conditional mean and the point forecasts.

Evidence against asymmetric loss:

- although forecast standard deviation is significant in our panel regressions, last period's actual value helps predict the difference between the mean and point forecast. At odds with rational behaviour by the forecaster

- point forecasts are more accurate (assuming a squared-error loss function) than the histogram means. If the respondents have asymmetric loss functions, then the expected squared error of a point forecast must exceed the expected squared error of the conditional mean.

The discrepancies between the point forecasts and histograms are sometimes taken as evidence ‘that point predictions may have a systematic, favourable bias’ (Engelberg *et al.* (2009)), but this appears to be unwarranted.

The possibility forecasters react differently to the arrival of new information when they come to update point and histogram forecasts, as might be the case if the costs of information acquisition and processing differ for the two types of forecasts. We find some evidence of systematic differences between the long horizon forecasts in this regard.

References

- Clements, M. P. (1995). Rationality and the role of judgement in macroeconomic forecasting. *Economic Journal*, **105**, 410–420.
- Clements, M. P. (2009). Internal consistency of survey respondents' forecasts: Evidence based on the Survey of Professional Forecasters. In Castle, J. L., and Shephard, N. (eds.), *The Methodology and Practice of Econometrics, Chapter 8*: Oxford University Press.
- Engelberg, J., Manski, C. F., and Williams, J. (2009). Comparing the point predictions and subjective probability distributions of professional forecasters. *Journal of Business and Economic Statistics*, **27**, 30–41.
- Mankiw, N. G., and Reis, R. (2002). Sticky information versus sticky prices: a proposal to replace the New Keynesian Phillips Curve. *Quarterly Journal of Economics*, **117**, 1295–1328.

- Nordhaus, W. D. (1987). Forecasting efficiency: Concepts and applications. *Review of Economics and Statistics*, **69**, 667–674.
- Patton, A. J., and Timmermann, A. (2007). Testing forecast optimality under unknown loss. *Journal of the American Statistical Association*, **102**, 1172–1184.
- Pesaran, M. H., and Weale, M. (2006). Survey expectations. In Elliott, G., Granger, C., and Timmermann, A. (eds.), *Handbook of Economic Forecasting, Volume 1. Handbook of Economics 24*, pp. 715–776: Elsevier, North-Holland.
- Romer, C. D., and Romer, D. H. (2000). Federal Reserve information and the behaviour of interest rates. *American Economic Review*, **90**, 429–457.