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Are entrepreneurs' forecasts of economic indicators biased?

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Insight into the investment behaviour of firms is central in understanding economic dynamics. A critical question, however, is whether firms provide sufficiently reliable data to enable them to make plausible forecasts at the meso (regional or sectoral) level. This paper analyses Dutch investment forecasts at different levels of aggregation. The central research question is whether entrepreneurs, individually or as a group, make systematic errors in their investment forecasts. A statistical test reveals that investment forecasts are not biased at the aggregated (regional and sectoral) level. At the micro level, however, there is a significant bias. Hence, using aggregated (regional and sectoral) data to test the lack of bias (unbiasedness) of forecasts may lead to the wrong conclusions. Moreover, aggregated investment forecasts may then be an inappropriate source for policy recommendations, despite their seemingly high reliability. This finding may in principle be valid for many European countries, since data collection on investment is organized in similar ways throughout Europe.

Keywords: entrepreneur; investment forecasts; economic policy.

1. Introduction

Forecasts play a vital role in economics. They offer a picture of an uncertain future and are instrumental in taking decisions in both the private and public sectors. For governments at both the national and regional level information on the Gross Domestic Product (GDP) is crucial. The most volatile component of GDP is investment (van der Ende and Nijkamp 1995). Hence, the accuracy of GDP forecasts often depends critically on the quality of investment forecasts. Surveys on investment plans both in Europe and the USA are widely used as an indicator of future levels of investment activity. Inaccurate investment forecasts may be an important source of inaccuracy in the overall GDP forecasts and may also lead to a bias in governmental decisions. The availability of reliable investment forecasts is not only relevant for macro-economic policy, but even more so at the meso level of regional planning. The policy regarding industrial sites in a given region, the planned capacity in the retail sector, the (public) investments in R&D and training as well as infrastructure (including ICT) are critically dependent on the growth of GDP in the region at hand (Bryson *et al*. 1999). Therefore, aggregate regional information on investment plans of firms in the region is essential. The same applies of course at the sectoral level.

This paper aims to contribute to the debate on reliability of investment forecasts by concentrating on the aggregation issue, that is by examining forecast errors at

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different levels of aggregation, both regionally and sectorally. In particular, attention is focused on the reliability of investment plans as forecasted and reported by Dutch firms. To this end, the authors will test empirical investment data on unbiasedness, which is a necessary condition for rational decision making, *at different levels of aggregation* (macro, meso and micro). Another relevant feature of investment data from the Netherlands is that the forecasted level in a given year is made in that same year (in the autumn). It is worth mentioning that the nature of such investment data is similar to the type of investment forecast data collected and used in many other countries throughout Europe.

Rational economic behaviour depends upon reliable information. It is a fairly common result and noteworthy in the literature that the rationality hypothesis is often rejected (Keane and Runkle 1990). However, as Keane and Runkle argue, this result can just as much be attributed to the researcher as to the forecaster. Many studies appear to use aggregate data, thereby ignoring the fact that systematic individual biases may be randomly distributed in the population. Keane and Runkle refer to, for example, Muth (1985), who studied the anticipated production for Pittsburgh steel firms, and found that some firms were consistently optimistic and others were consistently pessimistic, while the average expectations showed no bias. Gorter *et al.* (1996) – using Dutch data at the individual level – found evidence that firms can be consistently optimistic or pessimistic in regard to employment expectations. Moreover, aggregate data tend to ignore the fact that individual forecasts are conditional on individual data sets; the mean of individual forecasts is, in general, not an expectation conditional on any information set.

Furthermore, Keane and Runkle (1990) question the reliability of survey data to test economic indicators. They argue that forecasts are often made by non-professional forecasters who may have little incentive to report accurate forecasts. Against this background, it is interesting and noteworthy that Ehrbeck (1992) uses a data set in which the names of the forecasters are known. Therefore, they might have an incentive to do 'as well as possible'. Nevertheless, the rationality hypothesis is rejected in this study.

It should be added at this stage that, in general, investment predictions appear to fluctuate over the year. As the year passes by, more information becomes available. Is this information flow relevant? A simple illustration may suffice. Den Butter (1991) summarizes different forecasts for the growth rate of the volume of investments in the Netherlands for the year 1991 (table 1).

In table 1 it can be seen that different institutes provide rather different forecasts. The Dutch CPB's (Netherlands Bureau for Economic Policy Analysis) forecasts are rather stable over a 5-month period, but other forecasts differ quite substantially. The

Table 1. Forecasts of growth rate of investment volume in the Netherlands for (1991a)

Institute:	CPB, EB	CPB, MEV	CPB, CEP	GRECON	CESAM	OECD
Date	April 1990	Sept 1990	April 1990	Nov 1990	April 1990	Dec 1990
Forecast (%)	3.75	3.5	3.5	7.3	1.69	-0.8

Source: Den Butter, 1991.

EB: Economic Prospects, MEU: Macro Economic Outlook, CEP: Central Economic Plan, GRECON and CESAM are macro economic models developed at Groningen University.

most recent forecast appears to be the most pessimistic. This observation illustrates the volatility of investment figures.

The central aim of the present paper is to investigate whether firms, individually or collectively, – for example, at a regional or sectoral level – offer information on investment plans that is systematically biased. In the present study, the authors distinguish between small and large firms, where the distinction is set, rather arbitrarily, at 50 employees (in accordance with the classification used by the VVK (Vereniging van Kamers van Koophandel en Fabrieken in Nederland (Dutch Chambers of Commerce))(1994)), which provided the data for this analysis. The reason for this distinction is that one may plausibly assume that large firms have more – sometimes hired – expertise to make accurate investment forecasts (Vosselman 1989). This will be investigated in the empirical analysis too.

The paper is structured as follows. In section 2 the statistical test on biasedness will be explained and the data used in the analyses are described in section 3. Section 4 contains empirical results and in section 5 these are reflected upon in the context of trend analysis. Finally, some conclusions are presented in section 6.

2. A statistical test on unbiasedness

When comparing predicted values with realized values of a given variable we say that an expectation is rational in Muth's sense if 'they are equal to the true mathematical expectation conditioned on all relevant information known at the time forecasts were made' (Evans and Gulamani 1984). Simply put, an expectation is labelled as rational if *all* available information has been used in an optimal manner. Testing the rationality hypothesis (the *full rationality* hypothesis) is, however, very difficult, not to say impossible. One would need to know exactly what information was used by the firm in preparing the forecast, and how it was used. It is unlikely that all this information is available to the researcher. If the researcher knows the forecasts and the realized values, it is possible to test if the forecasts are biased. If the forecasts are biased, firms make systematic prediction errors. Moreover, if forecasts are biased, they cannot be rational in Muth's sense (unbiasedness is a weaker form of rationality; unbiased forecasts can be but are not necessarily fully rational, whereas biased forecasts are definitely not rational (Brown and Maital 1981).

In this section a statistical model is introduced to investigate whether the forecasts of a particular economic indicator (Y) are biased. The starting point of the analysis is the following equation:

$$Y_t^{\mathrm{real}} = Y_t^{\mathrm{pred}} + R_\epsilon \qquad (1)$$

where R_t is defined as the 'forecast' error, whereas Y_t^{real} is used for the *ex-post* realized value of Y in the year t (i.e. the level of Y reported in the survey one period later) and Y_t^{pred} is used for the predicted level of Y_t as reported in the survey held *during* the year t (i.e. measured before the end of the year).

The reason why R_t may be interpreted as a forecast error stems from the fact that entrepreneurs have to predict what they will do in the last part of the year concerned (assuming that the variable of interest (Y) in the first part of the year is largely known). This seems to be a reasonable approach, as during in the course of a given year most firms obtain fairly substantial evidence on the available budgetary space for new investments in that year.

Next, it is postulated – in line with the approach followed by Brown and Maital (1981) – that Y_t^{pred} is an unbiased estimate of Y_t^{real}, if

$$Y_t^{\text{pred}} = E(Y_t^{\text{real}} \mid Y_t^{\text{pred}}) \tag{2}$$

and the following linear regression equation can be used to test for unbiasedness:

$$Y_t^{\text{real}} = \alpha + \beta \cdot Y_t^{\text{pred}} + \mu_t \tag{3}$$

This equation will satisfy simultaneously $\alpha = 0$, $\beta = 1$, and $E(\mu \mid Y_t^{\text{pred}}) = 0$, if Y_t^{pred} is indeed unbiased. If a regression analysis of this equation[1] leads to a rejection of the joint hypothesis ($\alpha = 0, \beta = 0$), the hypothesis of unbiasedness is rejected (i.e. systematic errors are made in the predictions[2]).

Brown and Maital (1981) discuss a problem that is inherent in equation (3): the values of μ_t are likely to be serially correlated because one cannot rule out the possibility that the unknown future forecast errors are correlated (they show that the disturbance term μ_t is serially correlated of a moving average-type). This problem may occur when at the moment of prediction for a period ahead not all realized values in this period are yet known. So, for example, an annual prediction is made for the next year, while the forecast error for the current year is not yet known. In this case, one has to adjust the error process into a moving average process because the assumption of identically independent distributed (i.i.d.) error terms cannot be maintained. The error structure would then read as follows:

$$\mu_t = \varepsilon_t + \rho \cdot \varepsilon_{t-1} \tag{4}$$

However, one deals with a predicted level of Y in the current year and therefore the only relevant error that can play a role is the error of the current year (the error made last year is, of course, already known). In conclusion, one may assume i.i.d.-error terms over time in this model, and one can simply test the hypothesis of unbiasedness ($\alpha = 0, \beta = 0$) by means of an F-test. Nevertheless, a check will be made of whether the assumption of i.i.d.-error terms is valid by means of a test for autocorrelation.

There might of course also be a case of sectoral correlation, as entrepreneurs' forecasts may be biased by common information used (e.g. a favourable sectoral economic perspective). In that case one would have to test for sectoral autocorrelation among firms in the same area.

The test on unbiasedness of Y_t^{pred} is carried out at different levels of aggregation, namely the macro, meso and micro levels. At the aggregated (macro, meso) level, the variation of R_t over time is used in order to perform the test introduced above, whereas at the individual (micro) level the cross-sectional variation of R_t is used to determine the degree of mis-estimation of the predicted value (Y_t^{pred}). In this case, one obtains (adding a subscript i to identify firms):

$$Y_{i,t}^{\text{real}} = \alpha + \beta \cdot Y_{i,t}^{\text{pred}} + \mu_{i,t} \tag{5}$$

Therefore, in the analysis equations (3) and (5) will be estimated by using aggregated and micro data on a particular economic indicator obtained from Dutch entrepreneurs, namely the expected investment level. Before doing so, this data set is described in more detail.

3. The data set

3.1 Introduction to the database

For an empirical application of the method described in section 2, the so-called 'ERBO-data' (Enquête Regionale Bedrijfsontwikkeling) is used. This is a survey among Dutch firms organized by the Dutch Chambers of Commerce. This survey is both retrospective (i.e. realized output) and prospective (i.e. expected output) regarding the individual performance of firms. The survey is held annually in the months of September to November and – apart from one discretionary question which every Chamber is free to add – the survey is uniform all over the country. The results of the survey are presented annually in December (VVK 1994).

In principle, each Dutch firm employing at least 50 employees is surveyed, while from the smaller firms about 50% are requested to complete the ERBO survey. The response rate is usually fairly high (on average more than 70%), as it is also in the interest of entrepreneurs to co-operate in this nation-wide survey.

In our application to investment figures, the authors use aggregate (cross-sectional) data on the population of firms (based on a stratified sample) for the Netherlands as a whole and micro (panel) data obtained from three regions (Amsterdam, Utrecht and Den Bosch). The selection of these three regions was based on the simple idea that there might be systematic differences in the responses of firms in central economic areas (e.g. Amsterdam), intermediate areas (e.g. Utrecht) and peripheral areas (e.g. Den Bosch). The panel data can be used in two ways: (1) to obtain aggregate figures on predicted and realized investments in a particular year for a group of firms (by simply summing up the investments of the firms belonging to this particular group (region, sector, etc.), and (2) to obtain firm data on predicted and (*ex post*) realized investments for a particular year.[3] This double use of the same data makes it possible to analyse the aggregation issue.

The time period considered in this study is 1985–1994, although for the region of Den Bosch data is not available for the first year (1985). Overall this period may be considered as a period with relatively stable economic development, with a stable growth pattern and a low inflation rate. As a consequence, it is unlikely that differences in predicted and *ex post* realized investment levels are the result of unexpected economic shocks.

In the survey the following questions on investments of firms were asked and the results were used in the present study:

- the *ex-post* realized investments in the previous year (INV_t^{real}), reported in the survey of year $t+1$;
- the predicted level of investments in the current year (INV_t^{pred}), reported *during* the year t.

In the next section these two variables are used to analyse whether there is a systematic bias in the expectations of firms. First, in this section, the authors present statistics at the macro (national) level and meso (regional and sectoral) level, and finally they show the (average) outcomes at the micro (individual) level. Before the outcomes are discussed, it is essential to re-emphasize that the data at the national (macro) level are obtained by combining the subsequent surveys (and exploiting the retrospective information, that is, the realization of last year as reported in the current year). In other words, at the macro level the authors make use of repeated cross-

Table 2. Regional mean and standard deviation of the prediction error of investments.†

	Amsterdam	*Den Bosch*	*Utrecht*	*Netherlands*
Small	6774.56	1794.25	17908.78	1907.11
	(11658.53)	(15979.82)	(37597.48)	(1033.41)
Large	−14333.44	3410.00	74560.11	1287.33
	(87592.01)	(35401.15)	(142382.51)	(2009.02)

† Standard deviations in parentheses. Small companies have less than 50 employees. Means are calculated over the years 1985–1993, except for Den Bosch, for which the mean was calculated over the years 1986–1993.

sectional data based on different (stratified) samples from which estimates for the total investments (of all firms) in the Netherlands can be obtained. In contrast, the meso and micro data on INV_t^{pred} and INV_t^{real} are constructed by pooling the current and next year's surveys for each year. In other words, the authors first match the firms present in the current year with those in the next year, while they next compare INV_t^{pred} and INV_t^{real} for the same group of firms (for example, within the same region or the same sector) or for each individual firm separately (i.e. one makes use of the panel structure of the data) to compute firm-specific forecast errors in each year.

3.2 The macro level (based on repeated cross-sectional data) and meso level (based on panel data)

In table 2 the mean and standard deviation of the prediction error of investments are given in Dutch guilders for the three regions and for the Netherlands as a whole.

The results at the regional level lead to interesting conclusions. From these mean values there seems to be an underestimation of the investment level by both small and large firms in all three regions. The standard deviations are of such a scale that one cannot conclude that there are significant differences between the regions. Note that at the national level, the prediction errors and the standard deviations are much smaller; at a more aggregated level firms appear, on average, to make better predictions.

Next, the sectoral means and standard deviations are given in table 3 in Dutch guilders. In most cases, firms underestimate their level of investments. Again, due to the large standard deviations, one does not find that, on average, there are differences in the predictive capabilities of firms in different sectors.

3.3 The micro level (based on panel data)

Table 4 shows the mean values (in thousands of Dutch guilders) and the standard deviations for the forecast error of the investments at the individual (micro) level (realization minus expectation, R_i). It appears that (apart from 1993) the realization is always higher than the expectation, again indicating an underestimation of the current investments. On the other hand, the standard deviations are extremely high. There are however some outliers, extremely high expectations (realizations) with low realizations (expectations).

Table 3. Sectoral mean and standard deviation of the prediction error of investments.†

	Industry	*Services*	*Agriculture*	*Retail*	*Wholesale*	*Construction*
Small	6762.56	12232.33	2137.67	1428.56	−1204.78	4097.33
	(6076.58)	(43136.64)	(4263.09)	(6763.83)	(5986.37)	(9821.78)
Large	−1222.78	2102.78	1326.78	−4770.22	67198.33	3424.56
	(67418.68)	(85484.78)	(2797.96)	(19611.42)	(165219.68)	(13297.36)

† Standard deviations in parentheses. Small companies have less than 50 employees. Means are calculated over the years 1985-1993.

Table 4. Mean and standard deviation of the prediction error of investments.†

	1986	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*
Prediction error	2.60	32.88	5.30	28.65	8.35	5.53	−10.72	82.03
	(2016)	(1776)	(2397)	(2663)	(1733)	(1351)	(1700)	(8382)
Observations	2564	3341	3403	3685	4217	4792	3962	3667

† Standard deviations in parentheses. The mean values are influenced by economic development, sample size and the composition of the sample (with respect to sectors), so they cannot be seen as longitudinal series.

It may be concluded that on average $\mathrm{INV}_t^{\mathrm{pred}}$ includes a deviation at the aggregated (macro and meso) level. At the macro level, investments appear to be underestimated in each year, and this same phenomenon usually shows up at the meso level as well. The mean level of the forecast error at the individual level (in each year) is also negative, but the deviation from zero is far from significant. In summary, the data on predicted investments seem to deviate from their realized counterparts. The question then arises whether or not entrepreneurs (or groups of entrepreneurs) make *systematic* errors in their investment forecasts. This issue will be dealt with in the next section.

4. Further empirical investigation

The data described in the previous section will be used to apply the statistical model introduced in section 2 to investigate whether there is a systematic error in the investment figures at the distinct levels of aggregation. The following linear regression model is estimated

$$\mathrm{INV}_t^{\mathrm{real}} = \alpha + \beta \cdot \mathrm{INV}_t^{\mathrm{pred}} + \mu_t \tag{6}$$

by using repeated cross-sectional data on investments (INV_t) at the macro level and (aggregated) panel data at the meso (total investments INV_t in region r or sector s) and micro level ($\mathrm{INV}_{i,t}$). The empirical results of this model at the national level are presented in table 5.

It appears that at the macro level there is a significant biased estimation of the investment level of Dutch firms. The joint hypotheses ($\alpha = 0, \beta = 1$) are rejected for the total estimation and also for the estimation results of small firms. For large firms,

Table 5. Estimation results for investments at the aggregate level.†

	Small	*Large*	*Total*
α	5126.3	7592.9	12506.4
	(2085.5)*	(3412.4)*	(3724.27)*
β	0.79	0.67	0.73
	(0.13)	(0.18)*	(0.11)*
R^2	0.81	0.63	0.85
n	9	9	9
Var(μ_t)	0.09E+ 7	0.31E+ 7	0.31E+ 7
LM(SC)	0.40	1.12	1.66
F	19.44*	4.18	17.04*

† Standard errors in parentheses.
* Significant at 5%, we test $\alpha = 0$ and $\beta = 1$. F is a test with the joint hypotheses $\alpha = 0$, $\beta = 1$. LM(SC) is a Breusch/Godfrey-test for (first-order) autocorrelation with one degree of freedom.

however, the joint hypothesis is not rejected (at 5%), but it should be noticed that the separate hypotheses ($\alpha = 0$ or $\beta = 1$) are rejected. A striking finding at the macro level is that the model for total investments leads to a better fit than the separate models for small and large firms (as can be seen from the fact that the sum of the var(μ_t) for the separate models is larger than the var(μ_t) of the total model). Finally, it is observed that the disturbances are not serially correlated, which is consistent with the expectation beforehand. This finding at the macro (national) level has, of course, consequences for the possibility of applying a trend analysis to this type of data (see e.g. section 5).

Next, the authors turn to the test on unbiasedness of investment figures at the meso (regional, sectoral) level by using panel data. In tables 6a and b, the outcomes of the regression analysis at the regional level are presented. These regional findings are noteworthy.

It appears that there is no significant bias in the (total) investment level at this level (table 6). This conclusion holds both for the group of small and large firms (within a region) separately and for the total group of firms in the region. This may partly be due to the large fluctuations over time (as a result of outliers), as was shown in section 3, and partly a result of the smaller sample size (in comparison with the national level). Taking small and large firms together in a region usually does not improve the fit of the model (in terms of μ_t) with the exception of Utrecht, for which the fit of the total model is slightly better when compared with the two (separate) models for small and large firms.

The conclusion of unbiasedness is also valid for the sectoral decomposition (tables 7a, b and c). Again it appears that only in one sector (industry) the joint F-test is rejected in case of the models for small and large firms separately. Serial correlation is not detected in the sectoral models (as expected beforehand), with the exception of the large firms in Utrecht.

Hence, it may be concluded that when meso (panel) data is used, there appears to be no significant bias in almost all cases. In other words, at the meso (regional and sectoral) level, one cannot identify a systematic error in the reported forecast of investments ($\mathrm{INV}^{\mathrm{pred}}$). The important research question now arises whether this is also true for the individual firms in the regions (or sectors) analysed.

Table 6a. Estimation results for investments for Den Bosch and Utrecht.†

	Den Bosch			*Utrecht*		
	Small	*Large*	*Total*	*Small*	*Large*	*Total*
α	23 254.7	−6 590.8	−14 220.7	43 844.7	−65 143.9	9 137.8
	(18 009.4)	(92 568.1)	(108 106.0)	(27 990.7)	(138 209.0)	(144 559.0)
β	0.75	1.02	1.03	0.75	1.29	1.14
	(0.20)	(0.14)	(0.14)	(0.24)	(0.27)	(0.23)
R^2	0.65	0.88	0.88	0.53	0.73	0.74
n	8	8	8	9	9	9
Var(μ_t)	0.23E+9	0.15E+10	0.19E+10	0.14E+10	0.20E+11	0.21E+11
LM(SC)	0.11	0.04	0.80	0.37	4.47*	0.53
F	0.82	0.03	0.05	1.57	1.84	2.04

† Standard error in parentheses.
* Significant at 5%, test $\alpha = 0$ and $\beta = 1$. F is a test with the joint hypotheses $\alpha = 0$, $\beta = 1$. LM(SC) is a Breusch/Godfrey test for (first order) autocorrelation with one degree of freedom.

Table 6b. Estimation results for investments for Amsterdam.†

	Small	*Large*	*Total*
α	9 013.4	72 246.4	111 179.0
	(13 407.9)	(140 684.0)	(142 399.0)
β	0.97	0.92	0.88
	(0.18)	(0.19)	(0.18)
R^2	0.77	0.73	0.75
n	9	9	9
Var(μ_t)	0.15E+9	0.86E+10	0.86E+10
LM(SC)	0.28	0.02	0.06
F	1.36	0.19	0.44

† Standard errors in parentheses. F is a test with the joint hypotheses $\alpha = 0$, $\beta = 1$. LM(SC) is a Breusch/Godfrey test for (first order) autocorrelation with one degree of freedom.

As a consequence, the issue of biased or unbiased investment forecasts is addressed at the firm (micro) level. The authors first estimated equation (6) for *all* individual companies.[4] They have also tested for heteroscedasticity (and in the case of the longitudinal data also for autocorrelation). It appears that the size of the company (measured by the number of employees) certainly causes heteroscedasticity. In most cases there are no specific regional or sectoral influences. Therefore equation (6) was estimated for small and large (more than 50 employees) firms separately (tables 8a and b).

Both the separate hypotheses ($\alpha = 0$ and $\beta = 1$) and the joint hypotheses ($\alpha = 0$, $\beta = 1$) are rejected in all cases. In most cases α is significantly larger than 0, while β is significantly smaller than 1. So on the basis of the t-tests and F-tests presented in the above tables (and the LM(H) test in table 8),[5] one may conclude that the individual expectations on investments are biased. This conclusion holds both for small and large firms, and hence it is not found that large firms 'do a better job' in forecasting their investment levels.

There are several possibilities for explaining this bias at the level of the individual firm. First, the persons responsible for the answers given in the survey might simply

Table 7a. Estimation results for investments for the industry and services sectors.†

	Industry			*Services*		
	Small	*Large*	*Total*	*Small*	*Large*	*Total*
α	11 901.7	193 368.0	199 966.0	46 345.3	115 385.0	149 047.0
	(7 725.6)	(65 314.3)*	(69 982.2)*	(34 769.7)	(54 329.8)*	(64 720.7)*
β	0.93	0.72	0.75	0.65	0.84	0.83
	(0.10)	(0.09)*	(0.09)*	(0.32)	(0.07)*	(0.07)*
R^2	0.91	0.89	0.90	0.28	0.95	0.94
n	9	9	9	9	9	9
Var(μ_t)	0.40E+8	0.22E+10	0.25E+10	0.18E+10	0.48E+10	0.61E+10
LM(SC)	0.20	0.09	0.13	0.22	0.05	0.07
F	5.43*	4.72*	4.14	0.73	2.65	2.74

† Standard error in parentheses.
* Significant at 5%, test $\alpha = 0$ and $\beta = 1$. F is a test with the joint hypotheses $\alpha = 0$, $\beta = 1$. LM(SC) is a Breusch/Godfrey test for (first order) autocorrelation with one degree of freedom.

Table 7b. Estimation results for investments for the agriculture and retailing sectors.†

	Agriculture			*Retailing*		
	Small	*Large*	*Total*	*Small*	*Large*	*Total*
α	2647.9	2894.7	4752.5	5062.9	17149.6	18539.8
	(3591.8)	(2744.5)	(3917.0)	(4651.5)	(12708.5)	(14505.0)
β	0.97	0.90	0.96	0.85	0.59	0.72
	(0.17)	(0.16)	(0.10)	(0.16)	(0.21)	(0.17)
R^2	0.80	0.79	0.91	0.77	0.45	0.69
n	9	9	9	9	9	9
Var(μ_t)	0.21E+8	0.85E+7	0.19E+8	0.47E+8	0.28E+9	0.36E+9
LM(SC)	0.01	0.40	0.19	0.04	0.08	0.11
F	1.01	1.12	2.97	0.60	2.21	1.54

† Standard errors are in parentheses. F is a test with the joint hypotheses $\alpha = 0$, $\beta = 1$. LM(SC) is a Breusch/Godfrey test for (first order) autocorrelation with one degree of freedom.

Table 7c. Estimation results for investments for the construction and wholesale sectors.†

	Construction			*Wholesale*		
	Small	*Large*	*Total*	*Small*	*Large*	*Total*
α	1526.2	18494.8	18517.7	1549.8	78779.3	112166.0
	(5077.5)	(16937.3)	(17377.7)	(4544.8)	(193106.0)	(192481.0)
β	1.27	0.74	0.84	0.90	0.95	0.84
	(0.40)	(0.28)	(0.25)	(0.14)	(0.72)	(0.65)
R^2	0.53	0.43	0.57	0.83	0.08	0.08
n	9	9	9	9	9	9
Var(μ_t)	0.10E+9	0.18E+9	0.21E+9	0.38E+8	0.31E+11	0.31E+11
LM(SC)	3.92	0.36	3.17	0.29	0.02	0.29
F	0.96	0.72	1.43	0.40	0.66	0.66

† Standard errors are in parentheses. F is a test with the joint hypotheses $\alpha = 0$, $\beta = 1$. LM(SC) is a Breusch/Godfrey test for (first order) autocorrelation with one degree of freedom.

Table 8a. Estimation results for investments in small companies.†

	1986	1987	1988	1989	1990	1991	1992	1993
α	117.83	53.14	154.71	120.14	19.59	52.92	10.22	50.42
	(15.85)*	(6.42)*	(39.79)*	(30.14)*	(12.36)	(12.95)*	(8.62)	(9.83)*
β	0.29	0.84	0.23	0.47	1.03	0.72	0.95	0.62
	(0.01)*	(0.01)*	(0.05)*	(0.05)*	(0.01)*	(0.01)*	(0.01)*	(0.01)*
R^2	0.19	0.70	0.01	0.03	0.82	0.42	0.83	0.73
n	2032	2784	2826	3042	3546	4130	3383	3072
LM(H)	15.64**	14.74	3.70	5.39	4.87	8.54	9.36	18.68**
F	1426.24*	137.20*	102.78*	49.71*	10.29*	230.64*	20.79*	1639.98*

† Standard error in parentheses.
* Significant at 5%, ** significant at 1%, test $\alpha = 0$ and $\beta = 1$. LM(H) is a test for heteroscedasticity with sectoral differences as a possible cause. There are 5 degrees of freedom, chi-square$_5^{0.05} = 11.07$. F is a test with the joint hypotheses $\alpha = 0$, $\beta = 1$.

Table 8b. Estimation results for investments in large companies.†

	1986	1987	1988	1989	1990	1991	1992	1993
α	627.62	271.33	333.29	389.98	397.83	195.08	247.17	966.23
	(131.24)*	(187.98)	(105.20)*	(204.46)	(148.45)*	(117.29)	(175.20)	(866.83)
β	0.74	0.90	0.81	0.85	0.81	0.93	0.91	0.90
	(0.01)*	(0.03)*	(0.01)*	(0.02)*	(0.02)*	(0.01)*	(0.01)*	(0.05)*
R^2	0.86	0.70	0.94	0.79	0.76	0.87	0.90	0.38
n	532	557	577	643	671	662	579	595
LM(H)	6.44	5.34	10.32	10.32	8.54	6.62	3.68	6.38
F	197.12*	7.88*	248.84	36.15	62.39*	13.82*	29.59*	2.64**

† Standard error in parentheses.
* Significant at 5%, ** significant at 1%, test $\alpha = 0$ and $\beta = 1$. LM(H) is a test for heteroscedasticity with sectoral differences as a possible cause. There are 5 degrees of freedom, chi-square$_5^{0.05} = 11.07$. F is a test with the joint hypotheses $\alpha = 0$, $\beta = 1$.

not be able to produce accurate predictions due to permanent malfunctioning of information flows through the firm.[6] Second, they may give 'false' predictions as a form of strategy, but then one can wonder what would be the gain to the entrepreneurs. On the other hand, the systematic bias would support this idea to some extent. Third, there may simply be lack of interest by the person responsible for filling in the questionnaire.

In conclusion, it is found that the investment forecasts are biased at the level of the firm. When the individual forecasts are aggregated to the meso level, one does not find a systematic error over time. Thus, regional and sectoral forecasts are not biased. In other words, the aggregated, apparently *unbiased* investment forecasts at the meso level are – in fact – based on individual predictions that are not realiable (that is, biased in a statistical sense). Although the aggregate predictions appear to be a *seemingly* reliable policy instrument, there is a distinct possibility that it fails to capture the true investment behaviour of firms. If two groups of firms (regions, industries or large and small companies) have similar, unbiased aggregate investment predictions (as a whole), the individual predictions in one group may be characterized by large systematic positive forecast errors while the individual forecasts in the other region may be unbiased. Not only is it then misleading to compare the aggregate forecasts in both groups of firms, the unbiased aggregate forecast in one of the groups is only unbiased by chance; in the next period, the large forecast errors of entrepreneurs may no longer cancel out. It is not wise to base policy on such a forecast. Based upon the estimates in tables 8a and b it appears that $\alpha > 0$ and $\beta < 1$; an interpretation of this finding is that smaller firms are too optimistic in their forecasts and larger firms are too pessimistic in their forecasts. This investment behaviour of the larger firms can show ‘true pessimism’ (i.e. low confidence in the regional or national economy), but it could also show strategic behaviour by the larger firms; some investments may not be reported, either because these firms are aiming at government subsidies or because they simply have no interest in reporting these investments, knowing that they will have adequate funding anyway. In any case, national or regional economic policy based on aggregated data fails to capture such behaviour. The government then finances firms without recognizing the rent-seeking behaviour by the firms, or the government fails to see that some firms have low confidence in the economy.

The aggregation issue turns out to be an important factor in the debate on the reliability of the forecasts. Moreover, it may also have major consequences for the use of predictions for trend analysis. This topic will be further examined in the next section.

5. Investment developments and trend analysis

Basically there are two methods to use survey data, which consists of predicted values for the current year (e.g. on investments, but also exports and sales) for trend analysis. First, the realized level of the previous year may be compared to the ‘expectation’ for the current year. The advantage of this method is that the panel structure in the survey is used. It is clear that there is some uncertainty when the data from different surveys are combined (as will be done in the second method), because every year the figures have to be adjusted for non-response. As a result, the data are not entirely comparable to the results of the survey in the next year. On the other hand, the use of the panel structure also exhibits substantial problems when the predicted value of the current year is systematically underestimated. When this method is applied to the data on investments, for example, this leads to problems, since the result is a strongly declining trend in investments (figure 1). This is counter-intuitive because of the stable economic growth in the observed period and the contents of other published data (see, for example, Netherlands Central Bureau of Statistics [NCBS] sources as reported in Onderzoek voor Bedriff en Beleid [EIM] 1994). This also means that the so-called retrospective panel estimator may not be useful for measuring the development in the current year (relative to the previous year).

A second method may be to present the trend by using the *ex post* realized investments, which have been calculated by using the data from surveys in the subsequent years. By using this so-called repeated cross-section method to establish the investment development over time, one faces another problem, namely errors due to the changing composition of the sample over time. However, this method seems to be preferable for presenting long-term investment trends, since other sources also reveal that there is a clearly rising trend; this is also the case by applying this method (figure 1). The problem of the underestimated predicted value in trend analysis may thus be solved in a satisfactory way by applying the second method.

A problem of this method is, however, that an estimation has to be made for the current year on the basis of the data of the current survey. In this case, a forecast has

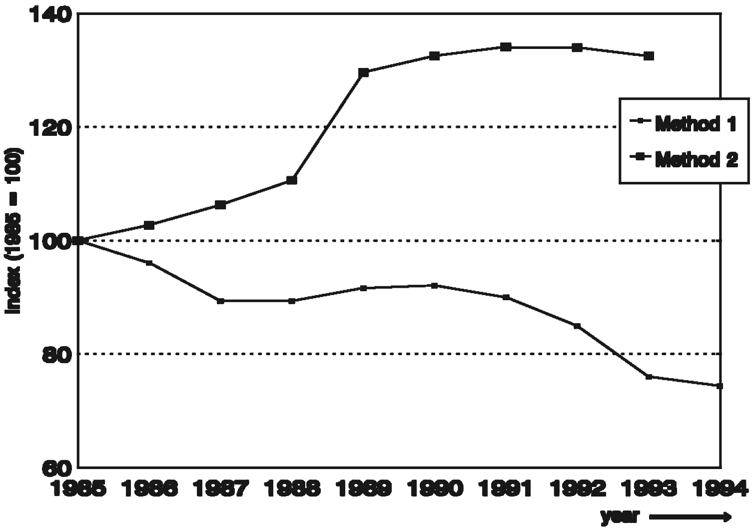

Figure 1. The two methods for presenting the trend in investment data. Method 1: the retrospective panel-estimator; and method 2: the repeated cross-section estimator.

to be made on the basis of the estimated parameters found at the aggregated level (tables 2, 3 and 4).

A relevant question is whether it is useful to disaggregate the correction procedure according to size. It appears to be not helpful to disaggregate the national data according to size. The standard deviation of the 'adjusted' forecast becomes much larger when the two models (for the small and large firms) are used separately; as a result the range in which the estimated level is found with 95% certainty is larger than when only the model for the total investments is used. This worsening of the accuracy of the (overall) investment forecast for the current year can also be understood when one recalls the finding that the model for total investments leads to a better fit than the separate models for small and large firms (i.e. the sum of the variances of the error term in the separate models is larger than the variance of the error term in the total model). Therefore, the 'best' and 'most precise' prediction of the 'true' investment level (at the macro level) for the current year is made when the model for total investments is used. Using the estimates of table 5, one finds an 'adjusted' forecast of total investments for the year 1994 of about 4% higher. The range in which the investment level will be found with 95% certainty is between [−14% and 22%] higher than that reported during the year.

6. Conclusions

This paper has focused on the reliability of investment forecasts by testing investment data on unbiasedness at different levels of aggregation. Analysis of predicted and realized investments in specific Dutch regions revealed that the forecasts are not biased at an aggregated (regional and sectoral) level. This result may be attributed to (1) the aggregation bias discussed by Keane and Runkle (1990), or (2) the large standard errors of the estimations (caused by fluctuations over time or outliers). When, however, this aggregated data set is analysed at the level of the individual firm, it is found that the investment forecasts of both small and large firms were clearly biased. Similar findings were reported by Avraham and Ungar (1987) and Dominguez (1986), who analysed exchange rate forecasts, and by Keane and Runkle (1990). As far as is known, studies on the reliability of investment forecasts are scarce.

The reasons for offering biased information on planned investments may be manifold, ranging from sheer ignorance to strategic response. Hence, one should be cautious in using aggregated data in tests on biasedness of forecasts (for example, to examine the hypothesis of rational firm behaviour). Moreover, seemingly unbiased aggregate investment forecasts are less useful for policy analysis than one would think at a first glance. This finding may in fact hold for many European countries, since the type of investment data collected and used is similar across nations.

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Notes

1. In this respect, it is also noteworthy that estimating the above-mentioned regression equation with Ordinary Least Square is equivalent to minimizing the squares of the stochastic error in the regression equation μ.
2. That is, the prediction is now equal to the mathematical expectation of the realization, conditional on the prediction.
3. An individual firm has an approximately 50% chance of being selected in two successive surveys (there is a response rate of about 70%; new firms emerge and other firms close down).
4. Results are available on request.
5. Just 2 out of 18 cases show signs of heteroscedasticity.
6. It is questionable whether this explanation is applicable for small firms since the person filling in the questionnaire might also be the owner of the firm.

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