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Mean, Variance and Skewness of Reported Expectations and their Differences to the Respective Moments of Realizations

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Zusammenfassung

Der zunehmenden Bedeutung von wirtschaftlichen Erwartungen in der theoretischen Literatur, steht eine geringe Benutzung empirisch erhobener Erwartungen gegenüber. In der vorliegenden Arbeit werden 39 Zukunftsdaten aus Japan, den USA und Europa auf ihre wichtigsten Unterschiede gegenüber jenen Zeitreihen (Realisationen) untersucht, auf die sich die Erwartungen, Pläne oder Prognosen beziehen.

Die Zukunftsdaten weisen schon im Mittel einen signifikanten Unterschied zu den Realisationen auf: Bei den quantitativen Unternehmererwartungen (bzw. -plänen) liegt das erwartete durchschnittliche Wachstum um ein Drittel unter dem später realisierten, bei den volkswirtschaftlichen Prognosen beträgt dieser Fehler *(Pessimismustendenz)* immerhin etwas mehr als 10 % der tatsächlichen Veränderung. Die Pessimismustendenz ist auch für die verwendeten Konsumentenbefragungen gegeben, nicht jedoch für Unternehmerbefragungen mit qualitativer Fragestellung.

Die analysierten Zukunftsdaten geben die konjunkturelle Dynamik geglättet wieder *(Glättungstendenz)*, wobei diese Tendenz für Expertenbefragungen am stärksten ist. Als Hypothesen über die Ursache dieser Fehler wird — in Anlehnung an frühere Erklärungsversuche — die Möglichkeit von Meßfehlern (Kapitel 3.1) aufgeworfen, dann werden aus der Literatur bekannte technisch-statistische Hypothesen überprüft, die eher die Glättungstendenz erklären sollten: Spezifikationsfehlerthese (3.2), Fälschliche-Ceteris-Paribus-Annahme (3.3) und Unsicherheitsthese (3.4). Besser belegbar scheinen die folgenden verhaltensorientierten Thesen zu sein: Das "Vergessen" der Amplitude früherer Zyklen (3.5), die übliche "Unterschätzung der Stärke kumulativer Prozesse" (3.6), die "spezifische Regressivität von Erwartungen" (3.7), sowie die Tendenz von Individuen, die Länge des Anhaltens von Ereignissen (3.8) zu unterschätzen, können plausible Erklärungen ebenfalls vor allem für die Glättungstendenz darstellen. Neben Modifikationen einiger der genannten Thesen kann die Pessimismustendenz vorwiegend auf die Tatsache zurückgehen, daß ein *Übertreffen* von Plänen (Prognosen, Erwartungen) geringere Kosten als ihr *Unterschreiten* verursacht (asymmetrische Verlustfunktion (3.9)). Auch die Tatsache, daß die häufigen besonders großen Zuwächse nie vorhergesehen werden (möglicherweise auch ab einem bestimmten Punkt nicht mehr als handlungsrelevant gesehen werden (3.10)), könnte eine Rolle spielen. Sie bewirkt,

daß die Realisationen stärker rechtsschief sind als die Erwartungen, wenn auch dieser Tendenzfehler im dritten Moment nicht so deutlich ist (und durch die Rezession 1974/75 stark verändert wird) wie die Fehler bezüglich Mittelwert und Standardabweichung.

The increasing use of expectations in theoretical reasoning is not accompanied by additional utilization of the existing empirical pieces of information. Attempts to explain reported expectational series by means of simple autoregressive processes [3, 4, 16, 17, 34, 35, 92] or by some obvious causal determinants [22, 87, 89, 94] did not succeed in explaining a large proportion of the variation of the reported expectational data. The "Rational Expectations Hypothesis" (REH) on the other hand, is usually tested only insofar as there are implications from the joint assumption of the REH and some other hypotheses (e.g. Natural Unemployment or Real Rate of Interest) for the structure of "objective" variables. Verification or falsification depends on the validity of the joint hypothesis and no empirical surveyed expectational data are necessary for these tests [11, 25, 51, 78, 79, 80]. There are only a few investigations testing directly for the REH with the aid of reported expectations [20, 38, 66, 72, 73]. More often expectational data are inspected with respect to their temporal relation to objective variables (lead or lag) because of their presumed forecasting value [1, 2, 3, 11, 40, 57, 58, 82]. The aim of the present paper is to investigate whether there are differences in the first three moments of expectations, respectively realisations. As to my best knowledge no systematic difference between the averages of expectations and realisations has been maintained in recent economic literature as a general characteristic of expectations. On the contrary most a priori assumptions (REH as well as the extrapolative formulas) do preclude this possibility. Systematic differences between the standard deviations of expectations versus realisations are reported. They are even implied by some optimal forecasting techniques. It has to be investigated, however, if the extent and the shape of the observable differences is consistent with optimality(1). Differences in the skewness are dealt with in chapter 3.10.

1. The Data

Contrary to the assumption that we have no information about expectations (see for example [78]), there is a large number and variety of empirically reported expectational data available. They differ according to the group of persons interviewed, to the variables reported, and the survey method. Differences exist regarding the horizon of the data (time span), degree of control at the disposal of the economic agent questioned (plans, expectations, forecasts). Table 1 provides an overview of the standard set of 49 variables used in the empirical parts of this investigation. With regard to the groups of persons surveyed in most cases, the data are collected in business surveys (variables number 1 to 23). Several consumer surveys (24 to 26) and forecasts made by experts (number 27 to 39) provide additional material. Within the set of business expectations we used the controversial Ship-

Characteristics of the Data Used

	Region	Period	Type of Data	Length of Forecasting Period	Horizon[1)]	Source	Sector	Mean[2)]	Standard-Deviation[2)]
Business Surveys									
Investment (1.)	Austria	65—78	quantitative	annual	actual	WIFO	Manufacturing	9,12	13,73
2. Anticipation					1 1/2			4,16	12,01
1. Anticipation					7 1/2			– 4,46**	9,48**
Capacity Increase (2.)	Austria	64—77	quantitative	annual	actual	WIFO	Manufacturing	4,92	1,90
1. Anticipation					7 1/2			3,84*	1,53
Investment (3.)	USA	55—77	quantitative	quarter (R1)	actual	OBE	Manufacturing	3,14	15,07
2. Anticipation					ø			7,38	13,28*
1. Anticipation					3			11,91	12,60**
Sales (4.)	USA	61—75	quantitative	quarter (R1)	actual	OBE	Manufacturing	1,87	2,24
2. Anticipation					ø			1,70	2,09
1. Anticipation					3			1,60	2,64
Investment (5.)	Japan	63—76	quantitative	quarter (R1)	actual	Bank of Japan	Big Business Manufacturing	2,51	6,91
2. Anticipation					ø			10,84	8,13
1. Anticipation					3			0,36*	3,55**
Sales (6.)	Japan	63—76	quantitative	quarter (R1)	actual	Bank of Japan	Big Business Manufacturing	3,61	2,44
2. Anticipation					ø			3,43	1,46**
1. Anticipation					3			3,04*	0,96**
Production (7.)	Japan	63—76	quantitative	quarter (R1)	actual	Bank of Japan	Big Business Manufacturing	3,58	2,84
2. Anticipation					ø			2,89*	1,43**
1. Anticipation					3			2,86*	0,84**
Exports (8.)	Japan	63—77	quantitative	quarter (R1)	actual	Bank of Japan	Big Business Manufacturing	6,05	5,17
2. Anticipation					ø			5,05	3,28**
1. Anticipation					3			3,14**	2,22**
Stocks of Finished Goods (9.)	Japan	63—77	quantitative	quarter (R1)	actual	Bank of Japan	Big Business Manufacturing	3,96	4,36
2. Anticipation					ø			1,17**	0,97**
1. Anticipation					3			0,98**	0,78**
Liabilities (Stock) (10.)	Japan	63—77	quantitative	quarter (R1)	actual	Bank of Japan	Big Business Manufacturing	3,15	1,63
2. Anticipation					ø			2,99	1,54
1. Anticipation					3			2,53**	1,24**
Long Term Liabilities (Stock) (11.)	Japan	63—77	quantitative	quarter (R1)	actual	Bank of Japan	Big Business Manufacturing	3,60	2,09
2. Anticipation					ø			3,20	1,66**
1. Anticipation					3			2,79**	1,40**
Cash and Deposits (12.)	Japan	63—77	quantitative	quarter (R1)	actual	Bank of Japan	Big Business Manufacturing	3,38	2,33
2. Anticipation					ø			1,91**	1,13**
1. Anticipation					3			0,90**	0,81**
Trade Receivables (13.)	Japan	63—77	quantitative	quarter (R1)	actual	Bank of Japan	Big Business Manufacturing	3,18	2,30
2. Anticipation					ø			2,95	1,16**
1. Anticipation					3			2,75	0,88**
Trade Payables (14.)	Japan	63—77	quantitative	quarter (R1)	actual	Bank of Japan	Big Business Manufacturing	3,90	3,58
2. Anticipation					ø			2,25**	1,29**
1. Anticipation					3			1,91**	0,89**
Shippers' Forecast (15.)	USA	28—39	quantitative	quarter (R4)	actual	Midwest Shippers' Board	Manufacturing	– 1,18	19,85
1. Anticipation					3			2,02	9,79**
Selling Prices (16.)	USA	73—77	semiquant.	quarter (R1)	actual	NFIB	Small Business Total Economy	8,23	2,61
2. Anticipation					ø			3,23**	0,98**
1. Anticipation					3			1,90**	0,49**
Production (17.)	France	63—78	qualitative	quarter	actual	OECD	Manufacturing	13,40	17,01
1. Expectation					1 1/2			11,41	25,50
Export Orders (18.)	France	63—78	qualitative	quarter	actual	OECD	Manufacturing	5,13	10,28
1. Expectation					1 1/2			5,33	16,72
Domestic Orders (19.)	Norway	74—78	qualitative	quarter (R1)	actual	OECD	Manufacturing	0,47	14,62
1. Expectation					1 1/2			– 1,06	12,75
Export Orders (20.)	Norway	74—78	qualitative	quarter (R1)	actual	OECD	Manufacturing	– 9,31	17,24
1. Expectation					1 1/2			– 4,32	12,72*
Selling Prices (21.)	Norway	74—78	qualitative	quarter (R1)	actual	OECD	Manufacturing	[illegible]	[illegible]

1. Expectation					1 1/2			5,33	16,72
Domestic Orders (19.)	Norway	74—78	qualitative	quarter (R1)	actual	OECD	Manufacturing	0,47	14,62
1. Expectation					1 1/2			— 1,06	12,75
Export Orders (20.)	Norway	74—78	qualitative	quarter (R1)	actual	OECD	Manufacturing	— 9,31	17,24
1. Expectation					1 1/2			— 4,32	12,72*
Selling Prices (21.)	Norway	74—78	qualitative	quarter (R1)	actual	OECD	Manufacturing	21,32	23,23
1. Expectation					1 1/2			22,00	20,16
Orders (22.)	Finnland	66—78	qualitative	quarter (R1)	actual	OECD	Manufacturing	4,66	22,70
1. Expectation					1 1/2			0,98	17,99**
Production (23.)	Finnland	66—78	qualitative	quarter (R1)	actual	OECD	Manufacturing	16,58	20,03
1. Expectation					1 1/2			17,40	19,83
Consumer Surveys									
Prices (24.)	USA	61—72	semiquant.	quarter (R4)	actual	University	Sample	2,92	1,74
1. Expectation					3	of Michigan	Consumer	2,79	0,54**
Financial Situation (25.)	Austria	72—78	qualitative	annual	actual	IFES	Sample	— 9,34	6,30
1. Expectation					6		Consumer	—12,29**	6,76
Prices (26.)	Austria	72—78	qualitative	annual	actual	IFES	Sample	48,37	25,04
1. Expectation					6		Consumer	30,53**	28,58
Experts									
GNP real (27.)	Austria	64—78	quantitative	annual	actual	WIFO	Total Economy	4,21	2,32
2. Forecast					6 1/2			3,65	1,22**
1. Forecast					9 1/2			3,89	1,23**
Equipment Investment (28.)	Austria	64—78	quantitative	annual	actual	WIFO	Total Economy	4,89	7.66
2. Forecast					6 1/2			4,35	4,33**
1. Forecast					9 1/2			4,72	4,33**
Plant Investment (29.)	Austria	64—78	quantitative	annual	actual	WIFO	Total Economy	4,28	4,84
2. Forecast					6 1/2			4,33	2,58**
1. Forecast					9 1/2			4,57	2,21**
Inventory Investment (30.)	Austria	64—78	quantitative	annual	actual	WIFO	Total Economy	6,99	5,18
2. Forecast					6 1/2			5,47	2,39**
1. Forecast					9 1/2			5,57	2,66**
Exports (goods) (31.)	Austria	64—78	quantitative	annual	actual	WIFO	Total Economy	7,78	6,39
2. Forecast					6 1/2			6,23	2,88**
1. Forecast					9 1/2			6,67	2,66**
Imports (goods) (32.)	Austria	64—78	quantitative	annual	actual	WIFO	Total Economy	7,29	7,21
2. Forecast					6 1/2			6,45	3,22**
1. Forecast					9 1/2			7,22	3,39**
Private Consumption (33.)	Austria	64—78	quantitative	annual	actual	WIFO	Total Economy	4,15	2,59
2. Forecast					6 1/2			4,43	1,38**
1. Forecast					9 1/2			4,77	1,33**
Consumer Prices (34.)	Austria	64—78	quantitative	annual	actual	WIFO	Total Economy	5,23	2,17
2. Forecast					6 1/2			5,28	2,14
1. Forecast					9 1/2			4,92	2,02
Unemployment Rate (35.)	Austria	64—78	quantitative	annual	actual	WIFO	Total Economy	2,23	0,52
2. Forecast					6 1/2			2,42	0,42
1. Forecast					9 1/2			2,43	0,44
GNP (real) (36.)	Austria	70—78	quantitative	annual	actual	OECD	Total Economy	4,29	3,02
2. Forecast					1			3,53	1,87**
1. Forecast					7			3,30	1,41**
GNP (real) (37.)	OECD-Total	68—78	quantitative	annual	actual	OECD	Total Economy	3,69	2,32
2. Forecast					1			3,74	2,33
1. Forecast					7			3,89	1,41**
Consumer Prices (38.)	USA	47—77	quantitative	semester	actual	Livingston	Total	3,44	3,52
2. Forecast					3 1/2		Economy	1,74**	2,57**
1. Forecast					6 1/2			1,70**	2,68**
Wholesale Prices (39.)	USA	47—77	quantitative	semester	actual	Livingston	Total	3,25	6,32
2. Forecast					3 1/2		Economy	1,34*	3,61**
1. Forecast					6 1/2			1,30**	3,37**

1) Time span between data collection and the middle of target period in months.

2) * 95 %, ** 99 % degree of significance for the rejection of the hypothesis that the mean respective the variance of expected change is greater or equal to the mean respective the variance of actual change.

pers' forecast, which gave rise to many discussions about the value of expectational series and about the "regressivity phenomenon" (see: [13, 22, 23, 25, 26, 34]).

As to the method of data collection, the questions can be posed in a quantitative, qualitative or semi-quantitative way. The answers are usually collected by questionnaires as far as business surveys are concerned, interviews dominate in consumer surveys, macroeconomic forecasting results from a wide variety of methods (from judgemental evaluations up to econometric models).

The data are of a rather short-term nature regarding the length of the target period (quarter or year) as well as the distance between the time of the survey and the target period (the data are collected immediately before the beginning up to the middle of the target period). In all cases rates of change were analyzed. In most cases this follows from the method used to collect the data.

2. The Main Results in Comparison to the Existing Literature

2.1 Secular Optimism or Secular Pessimism

The very few empirical investigations of biases in the means of expectations and realizations gave rise to the possibility of a secular optimism(2) of expectations (see *Carlson* [19]). *Ferber* [26] found this tendency in the sales forecast of Midwest shippers during a period of decline in their sales. *Ferber* reported additional hints for the same tendency albeit to a lesser extent in an investigation of a series on expected change of employment and for the Shippers' Forecast after World War II. *Modigliani* and *Sauerlender* [54] show an optimistic bias, in Fortunes' sales forecast, *Foss* [29] and *Carlson* [19] report that the forecasting error in recessions exceeds that of peaks as far as the sales anticipation of the Office of Business Economics in the US Department of Commerce are concerned(3). Comparing ex ante and ex post data in the Austrian Business Test, *Hoschka* and *Streissler* [84] confirm that expectations were too optimistic for a period in which industrial growth decelerated by as much as half of its previous speed (1957/1962). The contrary bias dominates the literature on investment anticipations: apart from surveys in which large corporations are overrepresented anticipations are lower on average than actual investment (for an overview see [3]). The specific characteristic of investment anticipations (high degree of determination within the firm, incompleteness of plans) did prevent the literature from establishing this bias as an antithesis to the secular optimism hypothesis.

Theil [88] as well as *Mincer* and *Zarnowitz* [56] ascertained the possibility of a downward bias of expectations in a growth period as an implication of the tendency that expected change is usually lower than actual change. However, they stopped far from establishing this as an autonomous characteristic of expectations.

Table 2

Existence and Extent of Systematic Biasses

	Number of variable	The mean of the future data (AM_e) is smaller	greater	significantly[1)] smaller	significantly[1)] greater	Average relation (AM_e/AM_a) in per cent
		than the mean of the actual variable (AM_a)				
Business surveys	23	17	6			65,55
quantitative[2)]	16	14	2	12	1	58,59[3)]
qualitative	7	3	4			83,64[3)]
Consumer surveys	3	3	0	2		79,33[3)]
Experts	13	9	4	2		88,45
All data	39	29	10	16	1	75,40

	Number of variable	The standard deviation of the future data (S_e) is smaller	greater	significantly[1)] smaller	significantly[1)] greater	Average relation (S_e/S_a) in per cent
		than the standard deviation of the actual variable (S_a)				
Business surveys	23	20	3	16	3	66,64
quantitative[2)]	16	15	1	14	1	49,18[3)]
qualitative	7	5	2	2	2	115,52[3)]
Consumer surveys	3	1	2	1	1	72,59[3)]
Experts	13	13	0	11		58,55
All data	39	34	5	28	4	64,15

1) 95 per cent level. — 2) Including semiquantitative question. — 3) Exclusive of extreme relations.

The empirical material used in this paper presents systematic differences between expectations and realizations. At least for the period under consideration (the sixties and the seventies) for the overwhelming majority of the variables the arithmetic mean of expected change is lower than that of actual change.

Out of the 39 variables in our standard set the mean of expectations is lower for 29 time series, only for ten variables the actuals exceed the expectations on average. Restricting the analysis to significant differences (95 per cent degree of significance) the relation is 16 versus 1. The pessimism of the expectation is particularly clear with respect to quantitative business expectations (the mean is lower in 14 out of 16 time series) and to consumer expectations (the expectations are lower in all three cases). However, this bias does not show up in the qualitative surveys (in three cases the mean of the reported expectational variable is lower, in four cases higher). The pessimism bias can be shown also for forecasts of experts, though the extent of the bias (approximately 10 per cent) is far below that of the quantitative business surveys (40 per cent). The only expectational series which overestimates actual change significantly is the investment anticipations in US manufacturing, the perennial optimism of the Shippers' forecast is not significant, neither that of the GNP forecast by OECD or some variables in the macroeconomic forecast of the Austrian Institute of Economic Research.

Although the systematic downward bias is well established it cannot be excluded that the bias is restricted to phases of economic growth. However, at least during a period including both the rapid growth of the sixties and the severe recession of 1974/75 there is rather strong evidence that expected change is lower than actual change by an extent which can be approximated by one fourth of actual change.

In the following this bias will be called "pessimism bias" rather than "underestimation bias" for two reasons. The first is an intentional contrast to the optimism hypothesis in earlier literature. The second is to avoid mixing up of the biasses in the first and second moment of expectations(4). The term pessimism tendency is better suitable for biasses in variables with a positive connotation (sales, growth etc.) than for those with an unfavorable connotation (inflation, unemployment). Fortunately the differences in the means will prove smaller for the later group of variables (at least in the macroeconomic forecast in Austria).

2.2 The Smoothing Bias of Expectations

The smoothing quality of expectations is known empirically and is supposed to be a property of optimal forecasting. Chapter 3.2 will deal with the requirements for optimality. *Theil* [88], *Modigliani* and *Sauerlender* [59], *Ferber* [26], *Mincer* and *Zarnowitz* [56], *Zarnowitz* [98] report expected change to be smaller than actual change, so that expectations are overpessimistic in growth period and overly optimistic in periods of decline. This tendency which could be demonstrated for business as well as macroeconomic forecasts was labelled "underestimation of change".

The comparison of the magnitude of changes differs from the comparison of the second moments (for example the standard deviation) in periods in which actual change is positive but below its average: in these periods the "underestimation of change" quality would imply expected change to be lower than the realizations (closer to zero), the tendency of underestimation of the second moment (henceforth called "smoothing tendency") would imply a higher rate of expected change (closer to the trend). An empirical examination of the variables used in this paper shows that the smoothing tendency prevails, because the expectations are smoothed around the trend and not around the zero level(5). It follows from this evidence that pessimism bias and smoothing tendency are no longer hypotheses where the latter implies the former, but that they may exist independently of each other.

The empirical evidence for smoothing bias is even stronger than for the pessimism bias. The standard deviation of the expectational series is smaller in 34 out of 39 cases, the statistical significance for the tendency in the individual series is given for 28 variables. The tendency is equally pronounced in the quantitative business series and among the forecasts of experts, but it is not visible in qualitative data(6).

The existence of the smoothing tendency of expectations can be demonstrated by other measures of dispersion than the standard deviation, like the range or time series decomposition methods. It can be shown that it is primarily the cyclical component of the actual data which is underestimated in the expectational series rather than the irregular component. The rank correlation between the pessimism and the smoothing bias is not overwhelming (R = 0,49, significant at the 95 per cent level, but not at the 99 per cent level). There are also some variables which do show the pessimism tendency even though there is no smoothing tendency.

2.3 The Dependence of the Biasses on the Forecasting Horizon

Some of the future data are available for different time spans of the surveys to the target period. The Japanese surveys used and a part of the US data are collected in advance of the target period as well as after the period to be forecasted has already started. The macroeconomic forecasts (regarding annual change) are revised several times: the first forecast is made in September of the previous year, in this investigation the December revision is considered as second forecast. Either of the two biasses is smaller for short run expectations. The pessimism bias decreases in 17 cases, it increases only in 8 time series. The smoothing quality is reduced in 20 cases when shortening the forecasting horizon.

The extent of the pessimism bias is reduced in this subset of quantitative data from 27 per cent to 6 per cent as the horizon is diminished, that of the smoothing bias from 47 per cent to 37 per cent in terms of the respective moments of actual data.

3. Possible Causes of the Pessimism and the Smoothing Bias

There are few hints in literature as to the possible causes determining either of the two biasses. Historically, the first guess referred to several types of errors in measurement,

Table 3

Dependence of the Systematic Biasses on the Forecasting Horizon

	In per cent of the same moment (AM resp. S) of the actual variable	Number of variables where the moment (AM resp. S) for this horizon is greater than for the other horizon
Average of the means (AM_e)		
for the shorter horizon	94	17
for the longer horizon	73	8
Average of the standard deviations (S_e)		
for the shorter horizon	63	20
for the longer horizon	53	4

Exclusive of extreme relations.

especially since the forecasting results of the Shippers' forecast as well as that of the OBE sales anticipations did not prove to be too successful (see chapter 3.1). Another hypothesis explains underestimation of change as well as the smoothing property as a specification error. But this is true only if reality performs according to a special model (one-sided causal flow). In 3.2 we will investigate the validity of those assumptions along the lines proposed by *Granger* [32]. *Theil* [88] proposed that the forecaster will assume some variables as constant (3.3) which prove to be variable. An extension of this idea may also yield one cause for the pessimism bias. In 3.4 we will discuss if standard techniques of forecasting under uncertainty will result in the two biasses revealed by the surveyed data and whether the differences between expectations and realizations are consistent with the optimal use of information.

Data on past, respectively present capacity utilization reveal that past cycles appear dampened in memory (3.5). This again may be a primary source of the smoothing bias. The phenomenon that expectations are relatively more regressive than realizations (specific regressivity) is a possible cause of the smoothing quality (3.6). This is discussed more thoroughly in other papers. Several rules of thumb lead to an underestimation of the cumulative forces of cycles (3.7). A specific problem of aggregation is investigated as the source of regressivity by *Bossons* and *Modigliani* [13], but can also be used as an explanation for the smoothing tendency (3.8). Finally, two explanations are proposed which can explain mainly the pessimism tendency: the loss function for opposite errors of forecasting may be asymmetric (3.9) and there is evidence that up to the last recession large positive changes occurred more frequently than large decreases. This skewness of realizations was not mirrored in the expectations (3.10).

3.1 Errors in "Measurement"

Historically the first explanation – especially for the smoothing bias – stated that the errors were present in expectations as measured, but not typical of true expectations (for an overview see [13]). One version ("The *Ferber-Hastay*-Hypothesis") contends that the bias results from that proportion of respondents which reports – either out of convenience or secretiveness – that "no change" would occur. The fact that the smoothing bias is much more pronounced in quantitative data argues, however against this possibility, since the "no change" answer is less convenient and also less concealing in this case. Moreover *Hart* [34] calculated, that the underestimation tendency would persist even if that part of persons which reported "no change" is excluded.

The possible confusion about the time period to which the expectations refer (rate of change over previous quarter or previous year) or problems of seasonal adjustment are very unlikely causes for the biasses exhibited by so many time series. Finally the different extent of the biasses for different variables within the same survey contradicts the hypothesis that measurement errors are a main cause of the reported phenomena.

3.2 Specification Error and the REH

The direction of causality existing in the true world between expectations and realization decides the question which statistical measures are sufficient to prove a bias of expectation and which represent only a specification error. Early regressions of expectations on realizations revealed regression coefficients below unity. But if in the real world realizations are influenced by expectations ("Reality I" is true, see equation *(1)*), this is the wrong regression and the low coefficient is due only to the common regression bias (equation *(2)*), as *Muth* [63] and *Bossons* and *Modigliani* [15] stressed. If "Reality I" is true (as assumed by the usual statement of REH) we have instead to regress realizations on expectations. The error term of this regression will be uncorrelated with the independent variable so that OLS will yield unbiassed coefficients. A regression coefficient exceeding one will be an adequate proof of the smoothing property.

By the same token, "Reality I" given, even systematic differences in the variances of expectations and realizations do not prove a specific economic tendency because the variance of actual change consists of the sum of the variance of expectations and that of the error term.

Reality I:

(1) $$A_t = k + b\,E_t + u_t; \quad \epsilon\,(E_t, u_t) = 0$$

If I is true it follows:

(2) $$E_t = \frac{A_t - k}{b} - \frac{u_t}{b}; \quad E(A_t - u_t) > 0$$

(3) $$var\, A_t = var\, E_t + var\, u_t$$

Reality II:

(4) $$E_t = k' + b' A_t + u'_t; \quad \epsilon(A_t, u'_t) = 0$$

If II is true it follows:

(5) $$A_t = \frac{E_t - k'}{b'} - \frac{u'_t}{b'}; \quad \epsilon(E_t - u'_t) > 0$$

(6) $$var\, E_t = var\, A_t + var\, u'_t$$

On the other hand, if the other direction of causality were true (see equation *(4)* for "Reality II": expectations are influenced by realizations plus an error term independent of realizations), then there is no objection against regressing expectations on realizations and interpreting a coefficient below unity as proof of existence of smoothing property. Equation *(5)* is now biassed, coefficients near one or even a little below are likely to be a proof of the smoothing property because they are biassed downward. Which of the two possible causal flows really prevails is far from evident. Economic reasoning usually assumes interdependency, though different opinions exist as to the question which causal flow is more important. Psychological business cycle theories usually stress the autonomous character of expectations. At least the reaction is thought to be more important than an eventual stimulus. "Undue optimism . . . may rise spontaneously" but also "as a psychological reflex from actual experience" (*Pigou* [74]). "Changes in attitudes resemble contagious diseases . . . because the same information . . . reaches millions of people at the same time" (*Katona* [43, p. 56], the waves of optimism and pessimism may originate from "infinitesimal impulses" (*Jöhr* [39]). *Keynes* distinguished between short-run expectations, which are caused by recent realizations(7) and long-run expectations, where the unpredictable autonomous character dominated(8).

If reasoning is to be cast into formal analysis, the assumptions about causality have to be stricter. The adaptive formula for the generation of expectations [18] implies that expectations are caused by realization. In this case the formal requirement corresponds to the economic rationale of the hypothesis. The Rational-Expectation-Hypothesis, however, did not intend primarily to state a one-sided causality, its aim was to stress the use of available

Table 4

Granger Test of Causality

Dependent Variable	Constant	a_t	a_{t-1}	a_{t-2}	a_{t-3}	a_{t-4}	e_t	e_{t-1}	e_{t-2}	e_{t-3}	e_{t-4}	Adj.R^2	Standard Deviation
							Sales, USA, OBE						
a_t	1,85		+ 0,32	– 0,51	+ 0,11	+ 0,03		– 0,33	+ 0,16	+ 0,35	– 0,05	0,16	2,19
	62		*49*	*45*	*196*	*839*		*62*	*137*	*67*	*358*		
a_t	2,94		+ 0,28	– 0,48	+ 0,07	– 0,26		– 0,22				0,10	2,18
	33		*52*	*40*	*211*	*64*		*80*					
a_t	1,30		+ 0,16					+ 0	– 0,14	+ 0,31	+ 0,05	0,08	2,27
	36		*88*					*9.159*	*110*	*50*	*315*		
a_t	2,22		+ 0,30	– 0,49				– 0,34	+ 0,09	+ 0,37	– 0,04	0,17	2,15
	25		*49*	*39*				*54*	*191*	*41*	*444*		
a_t	1,34		+ 0,48	– 0,39			+ 0,31	– 0,43	+ 0,02	+ 0,37		0,21	2,08
	51		*36*	*48*			*55*	*43*	*694*	*37*			
a_t	1,71		+ 0,31	– 0,30	+ 0,11	– 0,10						0,10	2,27
	28		*42*	*45*	*118*	*127*							
e_t	2,90		– 0,80	– 0,06	– 0,47	+ 0,20		+ 0,43	– 0,13	+ 0,16	+ 0,04	0,65	1,65
	27		*15*	*295*	*34*	*91*		*35*	*119*	*105*	*296*		
e_t	3,15		– 0,74	– 0,17	– 0,33	+ 0,07		+ 0,38				0,64	1,60
	22		*14*	*85*	*33*	*168*		*34*					
e_t	2,05		– 0,74					+ 0,58	+ 0,05	– 0,16	+ 0,10	0,58	1,79
	18		*15*					*18*	*225*	*74*	*122*		
e_t	2,49		– 0,68	– 0,23				+ 0,42	+ 0,15	– 0,14	+ 0,05	0,59	1,77
	19		*17*	*67*				*35*	*87*	*83*	*238*		
e_t	2,13	+ 0,21	– 0,71	– 0,17				+ 0,45	+ 0,16	– 0,17		0,60	1,72
	24	*55*	*16*	*94*				*34*	*80*	*72*			
e_t	0,93							+ 0,50	+ 0,06	– 0,06	– 0,13	0,22	2,44
	46							*28*	*252*	*278*	*127*		

Table 4/continued

Granger Test of Causality

Dependent Variable	Constant	a_t	a_{t-1}	a_{t-2}	a_{t-3}	a_{t-4}	e_t	e_{t-1}	e_{t-2}	e_{t-3}	e_{t-4}	Adj.R^2	Standard Deviation
						Consumer Prices, USA, Livingston							
a_t	1,05		+ 0,59	– 0,17	+ 0,14	+ 0,01		+ 1,26	– 1,56	+ 0,53		0,58	2,19
	46		*27*	*96*	*125*	*1.972*		*35*	*33*	*85*			
a_t	1,29		+ 0,60	– 0,11	– 0,18	+ 0,11		+ 0,40				0,51	2,36
	40		*25*	*147*	*84*	*111*		*68*					
a_t	1,18		+ 0,53					+ 1,10	– 1,40	+ 0,18	+ 0,42	0,61	2,10
	35		*28*					*32*	*29*	*203*	*50*		
a_t	1,10		+ 0,51	+ 0,11				+ 1,03	– 1,45	+ 0,10	+ 0,52	0,61	2,11
	39		*31*	*161*				*36*	*28*	*410*	*51*		
a_t	0,89		+ 0,23	+ 0,13			+ 1,40	– 0,02	– 1,34	+ 0,62	– 0,08	0,68	1,91
	44		*72*	*124*			*28*	*2.948*	*28*	*63*	*369*		
a_t	1,12		+ 0,73	– 0	– 0,16	+ 0,13						0,49	2,39
	45		*17*	*28.889*	*97*	*95*							
e_t	0,15		+ 0,20	– 0,01	+ 0,01	– 0,01		+ 0,77	– 0,10	– 0,37	+ 0,44	0,92	0,69
	104		*27*	*508*	*812*	*943*		*18*	*155*	*46*	*20*		
e_t	0,24		+ 0,26	– 0,18	– 0,03	+ 0,02		+ 0,84				0,89	0,82
	74		*20*	*33*	*176*	*275*		*11*					
e_t	0,14		+ 0,19					+ 0,76	– 0,10	– 0,38	+ 0,45	0,92	0,67
	94		*25*					*15*	*132*	*31*	*15*		
e_t	0,15		+ 0,20	– 0,01				+ 0,77	– 0,09	– 0,37	+ 0,44	0,92	0,68
	94		*26*	*508*				*15*	*142*	*34*	*20*		
e_t	– 0,03	+ 0,20	+ 0,16	– 0,18				+ 0,61	+ 0,19	– 0,02		0,92	0,72
	444	*23*	*35*	*26*				*21*	*74*	*372*			
e_t	0,40							+ 1,04	– 0,02	– 0,61	+ 0,50	0,90	0,76
	32							*9*	*605*	*20*	*15*		

Table 4/continued

Granger Test of Causality

Dependent Variable	Constant	a_t	a_{t-1}	a_{t-2}	a_{t-3}	a_{t-4}	e_t	e_{t-1}	e_{t-2}	e_{t-3}	e_{t-4}	Adj.R^2	Standard Deviation
						Production Expectations, France							
a_t	0,92		+ 0,80	+ 0,06	– 0,03			+ 0,16	+ 0,07	– 0,11		0,93	4,50
	49		*9*	*165*	*200*			*21*	*72*	*36*			
a_t	128		+ 0,78	+ 0,01	– 0,02	– 0,02		+ 0,17				0,93	4,59
	35		*10*	*695*	*469*	*377*		*13*					
a_t	0,93		+ 0,81					+ 0,16	+ 0,08	– 0,12	+ 0,02	0,93	4,50
	49		*5*					*21*	*68*	*44*	*212*		
a_t	0,92		+ 0,80	+ 0,01				+ 0,16	+ 0,08	– 0,12	+ 0,01	0,93	4,51
	50		*10*	*573*				*21*	*68*	*44*	*291*		
a_t	0,75		+ 0,77	+ 0,05			+ 0,10	+ 0,05	+ 0,11	– 0,12		0,93	4,40
	60		*10*	*122*			*35*	*96*	*46*	*31*			
a_t	1,05		+ 1,08	+ 0,01	– 0,04	– 0,12						0,90	5,28
	49		*7*	*990*	*271*	*61*							
e_t	1,78		+ 0,26	– 0,09	– 0,22			+ 1,15	– 0,43	+ 0,18		0,85	10,02
	57		*65*	*230*	*66*			*7*	*26*	*48*			
e_t	2,28		+ 0,15	– 0,07	– 0	– 0,18		+ 0,92				0,84	10,39
	44		*116*	*324*	*12.585*	*84*		*5*					
e_t	1,33		– 0,03					+ 1,19	– 0,42	+ 0,20	– 0,07	0,84	10,18
	77		*346*					*6*	*28*	*59*	*118*		
e_t	1,69		+ 0,27	– 0,33				+ 1,16	– 0,42	+ 0,17	+ 0,01	84	10,10
	61		*65*	*50*				*7*	*27*	*70*	*852*		
e_t	1,18	+ 0,48	– 0,12	– 0,33				+ 1,09	– 0,46	+ 0,23		0,85	9,85
	85	*35*	*176*	*45*				*7*	*24*	*39*			
e_t	1,16							+ 1,19	– 0,42	+ 0,20	– 0,08	0,84	10,15
	72							*6*	*28*	*60*	*104*		

Numbers below the regression coefficient represent the standard error in per cent.

information in an optimal way. But if in its short cut version expectations " . . . are essentially the same as the predictions of the relevant theory" (*Muth* [63, p. 316]) then it follows from the property of an optimal predictor that the error term is independent of expectations, while it is a part of the realizations. *Muth* and many other authors did explicitly confirm these properties, which represent a one sided causality, running from expectations to realizations. *Theil* [88] discusses the benefits of either assumption. The dependence of realizations on expectations represents the fact that expectations are available before realizations become known. This is also the stronger test for the verification of the "underestimation tendency". On the other hand *Theil* argues, that it is more modest from the forecaster's point of view to take realizations as given, than to choose the alternative assumption. *Theil* furthermore considers the symmetric treatment of expectations and realizations (orthogonal regression), which is implied by geometrical representations as well as by the comparison of standard deviations.

Empirical information on the relevant causal flow is usually derived from the time pattern of data, though this may be misleading, as known for example from the properties of the acceleration principle. A more complicated test — as compared to usual correlograms — has been proposed by *Granger* [32], but in principle it constitutes again a proof by means of the relation between expectations and realizations over time. Let X_t and Y_t be stationary time series, let U_t be all the information accumulated since time $t-1$ and let $U_t - Y_t$ denote all this information apart from the specified series Y_t. σ is the symbol for the standard deviation. $\overline{Y}$ refers to past values, $\overline{\overline{Y}}$ represents the set of past and present values of Y, $\overline{Y}(k)$ represents the set

$$Y_{t-j};\ j = k,\ \ k+1 \dots . \infty$$

Y is causing X, if $\sigma^2 (X \mid \overline{U}) < \sigma^2 (X \mid \overline{U-Y})$. I.e. Y_t is causing X_t if we are better able to predict X_t, using all available information than if the information apart from Y_t had been used. (And vice versa, X_t is causing Y_t if disregarding the information on X_t does not matter).

We say that feedback is occuring between X_t and Y_t if

$$\sigma^2 (X \mid \overline{U}) < \sigma^2 (X \mid \overline{U-Y})$$

as well as

$$\sigma^2 (Y \mid \overline{U}) < \sigma^2 (Y \mid \overline{U-X})$$

i.e. when there are two causal relations in the sense defined above.

Finally, *Granger* defines instantaneous causality:

If $\sigma^2 (X \mid \overline{U}, \overline{\overline{Y}}) < \sigma^2 (X \mid \overline{U})$ we say that instantaneous causality is occurring; i.e. if the present value of Y_t is included in the prediction, then the current value of X_t is better predicted. We say a causality lag is occurring if some recent values of Y do not contribute toward improving the prediction of X and only values of Y further in the past are relevant.

We did apply(9) the *Granger* test to three variables: US sales expectations (quantitative business data), French production expectations (qualitative business data), and US Consumer Price Forecast (quantitative forecast by exports). The following results are common to each of these three series; past expectations contribute significantly(10) towards the explanation of actual changes (in addition to past realizations) and past realizations contribute significantly towards the explanation of expected changes (in addition to past expectations). According to the definition by *Granger* "feedback" is proven. In addition to the influence of lagged values, the current values of the expectations, respectively the realizations are statistically significant(11) so that "instant causality" can be proven. "Causality lag" on the other hand cannot be shown.

The outcome of these results for the specification error debate is that neither model of the reality is correct because expectations and realizations are interdependent. The coefficient of the regression of expectations on realizations is biassed downward (the "below unity" criterion therefore is too weak), the coefficient of the other regression is biassed downward also (the "above unity" criterion therefore is too strict). In the absence of more complicated estimation techniques we would contend that the comparison of standard deviations is a modest procedure, but it is not biassed a priori.

The weak test (coefficients below unity in regressing expectations on realizations) is passed by 37 out of 39 variables in the standard set. Part of this result is due to regression bias, but not as much as it would be if "Reality I" were correct. The stronger test is passed by 15 variables. This modest result stems primarily from insignificant correlations. Taking the significant relations separately the average of the coefficients is well above unity (1,13 within the subset of significant regressions; using quantitative anticipations only it rises to 1,35).

This evidence in addition to the knowledge of the differences in the standard deviations between expectations and realizations leads us to the conclusion, that the regression bias is no sufficient explanation for the smoothing property(12).

Table 5

The Weaker and the Stronger Tests of the Smoothing Bias

	$e_t = k+ba_t$					$a_t = k+be_t$			
	k	s_k	b	s_b	R^2	k	s_k	b	s_b
Average of all regressions									
Business surveys	1,57	121	0,42	148	0,41	0,87	274	0,97	148
quantitative	1,37	114	0,29	206	0,36	1,09	74	1,06	206
qualitative	2,04	138	0,71	17	0,52	0,38	730	0,77	17
Consumer surveys	– 7,51	11	0,69	8	0,69	5,62	51	1,37	8
Experts	3,11	43	0,28	1998	0,27	2,25	165	0,67	1998
All data	1,39	87	0,39	754	0,39	1,70	220	0,90	754
Significant regressions only (s_b < 50 %)									
Business surveys	1,53	69	0,50	20	0,49	0,51	325	1,14	20
quantitative	1,23	29	0,37	22	0,48	0,59	88	1,35	22
qualitative	2,04	138	0,71	17	0,52	0,38	730	0,77	17
Consumer surveys	– 7,51	11	0,69	8	0,69	5,62	51	1,37	8
Experts	1,68	60	0,45	28	0,45	0,38	208	1,00	28
All data	0,63	61	0,50	21	0,50	1,01	268	1,13	21

s_k respectively s_b . . . . . Standard deviation of the coefficients in per cent of the coefficients.

3.3 "Incorrect–Ceteris–Paribus–Hypothesis"

Theil proposed, that the underestimation of change could stem from the erroneous assumption on the part of the forecaster that one group of determinants which actually varies would remain constant [88]. In his formal analysis *Theil* has to make an assumption about the properties of the unexplained residual in the "true model". The residual is again supposed to be independent of expected values and to be part of the actual. Therefore it is more likely to find coefficients below unity in the regression of expectations on realizations, than to find coefficients above unity in the reverse regression.

Theil's analysis starts from the "true model" that realizations consist of three components: one group of determinants *(V)*, which is correctly assessed as variable by the forecasting agent, another group *(S)* which actually varies, but is assumed to be constant and finally an error term (equation *(1)* in Table 6). Actual change can be calculated straightforward (equation *(2)*), the properties of the error term see equation *(3)*. Expected change however consist of two components only by definition, the coefficient h tells us if the actual change of those determinants assumed to be variable *(V)* is either forecast correctly, underevaluated or overevaluated, k is the autocorrelation coefficient assumed to govern the stochastic part of the realizations. It is easy to obtain a regression coefficient below unity if we regress expectations on realizations. The following components work together: the residual variance (σ^2), the variance of those factors (s^2) which were presumed to remain constant, and an eventual underestimation of the true coefficients of the variable factor group (h below unity). Additional components of lesser importance are the covariance between the deterministic variables and the relation of actual to presumed autocorrelation coefficient.

In the reverse equation coefficients above unity are less evident because the residual variance as well as the variance of the group S do not work unambiguously. Only the covariance between the two deterministic groups *(rsv)*, an eventual underestimation of the coefficients of the variables V and an incorrect assessment of the autocorrelation process will lead to coefficients above one.

These differences in the likelihood of $b < 1$ versus $b > 1$ do not surprise because they parallel those of the debate about the specification bias, only somewhat complicated because of a second source of bias. Table 6 demonstrates that the decomposition proposed by *Theil* can be reduced to the regression bias.

The economic core of *Theil's* decomposition, however, is the assumption that a part of the determinants is incorrectly assumed to be constant. This corresponds to the well known fact that ex post explanations are easier than ex ante explanations, because we know afterward which facts did change.

Table 6

Theil's Decomposition (and its Reduction to the Simple Regression Bias)

Actual Model		$f_t^A = f(S_t, V_t) + u_t$	
		$\Delta f_t^A = f^S \Delta S_t + f^V \Delta V_t + \Delta u_t$	
	$u_t = \rho u_{t-1} + u'(t)$	$Eu'(t) = 0$	$E\,[u'(t), u'(t-1)] = 0$
Expectation		$f_t^P = f(S_{t-1}, V_{t-1} + h_t\, \Delta V_t) + k_t\, u_{t-1}$	
		$f_t^P - f_{t-1}^A = h_t\; f\Delta V_t - (1 - k_t)\; u_{t-1}$	
	$e_t = b'(a_t)$	orthogonal regression	$a_t = b\,(e_t)$
	$b' < 1$ if	$b < 1$ if	$b > 1$ if
	$s^2 + (1-h)v^2 + (2-h)rsv + (1+k)\,(1-\rho)\sigma^2 > 0$	$s^2 + (1-h^2)v^2 + 2rsv + (1-2\rho+2k-k^2)\sigma^2 > 0$	$h(1-h)v^2 + hrsv + (1-k)\,(k-\rho)\sigma^2 > 0$
1. Reduction $s = 0$ (no ceteris paribus assumption)	$(1-h)v^2 + (1+k)\,(1-\rho)\sigma^2$	$(1-h^2)v^2 + (1-2\rho+2k-k^2)\sigma^2$	$h(1-h)v^2 + (1-k)\,(k-\rho)\sigma^2$
2. Reduction $h = 1$ (no underestimation of variable components)	$(1+k)\,(1-\rho)\sigma^2$	$(1-2\rho+2k-k^2)\sigma^2$	$(1-k)\,(k-\rho)\sigma^2$
3. Reduction $k = \rho$ (correct anticipation of the actual autocorrelative process)	$(1-\rho^2)\sigma^2$	$(1-\rho^2)\sigma^2$	$(1-\rho)\;0\;\sigma^2 = 0$
4. Reduction $\rho = 0$ (no autocorrelative process)	σ^2	σ^2	0

Theil's Decomposition (and its Reduction to the Simple Regression Bias)

S ... Group of variables expected to be stationary

V ... Group of variables expected to be variable

ρ ... Actual autocorrelation coefficient (1st order)

k ... Expected autocorrelation coefficient (1st order)

h ... Underestimation of regression coefficients of variable factors

s^2 ... Variance of $f^S \Delta S_t$

v^2 ... Variance of $f^V \Delta V_t$

rsv ... Covariance of $(f^S \Delta S_t, f^V \Delta V_t)$

σ^2 ... Variance of the residual term

The hypothesis implies that expectations which are based on past (rather than current) determinants should show the smoothing property to a lesser degree, because changes in the determinants are known at the time of the formation of the anticipation. Investment in big enterprises for example is known to depend on past capacity utilization, the smoothing tendency is in fact smaller for this group (see *Friend* and *Bronfenbrenner* [31] and *Aiginger* [3]). Less confirming is the evidence of different variables in our standard set: the smoothing bias of the *Livingston* price expectations, which are purported to depend on past determinants, is less than that of the Japanese sales or export anticipations, but not as compared to the US sales anticipations. In the macroeconomic forecasts inflation and unemployment (which again are purported to depend on past determinants) show a smaller smoothing effect consistent with *Theil's* hypothesis, but there are alternative explanations available for this fact (high autocorrelation, asymmetric loss function, etc.).

Theil's hypothesis may be extended to explain also the pessimism bias, if we assume that the level of determinant is erroneously assumed to be zero. Empirical support for *Theil's* hypothesis in general is found only insofar as one of its implications is not contradicted by available facts.

3.4 Uncertainty Hypothesis

Many forecasting techniques imply the smoothing property of expectations. Under certain assumptions concerning the loss function as well as the degree of uncertainty the smoothing bias may even be a result of optimal forecasting.

For example, if no other information is available as to which number out of an urn is to be expected and we are confronted with a quadratic and symmetric loss function, it is optimal to expect the mean in any single period.

Autoregressive forecasting techniques yield smoothed forecasts in almost every case, even if the autocorrelation coefficient used is equivalent to that generating the actual time series. The greater the part of the realization not generated by the autocorrelation process, the greater will be the extent of the smoothing effect. As far as cyclical time series are concerned, the usual technique of calculating an *average* autocorrelation coefficient results in even greater smoothing bias because the autocorrelation coefficients tend to move cyclically. Ideally complicated autocorrelative structures could approximate sinoidal waves as closely as necessary, though the structures usually estimated nearly never do generate turning points.

Moving-average-forecasting also reduces the variance. If the empirically reported expectations should be generated by application of this technique however, the number of periods used for smoothing (implicitly implied by the extent of the bias) would have to be very large. The empirical shape of the smoothing bias however does not support that this property of expectations is due to optimal forecasting techniques.

It can be shown that the smoothing bias results primarily from an underestimation of the cyclical component. The irregular component of expectations and realizations is equal in extent: the first order autocorrelation coefficients amount to 0,43 (averaged over all expectations), respectively 0,46 (averaged over the realizations, see table 8(13)).

The differences between expectations and realizations (errors) are serially correlated: the first order autocorrelation coefficient is on average 0,31, in the subset of quantitative business data 0,43. In an optimal forecasting technique these differences would be used to correct the forecast. For any phase of the business cycle we can calculate typical differences between expectations and realizations: in peak periods expectations are always lower than realizations (the US sales expectations are 2 per cent too low if actual growth exceeds 4 per cent, see table 7), in recessions they are too optimistic.

Even if the given smoothing bias could have been reduced and are therefore not optimal in respect to the existing degree of uncertainty, a less strict implication of the uncertainty hypothesis would be, that the smoothing bias is more pronounced for series confronted with a higher degree of uncertainty.

The stronger smoothing bias found for the long term expectations reported in chapter 2 corroborates this hypothesis. Uncertainty should furthermore be smaller for those variables, which can be determined by the reporting agent to a greater degree. The smoothing bias is indeed smaller for investment plans than for exports and for stocks of finished goods.

Table 7

The Dependence of Biasses on Average Growth, Respectively on the Phase of the Business Cycles

	Japan			
	Production expectations		Sales expecations	
	Ø actual change	underestimation (—) overestimation (+)	Ø actual change	underestimation (—) overestimation (+)
	quarterly change in %			
Cycles				
1	3,4	– 0,9	3,3	– 0,9
2	4,4	– 1,4	4,4	– 1,3
3	3,9	– 1,1	3,9	– 0,9
4	4,4	– 2,0	4,3	– 1,7
5	2,8	+ 0,3	3,0	+ 0,2
6	4,0	– 1,1	4,1	– 0,8
Phase				
TP_1 to MAX	5,7	– 3,3	6,0	– 3,3
MAX to TP_2	5,0	– 1,7	4,4	– 1,1
TP_2 to MIN	1,5	+ 1,5	1,9	+ 1,3
MIN to TP_1	1,7	+ 1,1	2,1	+ 0,6
Actual change				
More than 4		– 3,0		– 2,6
More than 3 1/2		– 0,7		– 0,5
More than 3		– 0,4		– 0,0
More than 2 1/2		+ 0,5		—
More than 2		+ 0,4		+ 1,1
More than 1 1/2		+ 1,8		+ 1,5
More than 1		+ 1,2		+ 1,3
More than 1/2		+ 4,3		+ 3,2
More than 0		+ 2,7		+ 2,1
More than – 1/2		—		+ 2,6
More than – 1		—		—
More than – 1 1/2		—		—
More than – 2		+ 1,6		—
Less than – 2 1/2		+10,0		+ 6,7

Note

TP_1 = Turning point between minimum (MIN) and maximum (MAX)

TP_2 = Turning point between maximum (MAX) and minimum (MIN)

Cycle: TP_1 to TP_1 respectively TP_2 to TP_2.

The Dependence of Biasses on Average Growth, Respectively on the Phase of the Business Cycles

USA

Sales expecations: Ø actual change	Sales expecations: underestimation (–) overestimation (+)	Consumer prices (*Livingston*): Ø actual change	Consumer prices (*Livingston*): underestimation (–) overestimation (+)
quarterly change in %			
1,7	+ 0,1	2,6	– 2,8
1,6	+ 0,7	1,2	– 1,1
1,8	+ 0,3	2,6	– 0,9
2,1	– 0,9	6,8	– 2,1
2,4	– 0,4	5,5	– 3,0
2,7	– 2,6	4,8	– 1,9
0,6	+ 0,8	1,8	– 0,5
1,3	+ 0,9	1,3	– 0,3
	– 2,0		– 3,9
	– 3,3		– 0,7
	– 1,3		– 0,7
	– 2,0		– 1,6
	+ 1,0		– 1,8
	– 0,9		– 0,7
	+ 1,1		– 0,0
	+ 0,5		+ 0,7
	+ 2,0		+ 0,4
	–		– 0,1
	+ 2,7		– 0,1
	+ 1,2		– 1,6
	+ 1,5		–
	+ 6,5		+ 1,9

Note

TP_1 = Turning point between minimum *(MIN)* and maximum *(MAX)*

TP_2 = Turning point between maximum *(MAX)* and minimum *(MIN)*

Cycle: TP_1 to TP_1 respectively TP_2 to TP_2.

The somewhat larger bias of production anticipations as compared to sales anticipations however seems to contradict the hypothesis.

If costs and benefits of the collection of information have to be taken into account, more important variables should be forecast better than unimportant ones. The large biasses in forecasting finished stock and liquid assets may be interpreted as confirmation, the strong bias in forecasting GNP as compared to less important variables indicates that this implication must be countered by other determinants. Again the hypothesis can at most explain the smoothing property. Uncertainty cannot explain the extent of this bias, but seems to be relevant for the different degree of the smoothing tendency among the variables.

Table 8

First Order Autocorrelation of Expectations, Realisations and the Error Terms $(a_t - e_t)$

	First order autocorrelation coefficient (R) of			
	Long-run expectation	Short-run expectation	Actual data	Residual (actual minus expected)
Business surveys	0,47	–	0,51	0,40
quantitative	0,46	0,35	0,47	0,43
qualitative	0,49	–	0,59	0,31
Consumer surveys	0,84	–	0,92	0,80
Experts	0,23[1)]	0,27[1)]	0,25[1)]	0,01[1)]
All data	0,43[1)]	0,31[1)]	0,46[1)]	0,31[1)]

1) Excluding OECD data (GNP-Austria and GNP-OECD-total).

3.5 Forgetting Hypothesis

It is reasonable to assume that the expected amplitude of future business cycles is dependent on past experience. If the amplitude of past cycles fades away in memory we should not be surprised if the expected amplitude of future cycles is smaller.

A possible explanation for the tendency to forget the intensity of past cycles would be that only "permanent", "important" or "systematic" tendencies are memorized. This assumption can easily explain the smoothing of the irregular components. In order to explain the forgetting of the cyclical strength it is necessary to assume that a trough loses part of its importance if it is followed by a recovery and vice versa.

The forgetting hypothesis can be demonstrated by data collected in an investment survey: Austrian entrepreneurs are asked twice as to their capacity utilization rate; once regarding their current utilization rate (survey in year t concerning capacity utilization in $t \ldots t_{cap_t}$) and then one year later regarding their capacity utilization in the previous year $(t{-}1_{cap_t})$.

The reported utilization rates regarding the current year imply a cyclical amplitude twice as large as that in the retrospective view (after one year had passed). The difference between the highest and the lowest capacity utilization in the current perspective lies (averaged over the different cycles) around 4,8 per cent, in retrospective the amplitude declines to 3,2 per cent.

Out of seven extreme points of utilization, six were corrected one year later in the direction of the mean (the seventh only after adjusting for the lack of response from a large firm). The forgetting tendency amounts to one third of actual change(14). This degree corresponds approximately to the extent of the smoothing bias. The degree of the retrospective correction is not independent of the extent of cyclical change, in 1968 for example an industry in which utilization rose by 9 points corrected its earlier report from the previous year by as much as 4 per cent. An industry which did experience (contrary to the general trend) a decline in its utilization, corrected its earlier report downward.

The tendency to forget the intensity of past changes does not contradict the possibility that present changes are sometimes overexaggerated. *Streissler* and *Hoschka* [84] presented some material in this direction, the large amplitude of the assessment variables in the business tests (assessment of orders, stocks etc., see [6]) confirm this tendency. In the case of capacity utilization other methods of calculation (Wharton method, Potential output etc.) however do not indicate that the reports about current utilization exaggerate actual cycles.

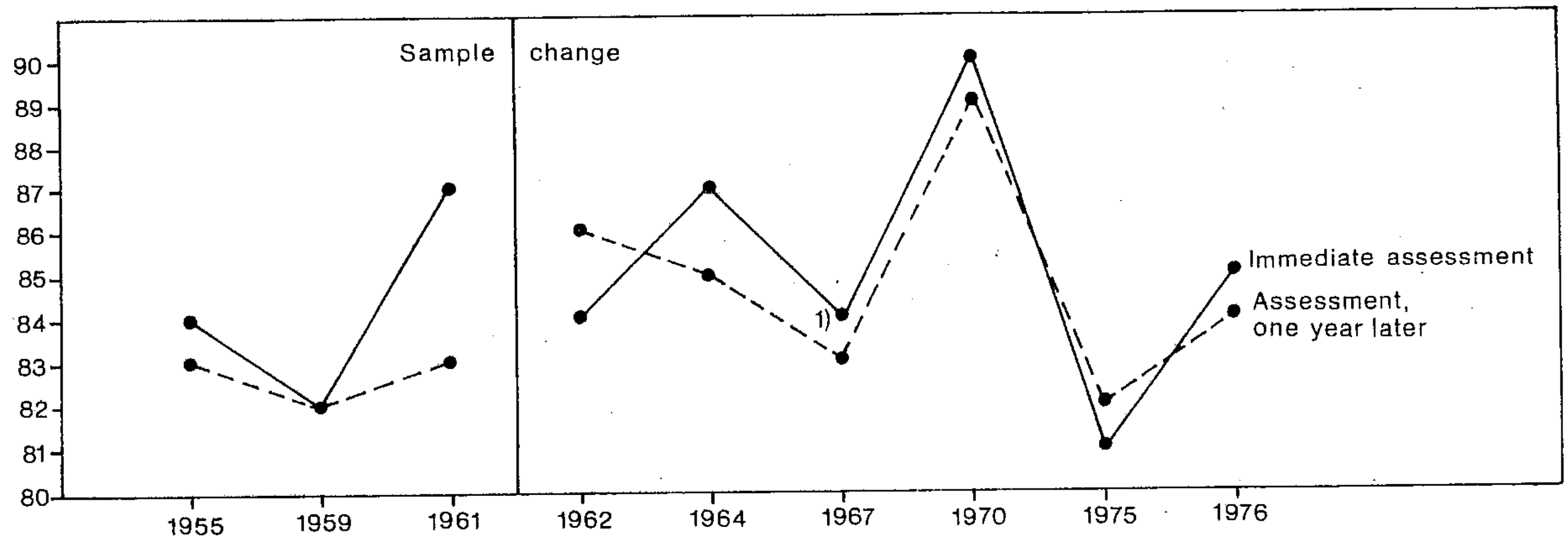
The forgetting hypothesis can be modified so as to explain also the pessimism tendency if we hypothesize that not only the intensity of past cycles but also the intensity of average past growth is forgotten. Such a tendency may indeed exist. Claims on the part of consumers that their income has fallen even in periods of fast increases (as in Austria in the years 1972/1974 in which it rose by annual rates of + 13 per cent in nominal and + 5 per cent in real terms) may point in this direction, but they are also open to other interpretations (exaggeration of present inflation, rise in the aspiration level, higher inequality of income distribution etc.).

Table 9

The Forgetting of Past Cycles
(Capacity Utilization, Austria)

	1955 *MAX*	1959 *MIN*	1961 *MAX*	1962 *MIN*	1964 *MAX*	1967 *MIN*	1970 *MAX*	1975 *MIN*	1976 *MAX*
Immediate assessment	84	82	87	84	87	84[1)]	90	81	85
Assessment, one year later	83	82	83	86	85	83	89	82	84

1) Disregarding a sample error in chemical industry 82 1/2 per cent.



3.6 Specific Regressivity of Expectations

Several investigations of expectational series indicate regressivity of expectations. (For an overview see *Aiginger* [4]).

We speak of regressive expectations if the coefficient in the regression of expectations on past realizations is below unity (defined in [4] as "discounting property") or even negative ("classical" regressivity).

Despite the similarity between regressivity of expectations and the smoothing property these are quite different phenomena: regressivity is a hypothesis about the formation of expectations(15), while the smoothing property is a forecasting error (reducable or not). The former relates expectations to past realization and therefore is not blurred by the possibility of the regression bias (see *Bossons* and *Modigliani* [15]).

Actual data may contain a certain degree of regressivity in themselves out of the nature of cyclical processes as well as because of their irregular component(16). Regressivity then becomes important for the explanation of the smoothing property only, if the regressivity of expectations is stronger than that of realizations (labelled "specific" regressivity of expectations henceforth). *Bossons* and *Modigliani* [14] demonstrate that regressivity may be a property of optimal forecasting, if the actual level of a variable consists of a permanent and an irregular component ($A_t = E + \xi_t$). The regression of changes in the actual data on the last change ($\xi_{t-1} - \xi_{t-k}$) gives a regression coefficient of $\gamma = -1/2$ in absence of autocorrelation of the residuals ($g = 0$). The coefficient has a negativ sign as long as the autocorrelation coefficient is smaller than unity [$\gamma = 1/2\ (g - 1)$ in case of autocorrelation].

The specific regressivity of empirically reported expectations can be demonstrated by a comparison of the regression coefficient of the autoregressive structure of actual data and the formation procedure of expectations. The regression of actual data on their past realization gives a regression coefficient (averaged over the standard set of variables) of 0,44, the regression of expectations on the same variables yields a coefficient of 0,30. If an acceleration term is added to either regression, its average coefficient is 0,156 for the realizations versus zero for expectations (in the latter case 19 regression coefficients are even negative). These differences indicate the degree of "specific" regressivity of expectation. *Keynes* supposed that it would be reasonable if people expected the interest rate to return to its normal value. Psychology has used the term regressivity for the tendency of people or groups to return to earlier habits (especially in critical situations). *Bossons* and *Modigliani* [14] exhibit the similarity between the specific regressivity in the formation of expectation with the phenomenon known as "Gamblers' fallacy" (i.e. to underestimate the length of runs.)

Table 10

Differences between the Regressivity of Expectations and the Regressivity of Actual Data

	$e_t = k + ba_{t-1}$		$e_t = k + ba_{t-1} + c(a_{t-1} - a_{t-2})$			For comparison $a_t = k + ba_{t-1}$		For comparison $a_t = k + ba_{t-1} + c(a_{t-1} - a_{t-2})$		
	∅ b	∅ R	∅ b	∅ c	∅ R^2	∅ b	∅ R^2	∅ b	∅ c	∅ R^2
Business surveys	0,23	0,32	0,25	– 0,04	0,41	0,51	0,38	0,32	0,16	0,39
quantitative	0,11	0,29	0,09	0,02	0,36	0,48	0,36	0,36	0,13	0,35
qualitative	0,50	0,37	0,64	– 0,26	0,51	0,58	0,44	0,22	0,23	0,49
Consumer surveys	0,61	0,55	0,60	0,12	0,56	0,94	0,84	0,91	0,05	0,86
Experts	0,35	0,40	0,32	0,07	0,47	0,22	0,18	0,06	0,18	0,25
All data	0,30	0,36	0,30	– 0,00	0,44	0,44	0,35	0,28	0,16	0,38

If we do not want to stop in the explanation of specific regressivity as a "fundamental psychological law" which requires no further explanation, we can refer to the explanations in the other chapters of this analysis: uncertainty, forgetting past changes as well as the underevaluation of cyclical effects may result in the regressivity phenomenon. An additional source of this phenomenon may consist in the tendency of economic agents reflecting about their present situation to overexaggerate casual or individual factors and underevaluate the cyclical or general component.

A survey on the causes of the cyclically very different plan revisions of investment in Austria manufacturing [3] for example did stress the technical points (incompleteness of planning, technical innovations). Cyclical factors were considered unimportant on the other hand.

3.7 The Underestimation of the Strength of the Cycle

Cumulative forces are known to constitute the hard core of the business cycle. Each component of demand depends on another, its change usually influences simultaneously the next. The use of one isolated variable as proxy for the economic development of environment and the neglect of the influence of the own decision on the environment leads to an underestimation of the cumulative nature of the business cycle. *Carlson* [19] demonstrated that "underestimation of change" is – certain assumptions given – implied by the nature of business cycle. If periods of expansions are defined as situations below a temporary equilibrium and a temporary equilibrium is defined as a situation in which consumption expectations are fulfilled, then it follows ex definitione that expansion periods are characterized by a tendency to underestimate consumption. Beyond this definitional identity *Carlson* finds empirical support that periods of growth coincide with underestimation of consumption and he demonstrates how persistent the underestimation tendency is in case of interdependencies: even if the full difference of the past error is considered in the next forecast (unity coefficient in the adaptive hypothesis), the next expectations are likely to be too conservative, because of the implied change in incomes following from the correction of the production plan.

In contrast to *Carlson* we would like to stress the possibility to underestimate the growth of investment and the impact of an eventual rise in investment on profits and the influence of profits on investment again. Investment is much more volatile and more difficult to forecast than consumption. It can be demonstrated that a great variety of assumptions about the formation of investment plans lead to the dampening bias of investment anticipations. Two of them are formalized in the following simple models (consisting of very simple investment and consumption function): one model assumes that entrepreneurs base the investment decisions on the (correct) assessment of consumer demand, the other that they base it on a demand proxy consisting of consumer demand plus last period investment. If consumer demand fluctuated less than investment demand ($r < s$) the

Table 11

The Regressivity of Macro-Investment Anticipations versus the Regressivity of Sectoral-Investment Anticipations in Austria

	$e_t = k + ba_{t-1}$					$a_t = k + ba_{t-1}$				
	k	s_k	b	s_b	R^2	k	s_k	b	s_b	R^2
Mining	14,53	51	– 0,39	69	0,16	12,59	69	– 0,27	114	0,07
Petroleum	35,17	39	0,22	164	0,03	14,43	77	0,03	999	0,00
Iron & Steel	6,58	72	– 0,03	451	0,00	6,22	175	0,52	57	0,24
Non-Ferrours Metals	27,31	82	– 0,25	150	0,04	22,66	83	– 0,19	166	0,04
Stone & Clay	– 7,73	83	– 0,29	59	0,21	11,27	105	– 0,04	686	0,00
Glass	– 19,40	38	– 0,29	79	0,13	7,31	147	– 0,18	181	0,03
Chemicals	1,76	295	– 0,10	274	0,01	11,58	50	– 0,04	825	0,00
Pulp & Paper	2,36	421	0,07	531	0,00	10,66	78	0,13	222	0,02
Paper Products	– 5,85	113	– 0,52	29	0,52	16,08	82	– 0,34	92	0,10
Wood Products	– 22,54	33	– 0,13	136	0,05	9,86	138	0,13	236	0,02
Food & Tobacco	– 2,01	196	– 0,39	38	0,39	5,32	88	– 0,07	240	0,02
Leather	– 18,89	67	– 0,29	97	0,09	3,63	403	0,03	1025	0,00
Leather Products	– 30,21	11	– 0,24	54	0,24	12,78	64	– 0,28	137	0,05
Textiles	– 19,01	14	– 0,15	80	0,13	7,80	84	– 0,38	95	0,10
Apparel	– 23,53	20	– 0,08	230	0,02	3,58	227	0,33	97	0,10
Foundries	– 1,76	555	– 0,20	136	0,05	18,51	67	– 0,21	154	0,04
Machinery (non-electric)	– 9,23	50	0,10	224	0,02	9,33	73	0,14	215	0,02
Vehicles	19,75	43	– 0,26	58	0,21	9,31	111	0,10	173	0,03
Metal products	– 17,70	31	– 0,17	109	0,07	13,77	67	– 0,20	154	0,04
Electrical Eng.	– 6,24	138	0,18	169	0,03	13,48	72	0,04	845	0,00
Average of Sectoral Regressions	– 3,83	118	– 0,16	157	0,12	11,01	113	– 0,04	336	0,05
Macro – Regression	– 3,75	84	– 0,08	250	0,07	6,06	75	0,27	108	0,11

smoothing bias becomes evident (even if only a part of the entrepreneurs follow this rule). The same result occurs if lagged investment is used because the sum of two originally parallel sinus curves shows a smaller amplitude if one of them is shifted. Empirical support for the last assumptions is given by the fact that the amplitude of the sum of consumption and investment changes in Austria amounts to 17,3 per cent, while this measure decreases to 11,2 per cent if investment is lagged by one year.

The possibility that the very neglect of the cumulative effects of investment itself is a source of the smoothing bias of investment anticipations is strengthened by the fact that investment anticipations are more closely related to a demand variable excluding recent change in investment, while actual investment in manufacturing is related more closely to a demand variable including investment change. Moreover the difference between investment anticipations and actual investment is significantly related to the change in investment(17).

An implication of the hypothesis that the smoothing bias stems from the neglect of cumulative forces would be, that this bias should tend to be smaller for big enterprises as well as for the macroeconomic forecasters (because both of them should consider cumulative processes to a greater extent than small business). It was shown above that this implication is fulfilled as far as the big enterprises are concerned. The smoothing bias is large in the macroeconomic investment forecast, though investment exhibits a smaller smoothing bias in relation to exports (which are not determined by national cumulative processes).

3.8 Aggregation Problems

Reported expectations are usually aggregated over many individuals. In case of macroeconomic forecasts aggregation may be given over different forecasts by different forecasting methods or different persons. *Bossons* and *Modigliani* [14] found that the specific regressivity of expectations (which also leads to the smoothing property) can be found on the aggregate level only (B^* is smaller than B) but not on the individual level (β^* and β are approximately identical). They explain this difference with the help of the empirically supported fact that individual firms disregard the absolute term in their expectation formation. This reduces the absolute term in the cross section regression (equation *(11)*) while the absolute term is present in the same equation running the actual data on past values and finally it biasses the coefficient B^* in relation to B. As economic rationale *Bossons* and *Modigliani* refer to "Gambler's fallacy" (underestimation of the length of runs) and to the fact that the absolute terms may be small on the individual level (and probably insignificant).

Two Simple Hypotheses About Demand Proxies Implying Smoothing Bias for Investment Anticipations

Model

$$C = cY + r \sin t$$
$$I = vY + s \sin t$$
$$Y = C + I = (c + v)\, Y + (r + s) \sin t$$

Reduced form

$$Y = \frac{r + s}{1 - c - v} \sin t = k \sin t$$

Auxiliary definition

$$\frac{r + s}{1 - c - v} = k$$

$$C = ck \sin t + r \sin t = (ck + r) \sin t$$
$$I = vk \sin t + \sin t = (vk + s) \sin t$$

$$AMP_C = ck + r$$
$$AMP_I = vk + s$$

Assumptions

$$r < s \Rightarrow \exists\, u_1 > 0 \quad : \quad r + u_1 = s$$

$$c > v \Rightarrow \exists\, u_2 > 0 \quad : \quad v + u_2 = c$$

$AMP_I > AMP_C$ if $\frac{u_1}{u_2} > k$

1. Assumption: Investment anticipations then I^* are based on development of consumption

$$I^* = v \,.\, Y^*; \qquad \frac{\delta Y^*}{\delta t} = \frac{\delta C}{\delta t}$$

$$\frac{\delta Y^*}{\delta t} = (ck + r) \cos t$$

$$Y^* - \int (ck + r) \cos t \, \delta t = (ck + r) \sin t + C_1$$

$$AMP_{I^*} = v\, (ck + r)$$

Result

$v\,(ck + r) < vk + s$ since $c < 1, v < 1$ and $r < s$

2. Assumption: Investment anticipations are based on current consumption and on lagged investment (lag . . . $\frac{2\pi}{5}$)

$$Y^* = C + I_{t-1}$$

$$I_{t-1} = vY_{t-1} + s \sin\left(t - \frac{2\pi}{5}\right) = (vk + s) \sin\left(t - \frac{2\pi}{5}\right)$$

$$Y^* = (ck + r) \sin t + (vk + s) \sin\left(t - \frac{2\pi}{5}\right) =$$

$$= (ck + r) \sin t + (vk + s) \left(\sin t \cos \frac{2\pi}{5} - \cos t \sin \frac{2\pi}{5}\right) =$$

$$= \sin t\, [ck + r + 0{,}31\, (vk + s)] - [(vk + s)\, .\, 0{,}95]\cos t$$

$$I^* = v\, [\sin t\, .\, U - \cos t\, .\, X]$$

Auxiliary definitions

$$U = ck + r + 0{,}31\, (vk + s)$$

$$X = (vk + s)\, 0{,}95 = AMP_I\, .\, 0{,}95$$

$$Z = -\frac{U}{X}$$

Conditions for extremes:

$$\frac{\delta I^*}{\delta t} = 0 \quad \Rightarrow \quad \cos t\, (U) = -\sin t\, (X) \quad \Rightarrow \quad tg\, t = Z \quad \Rightarrow \quad t = arc\, tg\, Z$$

Location of extremes:

$$|I^*(arc\, tg\, Z)| = |v\, [\sin(arc\, tg\, Z)\, .\, U - X \cos(arc\, tg\, Z)]| =$$

$$= \left| v \left[\frac{U\, .\, Z}{\sqrt{1 + Z^2}} - \frac{X}{\sqrt{1 + Z^2}} \right] \right| = \left| v\, X \sqrt{1 + Z^2} \right| = |v\, AMP_I\, .\, 0{,}95\, K|$$

Auxiliary definitions:

$$K = \sqrt{1 + Z^2} = [K]$$

$AMP_{I^*} < AMP_I$ if $W = |0{,}95\, .\, v\, [K]| < 1$

that condition is fulfilled for a wide range of parameters, especially for the following specifications:

$$r = 0{,}2$$
$$s = 0{,}6$$
$$c = 0{,}45$$
$$v = 0{,}40$$
$$\Rightarrow W = 0{,}63 < 1$$

Actual data

(7)	$a_t^i = \beta_i a_{t-1}^i + K_i + \theta_{it}$	$\epsilon\ \theta_{it} = 0,\ t = 1, \ldots, T$	firms time series
(8)	$a_t = b_t a_{t-1}^i + k_t + \eta_{it}$	$\epsilon\ \eta_{it} = 0,\ i = 1, \ldots, N$	firms cross section
(9)	$\bar{a}_t = B \bar{a}_{t-1} + K + \epsilon_t$	$\epsilon\ \epsilon_t = 0,\ t = 1, \ldots, T$	macro-time series

Expectations

(10)	$e_t^i = \beta_t^* a_{t-1}^i + K_i^* + \theta_{it}^*$	$\epsilon\ \theta_{it}^* = 0,\ t = 1, \ldots, T$	firms time series
(11)	$e_t^i = b_t^* a_{t-1}^i + k_t^* + \eta_{it}^*$	$\epsilon\ \eta_{it}^* = 0,\ i = 1, \ldots, N$	firms cross section
(12)	$\bar{e}_t = B^* \bar{a}_{t-1} + K^* + \epsilon_t^*$	$\epsilon\ \epsilon_t^* = 0,\ t = 1, \ldots, T$	macro-time series

These proposed tendencies are valid for Austrian investment anticipations: the specific regressivity for total manufacturing exceeds that of the average over the individual sector regressions (time series regressions are compared). Comparing the cross section regressions for three years the regression coefficients for actual data versus anticipations are approximately the same (– 0,24 respectively – 0,27), but the constant term relevant for actuals is absent in the regression of expectations on past realizations.

3.9 Asymmetric Loss Function

Expectations to be on average identical to realizations is desirable only(18), if the economic loss resulting from a given error, say x per cent, is the same if the expectations held prove too optimistic or too pessimistic (symmetric loss function)(19). There are however indications that neither for managers nor for macroeconomic forecasters loss functions are symmetric(20). Starting with the consideration of asymmetric loss functions entrepreneurs or managers are confronted with, we must be careful to formulate the exact question: we do not have to compare the alternatives of smaller or bigger rates of growth, but two situations in which the same rates of growth occur while the rate was underestimated one time (positive surprise, i.e. the expectation was lower than the actual) and overestimated in the other case (negative surprise, i.e. expectations exceeded actuals).

Considering the cost of surprises concerning the demand for the firm's products we can pass over the case where unexpected demand can be met without additional cost (because factors were used as before or they do not cost anything). Neglecting this possibility we assume that surprises concerning demand will result first in *variations in the stocks of finished goods*, at first without affecting the production volume. Depletion of stocks will reduce the ability to deliver in time, especially if it results from a wrong forecast confined to a single firm. On the other hand the cost are lower than in case of expected demand, since no cost of production are incurred(21). An unintended increase in stocks in reaction to a negative surprise however results in higher storage cost as well as in the higher cost of producing too many units. The small reduction of cost stemming from the fact that the firm can now meet exceptional demands (which are not considered ex ante in the calculation of an optimal amount for the stocks) is quantitatively neglegible.

In case surprise is larger (also for firms producing on orders only) firms will vary the *volume of production* in response to surprises in demand, thereby changing also the quantity of labor and capital employed. An increase in the amount of labor used, which was not known at the beginning of the period is more expensive than planned increase because of overtime expenses or cost of quick training for the jobs. We could perhaps assume a 50 per cent mark-up in accordance with Austrian law. An unanticipated reduction of labor, however, will result in extra cost near 100 per cent as compared to the case when this necessity was foreseen, because we assume that dismissals are permitted up to the beginning of a new period(22).

As far as capital is concerned the cost of anticipated versus unanticipated variations in the utilization rate will not differ very much. Unanticipated increases of capacity (investment) are a little more expensive than in the case of a correct forecast (the search for optimal offers is limited, etc.). A reduction in capacity is difficult even if it is anticipated. The main difference of a positive or negative surprise in demand will therefore consist mainly of the different possibilities to react (see the asymmetry in plan revisions of the investment anticipations)(23).

The assumed tendency to asymmteric cost in case of positive versus negative surprises are accentuated if we consider financial and risk implications. Negative surprises result in higher credit cost ("emergency credits") and increasing risk of illiquidity. Thus it seems plausible that the cost of negative surprises will tend to increase rapidly if a certain degree

Table 13

Survey on the Loss Function of Forecasting Errors (Including Reactions in Case of Positive versus Negative Errors)

Disregarding the fact, that a growth of your sales is more favourable than a decline, do you evaluate that

- an upward error in your forecast versus an equal downward error does incur the same cost *79*
- it is more expensive if you expected your sales to grow by 5 % too fast than if you expected them to grow by 5 % too slow (as compared to the actual course) *234*
- it is more expensive if you expected your sales to grow by 5 % too slow than if you expected them to grow by 5 % too fast (as compared to the actual course) *59*

If your sales anticipation were too optimistic (too pessimistic) please assess the following possible reactions within the planning period

	too pessimistic anticipation			too optimistic anticipation		
	first reaction	in case of large errors	unimportant	first reaction	in case of large errors	unimportant
price variation	69	131	204	80	167	160
variation in stocks	195	90	84	132	114	118
volume variation	246	116	55	239	129	48
capacity variation	75	189	124	64	145	168

is passed. That is not true for positive surprises: perhaps the cost of a very large increase as compared to that of a large surprise is not much different, because the firm would not have met a very big increase even if it had been foreseen (because it is supposed to be ephemeral).

An empirical survey conducted in Austria in 1979 verified these theoretical considerations. 500 firms in manufacturing industries were asked if they assessed the cost of a positive surprise versus that of a negative surprise of the same extent as equal. Special attention was directed to the difference between a positive *development* as such and a positive *surprise* (defined as difference between expected and actual change of their sales). 21 per cent of the firms answered that the loss was independant of the sign of the error, 16 per cent assessed it as more expensive if they had been too cautious, 63 per cent reported the loss to be higher if they had been too optimistic.

As their first reaction to either a positive or a negative surprise the respondents reported a variation in the production volume. In case of a positive surprise the changes of stocks follow pretty close, variations in capacity as well as price changes are reported very seldom. In case of a negative surprise variations in stocks are less important, price variation is not excluded to the same extent as in the above case, though it is not mentioned as strategy of first choice anyway (see table 13).

The tendency to prefer cautious planning to planning based on the most likely outcomes is inherent in decision rules under uncertainty (for example the MINIMAX principle, according to which the most favourable conditions are assumed for competing firms, for the own firm the most unfavourable ones) and in accounting principles (asymmetric treatment of revenues and liabilities, in case of doubts about their exact magnitude) (24).

Löwe and *Shaw* [50] report on the tendency of managers to propose too pessimistic forecasts, intentionally, because they are rewarded according to the difference between forecast and realization. This tendency is reversed only in firms confronted with a heavy decline in sales: the regional managers prefer the probable loss of income as compared to the risk of dismissal following from negative forecasts. *Hart* [34] supposes that the loss of forecasting errors is not dependent on their extent as long as the direction of future development is anticipated correctly, in case of an error regarding the sign of the development the magnitude of the error gains importance. This tendency implies a pessimistic bias in the average of anticipations, if periods of growth prevail.

Mincer and *Zarnowitz* [56], *Zarnowitz* [98] report that macroeconomic forecasts are biassed downward. The variables reported in the standard set confirm this tendency. The contrary finding for the GNP forecasts of OECD may be due either to the deceleration of growth rates in the seventies (data are available only for the period 1968/1978) or to the forecasting procedure of international organisations (influence of national governments).

In general, however, forecasts of macroeconomic variables also exhibit the pessimism bias, though not to the same extent as quantitative business forecasts. Cautious forecasts of economic growth by national forecasters are possibly more appreciated than unbiassed ones, because the policy maker wants to take stronger action in case of lower growth than in case of excessively high growth. Employment problems as the result of slow economic growth are considered a more serious evil than a high rate of inflation in the wake of too rapid growth (at least in most European countries and by members of the democratic party in the US). A cautious forecast also puts the ruling political party in a position where it can claim that any improvement (over the forecast) was the direct result of its successful economic policy(25). Differences in the average errors between the variables of macroeconomic forecasts seem to support the idea of asymmetric loss functions. For the Austrian economy variables with a positive connotation (growth, exports) are underestimated, but those with an unfavourable connotation (unemployment, inflation, imports) are predicted correctly or overestimated(26). Furthermore it can be shown that when negative indicators become available, forecasts are revised promptly, but rather slowly in case of positive changes in the indicators.

3.10 Differences in the Skewness of Expectations and Realizations

Neither expectations or realizations are distributed symmetrically about their mean. In contrast to the biasses of the mean and the variance, the findings are dependent on the time period used and very different for the various types of variables. Especially up to the beginning of the recession in 1974 and as far as the quantitative business anticipations are concerned, actual changes are skewed to the right to a larger degree than expectations. The differences become smaller if we analyze the forecasts of experts or if we include the last five years (in the case of exports actual and expected changes are skewed to the left).

The tendency of actual changes to be skewed to the right may be due to the fact that cyclical peaks usually last longer than recessions. The tendency of expectations to be skewed to the right far less corroborates the observation that it is precisely the large increases which are underestimated in quantitative forecasts. (This may be so because the consequences to be drawn from the difference between large and very large increases are small, or because very large increases happen more or less at random.) The deep and long recession of 1974/75 and its large forecasting error did reduce the differences as far as the quantitative business anticipations are concerned and also reverted the skewness for experts' forecast.

The statistical consequence of the differences in the skewness is that the difference between the medians is somewhat smaller than that of the arithmetic means. Which of them is more important from the economic point of view depends on the loss resulting from errors in expectations: if the loss increases with the absolute error, the median is to be preferred; if the function is quadratic the mean is the better representation (see e.g. [38]). Pessimism tendency however can be demonstrated by either of them.

Table 14

The Skewness of Expectations and Reality

	Skewness[1]			
	Up to recession 1974		Inclusive of recession	
	actuals	expectations	actuals	expectations
Business surveys	0,93	0,69	0,20	0,25
quantitative	1,06	0,51	0,52	0,35
qualitative	0,62	1,10	– 0,54	0,02
Consumer surveys	– 0,66	1,49	– 1,00	0,26
Experts	0,27	0,02	– 0,31	– 0,33
All data	0,59	0,53	– 0,07	0,06

1) Skewness $= \frac{1}{n} \cdot \frac{\Sigma (X_i - \bar{X})^3}{s^3}$

4. Conclusions

1. Despite the commonly traded assertion that expectations are not measurable (see for example *Rutledge* [78]), there exists a great variety of data on expectations, plans and forecasts made by experts. In the empirical part of this paper a standard set of 39 future series were used, reported or surveyed in Japan, the USA and Europe. Some of them are available for different distances to the target period.

2. Systematic differences between expectations and realizations exist for averages as well as for the variance. In contrast to earlier findings in literature future data are on the average too cautious (pessimism bias) and they smooth the actual development (smoothing bias), especially the cyclical amplitude (not the irregular one). This bias is symmetric around the average expected change (not around the zero level as the hypothesis on the "underestimation of changes" would make us believe). The extent of the pessimism bias as well as that of the smoothing bias amounts to one third of the

respective moment of actual change as far as quantitative business data are concerned (in case of availability of two series with different forecasting horizon we refer to the longer horizon). Forecasts made by experts show a relatively small pessimism bias, but the strongest smoothing tendency. Both biasses do not show up in surveys, where the questions are posed in a qualitative way.

3. These tendencies apply to so many variables generated by different survey methods that it seems unlikely that errors in measurement (representation, mistakes by the respondents, convenience and intentionally wrong answers) will play an important part in the explanation, though we find that the type of question posed (quantitative or qualitative) as well as distance of the target period does influence the results.

4. The hypotheses which are designed to explain primarily the smoothing bias can be grouped into those which stress the statistical or technical point of view (specification errors, incorrect ceteris paribus assumption, uncertainty hypothesis) and those emphasizing the psychological behavioristic factors (forgetting hypothesis, underestimation of cumulative forces, specific regressivity, and aggregation hypothesis). This classification is not water-tight however, because the question if and why the assumptions of the statistical hypotheses are fulfilled depends on economic or psychological reasons.

5. The smoothing bias, for example, is a statistical implication of a model in which realizations depend on the expectation plus an error term which is independent of the expectational series. Running the opposite regression (expectations on realizations) yields the well known regression bias. But whether the model assumed is valid, depends on economic forces and may be tested empirically. As regards the "Incorrect-Ceteris-Paribus-Hypothesis" statistics can demonstrate the implications of the incorrect assumption, but the question which variables are erroneously assumed to be constant, leads into the economic field again. Uncertainty gives rise to the probability and even the optimality of the smoothing property, economic or psychological reasons decide in which situations and concerning which variables uncertainty is greater.

6. The hypotheses in the second group refer to or know about fundamental economic or psychological laws. Imperfect memory, regressivity of behavior in critical situations as well as the "Gambler's fallacy" are wellknown in psychology, underevaluation of cumulative forces and overevaluation of the unique character of specific developments are known from experience.

7. Empirical investigations seem to favor the second group of hypotheses: the direction of causality necessary to unmask the smoothing property as a specification error is not valid unambigously, though the regression of expectations on realization is a weak test for the existence of the smoothing bias. The reverse regression on the other hand is too strong a criterion, the symmetric treatment of expectations and realization cannot be

a priori rejected. Therefore the smoothing tendency is not a result of a specification error, but well established as economic behavoir. The smoothing property can not be regarded as a property of optimal forecasting (e.g. in an optimal forecast the errors should not be autocorrelated), but its degree varies with the extent of uncertainty. Some implications of the "Incorrect-Ceteris-Paribus-Hypothesis" are revealed by the empirical data. "Forgetting" of past changes can be demonstrated by means of survey data, regressivity is found in many investigations. There are several indications underlining the plausibility of the "underestimation of cumulative processes" and the neglect of the constant term in individual forecasting.

8. The pessimism bias would be explained if we modified some of the above mentioned hypotheses (the level of a variable is assumed to be zero on average, development fades in memory, etc.), but the best explanation seems to be the assumption of an asymmetric loss function with a greater weight of negative surprises. Business economics suggest unsymmetric loss functions, macroeconomic forecasting experience intensifies this assumption. A special survey on the importance of the direction of errors as well as on the structure of the errors between the different variables in a macroeconomic forecast provides additional empirical material.

9. The difference between expectations and realizations is especially large in case of big increases of the variables. Therefore at least up to the last recession the actual data were skewed to the right to a larger extent than expectations. Together with the fact that the pessimism property is not valid for qualitative data, the conclusion may be drawn that differences between large and very large increases may not be very important for the forecasters, because decisions for the next period would not differ very much.

5. Notes

(1) The comparison of means and variances between expectations and realizations as well as the investigation of the autoregressive structure of the error term contain implications important for the REH. A forthcoming paper by this author will discuss the question under which circumstances and qualifications these results contradict the REH and how they are related to more favourable empirical results found in other papers [11, 24, 51, 78, 79, 80].

(2) It is interesting to note the *Keynes* [47, p. 150] supposed profit opportunities would be usually overrated.

(3) *Hirsch* and *Lovell* [38] do not find a significant difference between the averages of expectations and realizations of sales. *Foss* [29] as well as *Hirsch* and *Lovell* calculate that inventory anticipations are too low on average.

(4) The literature [19, 59, 88] labelled a brother in law of the smoothing tendency as "underestimation of change" (see chapter 2.2).

(5) The break-even point between optimistic and pessimistic expectations (change in the sign of the error term) lies between + 2 per cent and + 3 per cent for the Japanese production anticipations, as well as for US and Japanese sales forecasts, *Livingston's CPI* forecast changes the direction of the error between + 1/2 per cent and + 1 1/2 per cent.

(6) Another test of the significance would be, whether the number of variables in which the tendencies are shown could be derived by chance. According to a binomial distribution the probability to get 29 times a lower mean for expectational data than for actual is 0,0012, the probability to get 36 favourable results (as we did calculate for the smoothing bias) is even less (0,000001). The assumptions of the binomial distribution, however, cannot be assumed to be fulfilled strictly, because the variables are not independent. We did construct a stronger test insofar as we assumed, that there is no independence between the variables conducted in the same survey (e.g. Survey of the Bank of Japan) but that independence is given only for the variables stemming from different agencies. The individual moments of the variables for the same agencies were averaged and tested again: the probabilities for the result were 0,06 for the pessimism bias and 0,006 for the smoothing bias.

(7) *Keynes* [47, p. 51] "producer forecasts are more often gradually modified in the light of result, than in anticipation of prospective changes".

(8) *Keynes* [47, p. 51] "are liable to sudden revisions . . . cannot be approximately eliminated or replaced by realized results".

(9) The calculations were carried out by regression analysis (not by the way of spectral analysis). No individual ARIMA-whitening was done.

(10) The significance is tested for the individual regression coefficients. Coefficients of determination do not differ significantly.

(11) In the case of US sales expectations only at the 90 per cent level.

(12) Of course the specification error hypothesis does not contend to explain the pessimism tendency.

(13) *Hatanaka* [36] demonstrates that all components of an expectational series will be dampened, if the realized values are generated by concurrent and past stochastic determinants, while the expected value is generated only by the past ones. If however a deterministic variable is introduced, the variance of the expectations degenerates only to the variance of the deterministic variable and it is not evident that the smaller variance is true for all components of an expectational series.

(14) The regression of the trend deviation of capacity utilization as reported retrospective on the same variable as reported in the current year yields the following result

$$^{t-1}cap_t = \underset{18.305}{0{,}003} + \underset{30}{0{,}62}\ ^{t}cap_t \qquad R^2 = 0{,}62$$

(15) *Brimer* [17] emphasizes this point.

(16) The regressivity of the actual changes of production in Austrian manufacturing is shown in [4].

(17) The econometric testing is blurred by well known problems. The extent of the bias introduced by the fact that investment influences demand in reverse, should be somewhat less important since here manufacturing investment is related to total demand (investment in manufacturing constitutes less than 10 per cent of GNP, moreover half of the equipment is imported).

The following equations were estimated:

$$I^{man} = \underset{51}{12{,}07} + \underset{28}{2{,}189}\, VA \qquad R^2 = 0{,}54 \qquad D.W. = 1{,}08$$

$$I^{man} = -\underset{67}{15{,}25} + \underset{47}{2{,}2671}\, VA^{corr} \qquad R^2 = 0{,}38 \qquad D.W. = 0{,}98$$

$$IA^{man} = \underset{680}{0{,}917} + \underset{77}{0{,}794}\, VA \qquad R^2 = 0{,}16 \qquad D.W. = 1{,}33$$

$$IA^{man} = \underset{183}{5{,}99} + \underset{56}{1{,}542}\, VA^{corr} \qquad R^2 = 0{,}26 \qquad D.W. = 1{,}47$$

$$IA^{man} - IA^{man} = \underset{27}{157{,}6} + \underset{27}{0{,}610}\,(I_t - I_{t-1}) \qquad R^2 = 0{,}58 \qquad D.W. = 0{,}91$$

VA^{corr} ... GNP less investment change (Austria)

IA^{man} ... Investment anticipation in Austrian manufacturing

I^{man} ... Actual investment in Austrian manufacturing

I ... Actual investment, total (Austria).

(18) *Hirsch* and *Lovell* [38] refer to a possible asymmetry in footnote p. 73, *Carlson* [20] allows for different accuracy of price expectations in situations below respective above equilibrium.

(19) Among the measures of the average the choice of the arithmetic mean depends on an quadratic loss function, as discussed in the next chapter.

(20) Asymmetric loss functions and certainty equivalence seem to be similar at first glance. The certainly equivalent, however, compares situations with different degrees of uncertainty, the asymmetric loss function refers to the cost of different signs of error in a situation with the same degree of uncertainty.

(21) This is true by definition for the period under consideration. As far as the following period is concerned, production has to be increased in case of rising demand. If demand declines, however, there are even lower cost in the next period, because the decline in demand induces less reduction in production now as compared to a higher production volume in period one. This indicates once more, that a positive surprise is especially cheap, if it happens at a cyclical peak.

(22) Especially in case of white collar workers it is not usual to assume that changing amounts of labour will be fully reflected in the wage bill. Furthermore dismissals are usually more difficult and more expensive.

(23) As an alternative to the variation in the volumes (of stocks or production) the possibility of price changes exist. The results are somewhat more complicated for this alternative and depend on the price elasticity of demand as well as on the question of whether further demand will depend degatively on the variability of price changes. The survey on the importance of different strategies reported later on asserts the minor importance attributed to this strategy (last place in case of positive surprise, last but one in case of negative surprise). This corroborates with the assumption of modern contract theory that firms want to supply at constant prices as long as possible.

(24) The current argument is valid only for variables with a positive connotation. As far as price expectations are concerned we have either to argue that they have a positive connotation too (this is more likely for selling prices) or to look for other arguments (differences in reversibility or different probability of policy to act on different signs in the price forecast, see *Carlson* in a revised version of [21]).

(25) Following the lines of the theory of political economy, governments might be interested in cautious forecasts immediately after the election, but in optimistic forecast in pre-election time. This tendency cannot be verified for Austria: four out of five forecasts in pre-election time were too pessimistic.

(26) It may be argued that there is a self-destroying tendency of forecasts in case of high values for variables with an unfavourable connotation (because the government reacts promptly).

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