Department of Applied Econometrics Working Papers

Working Paper No. 1-07

Testing rationality of price expectations on the basis of contingency tables

Emilia Tomczyk
Warsaw School of Economics

Testing rationality of price expectations
on the basis of contingency tables

Emilia Tomczyk

Warsaw School of Economics

Emilia.Tomczyk@sgh.waw.pl

Abstract

A method of analyzing rationality of expectations of economic agents, based on contingency tables, is applied to price expectations of Polish industrial enterprises. The source of data are surveys designed by the Economic Development Institute of the Warsaw School of Economics within the framework of business conditions surveys in industry. Empirical results clearly show that expectations of Polish entrepreneurs are not formed rationally. Rationality condition is confirmed in such a limited number of cases that it is not even feasible to differentiate between private and public enterprises as far as rationality of their expectations is concerned. Price expectations seem to be even more irrational than industrial production expectations analyzed earlier.

1.   Introduction

Expectations[1] of economic agents exert unquestionable influence on their decisions. Not surprisingly, analyses of properties of expectations formation processes often provide valuable insights for both explanation and prediction of economic behavior. In particular, expectations concerning price changes are believed to have substantial effect on decisions undertaken by economic agents.

This paper aims to formulate and verify the hypothesis that price expectations of Polish industrial enterprises are formed rationally. Empirical analysis is based on contingency tables summarizing firm-level data collected by the Research Institute of Economic Development of the Warsaw School of Economics through business tendency surveys.

As a tool of empirical analysis of rationality of expectations, Rational Expectations Hypothesis (REH) is used. J. F. Muth expressed it in the following way:

(...) expectations, since they are informed predictions of future events, are essentially the same as the predictions of the relevant economic theory. At the risk of confusing this purely descriptive hypothesis with a pronouncement as to what firms ought to do, we call such expectations 'rational.' [1961, s. 316]

Since the 1970-ties, enormous growth of interest in Muth's hypothesis has been documented in thousands of publications. A high point of this research program – which has since earned the name of Rational Expectations Revolution – was the Nobel Prize awarded in 1995 to R. E. Lucas in recognition of his work of applications of REH in macroeconomics.

Features of expectations formation processes – among them, their rationality – may be analyzed either directly or indirectly. Indirect studies of various hypotheses as to the way expectations are formed are based on cross-restrictions tests in simultaneous equations systems and therefore are dependent on structural relationship described by a model. Direct analysis of expectations formation processes consists of verifying if expectations observed in experiments or surveys meet certain requirements (among them, unbiasedness and

---

[1] Terms „expectations", „predictions" and „forecasts" are used interchangeably to denote beliefs of economic agents concerning future value of economic variables.

orthogonality of forecasts errors with respect to selected elements of the information set; see Tomczyk [2004 b]).

Results of tests performed so far proved to be inconclusive and highly dependent on time period considered, variables selected, methods of aggregation, forecast horizon, and other factors. Such sensitivity of results does not allow to safely extrapolate findings from U. S. and Western European studies to expectations formation processes of Polish entrepreneurs. Independent analysis seems therefore justified. Attempts to analyze rationality of expectations of Polish economic agents made to date (see Osińska [2000], Łyziak [2003], Tomczyk [2004 a], Tomczyk [2004 b]) did not lead to unequivocal results either.

Moreover, both indirect and direct methods of testing rationality of expectations require numerous additional assumptions. An attempt to assess rationality of expectations undertaken in this paper – based on contingency tables obtained in business tendency surveys – does not rely on such strong assumptions. In addition, it offers the advantage of being relatively simple in comparison to classical direct tests of REH, allowing to draw tentative conclusions before embarking on more time- and effort-consuming rationality analysis program.

2.   RIED business tendency surveys in industry

Measurement of expectations is plagued by numerous difficulties arising mainly from the fact that expectations, as such, are not directly observable. Data may be obtained either through observation of behavior of economic system, or through declarations of economic agents, considered unreliable by many economists. Dependability of expectations of survey respondents expressed as point forecasts is particularly often called into question. Therefore in many analyses of properties of processes of expectations formation, researchers purposefully avoid quantitative measurement of expectations; point forecasts are replaced with questions that require respondents to define predicted direction of change of an economic variable.

Data on expectations of Polish industrial enterprises have been systematically collected through business tendency surveys conducted by the Research Institute of Economic Development (RIED) at the Warsaw School of Economics. The surveys, launched in 1986 within the framework of centrally planned economy, have been

redesigned in 1991 to reflect system transformation and to conform to standards set in leading business survey research centers. Since then, continuing efforts to improve data collection procedures and ensure reliability of collected data resulted in establishing an unique database that encompasses data on current situation faced by Polish households and enterprises as well as their expectations for the future.

For the purpose of empirical analysis, expectations of manufacturing industry enterprises (in public and private sectors) have been selected. In monthly surveys of industrial enterprises, respondents evaluate changes in eight selected areas of economic activity (see Appendix 1) by assigning them to three categories: increase, decrease, or no change. Each survey question asks respondents to evaluate both current situation and expectations for the next 3 – 4 months. Raw data is therefore qualitative in nature. Aggregated survey results are regularly published and commented on in RIED bulletins: each month, a number of respondents is announced, along with a percentage of respondents who observed increase / no change / decline and who expect increase / no change / decline in a given area of economic activity.

Data collected through RIED questionnaires (on both expected and observed changes in prices) may be therefore classified into three categories. Let's introduce the following notation for question number 5: prices of goods manufactured by the enterprise.

1 – expected or observed increase in prices of goods manufactured by the company,

2 – expected or observed constant level of prices,

3 – expected or observed decrease in prices.

Imprecise formulation of the forecast horizon (3 – 4 months) requires taking both possibilities into account. 3-month forecasts ($h = 3$) will be therefore analyzed independently from 4-month forecasts ($h = 4$). Available data set spans the period from April 1997 until July 2006 (that is, 112 months) and presently cannot be enlarged because expectations are compared with changes observed after up to 4 months (that is, July 2006 expectations are evaluated against November 2006 realizations, which is the latest data point currently available).

After aggregation of answers of all respondents who expressed their expectations in period $t - h$ and then reported changes in prices in period t, joint probability distribution may be expressed through contingency table (p_{ij}), where p_{ij} denotes fraction of respondents whose expectations in period $t - h$ belonged to category i, and whose change in prices observed in period t belonged to category j ($i, j = 1, 2, 3$). Element p_{ij} – taking

p_{13} as an example – has therefore the following interpretation: it denotes the fraction of survey respondents who expected prices of manufactured goods to increase in the next h months, but when they found themselves in period $t + h$, they actually observed that prices had decreased.

Comparison of expectations formed in period t with price changes observed h months later requires identifying respondents and fitting their expectations to changes reported later. From the database, only those respondents have been selected who expressed their expectations and then commented on actually observed changes in prices of goods manufactured by their enterprises.[2] This approach unfortunately limits the number of individual observations available. For example:

- in April 1997, 976 respondents formed price expectations for July 1997,
- in July 1997, 870 respondents commented on price changes as compared to April 1997.

However, after comparing expectations and observed changes for enterprises, number of individual responses that could be included in contingency table analysis was reduced to 658, as this number of respondents took part in both surveys.

3. Definitions

Let us consider forecasting (or forming expectations about) K-dimensional vector $y = (y_1, ..., y_K)'$. Survey respondents express their expectations by identifying the direction of forecasted changes in prices: increase, no change, or decrease; observed changes are reported in similar manner. In order to account for qualitative nature of data obtained through such questionnaires, and following Gourieroux and Pradel [1986], variables $z = (z_1, ..., z_K)$ will be defined using characteristic function of appropriately defined sets:

$$z_k = \mathbf{1}_{A_k}(y) = \begin{cases} 1 & \text{if } y \in A_k \\ 0 & \text{otherwise,} \end{cases} \tag{1}$$

where family of sets $\{A_i, \ i = 1, \ 2, \ ..., \ K\}$ meets the following condition: $\bigcup_{k=1}^{K} A_k = \mathbf{R}$ and $A_k \cap A_j = \varnothing$ for $k \neq j$.

Closed vector space $\tilde{\Gamma}$, which represents information set for qualitative survey responses, may be associated with the σ-field $\sigma(\tilde{\Gamma})$ generated by $\tilde{\Gamma}$. The information set Γ is defined as a family of random variables with their values in $\mathbf{R}^K$, by analogy with equation (1):

$$\Gamma = \left\{ x = (x_1,...,x_K) : x_k = \mathbf{1}_{B_k} \ \text{ dla } \ k = 1,...,K; \ B_k \in \sigma(\tilde{\Gamma}); \right.$$
$$\left. \bigcup_{k=1}^{K} B_k = \mathbf{R} \ \text{ i } \ B_k \cap B_j = \varnothing \ \text{ dla } \ k \neq j \right\} \tag{2}$$

Selection of category k_0 corresponds to the following answer: $x_k = 1$ for $k = k_0$, and $x_k = 0$ otherwise.

Optimal forecast is defined as forecast with the smallest mean square error (see Shiller [1978]) on information set Γ:

$$S(y|\Gamma) \equiv \min_{x \in \Gamma} \sum_{k=1}^{K} E(y_k - x_k)^2 , \tag{3}$$

where E denotes expected value operator.

Expectations y^e are, however, unobservable, and known only through their forecasted changes z^e. Hypothesis that observed expectations z^e are equal to the optimal forecast may be expressed in the following way:

$$\exists \Gamma \in \tilde{\Omega} : z^e = S(z|\Gamma), \tag{4}$$

where $\tilde{\Omega}$ is the family of information sets defined, by analogy with (2), by

$$\Gamma = \left\{ x = (x_1,...,x_k) : x_k = \mathbf{1}_{B_k}, \ B_k \in \sigma(\tilde{\Gamma}); \right.$$
$$\left. \bigcup_{k=1}^{K} B_k = \mathbf{R} \ \text{ i } \ B_k \cap B_j = \varnothing \ \text{ dla } \ k \neq j; \ \Gamma \in \Omega \right\}. \tag{5}$$

In order to test rationality of expectations I will assume that equation (4) describes the necessary condition for the forecasts of respondents of the RIED business survey test to be considered rational. REH requires that economic agents effectively make use of all available and relevant information, including their knowledge about processes taking place in the economic system. It also postulates that economic agents know the system sufficiently well to be able to forecast its behavior from experience and do not systematically ignore information that could be used to improve their forecasts. Optimality

of forecasts, as described by equation (4), does not considerably reduce the generality of analysis. It can be proved (see Gourieroux and Pradel [1986]), that in case of qualitative variables, forecast with minimal square root error belongs to the wide class of forecasts for which results of rational expectations tests are comparable.

In order to verify the hypothesis that expectations of Polish manufacturing industry enterprises are formed in a rational manner, the following theorem will be employed.

Theorem (Gourieroux, Pradel [1986])

Rational expectations hypothesis defined by (4) is true if and only if

$$p_{kk} \geq \max_{j \neq k} p_{kj} \qquad \text{for all } k = 1, ..., K. \qquad (6)$$

The proof consists of two parts. First, authors show that the optimal forecast corresponds to selection of the category characterized by the highest conditional probability on a given information set. Then they prove identity of three notations of REH defined as the optimal choice from the point of view of minimizing mean root square error of prediction. They point to one of these notations as particularly useful in case of qualitative data. It allows to replace REH, in which information set is not clearly defined, by a condition based on the smallest element of an information set that includes forecast of variable under consideration.[3]

---

[3] Author wishes to thank Mr Tomasz Łyziak for drawing her attention to the fact that the Gourieroux – Pradel test cannot be directly compared to classical REH tests based on aggregated data.

4.   Results of empirical analysis

Theorem (6) will be now used for making inferences about rationality of Polish entrepreneurs. Appropriate contingency tables have been created on the basis of business survey data for two forecast horizons (3 months and 4 months) and constructed separately for public sector, private sector, and all enterprises jointly.[4] Detailed results are presented in tables in Appendix 2. The following notation is used:

T   – condition described by equation (6) is fulfilled,

N (1)   – condition described by equation (6) is not fulfilled because of category number 1 (which means that among enterprises expecting increase in prices, more enterprises later observed decrease or no change in prices than actual increase),

N (2)   – condition described by equation (6) is not fulfilled because of category number 2,

N (3)   – condition described by equation (6) is not fulfilled because of category number 3.

For once, question about rationality of price expectations of Polish industrial enterprises seems to have been answered: they were consistently irrational. Hypothesis (6) is supported by the data in only 8 cases out of 672 (across 112 months, 2 forecast horizons, and 3 types of ownership structure). In all remaining cases it is not.

The major source of irrationality seems to be error of type N (1); it appears in 96% of all the cases considered. N (1) denotes overly optimistic attitude of respondents who expect increase in prices while a more rational forecast would describe no change or decrease in prices. (Let's remember that respondents express forecasts about prices of their own products and therefore expectations of high prices may be interpreted as optimistic.) However, in majority of cases, N (1)-type error is accompanied by N (3)-type error of excessive pessimism. N (2)-type error does not appear even once, and "no change" category always constitutes the largest fraction, by far, of every contingency table.

Results summarized in Appendix 2 clearly suggest that vast majority of respondents expect no change in prices of products manufactured in their companies in the 3-to-4 month time horizon, and find their expectations confirmed. Those respondents, however, who expect either increase or decrease in prices, generally miss the target. "Optimists" noticeably outnumber "pessimists".

---

[4] Total number of enterprises is not always equal to the sum of private and public sector firms. Every RIED questionnaire includes a small group of enterprises that did not report their ownership structure and are described in the database as "of unknown legal status".

It may be interesting to compare these results with those obtained for expectations about industrial production (see Tomczyk [2005]). Analysis was based on the same set of survey data (RIED questionnaires in manufacturing industry) spanning the period of March 1997 – January 2004. The results were different, though. Rationality condition (6) was fulfilled much more often, up to 32% of cases for privately owned enterprises. A difference in degree of rationality between private and public companies was noticeable, the private ones exhibiting more rational expectations. N (1)-type error (i.e., excessive optimism) was a dominant one, with N (3)-type and N (2)-type errors (i.e., excessive pessimism or excessive inertia) appearing only rarely.

5. Concluding remarks

Analysis of contingency tables obtained through business tendency surveys in industry suggest that expectations of Polish entrepreneurs are not formed rationally. Rationality condition (6) is fulfilled only in 8 cases out of 672, and such a small number of confirmations does not even allow to differentiate between private and public enterprises as far as rationality of their expectations is concerned. Price expectations seem to be even more irrational than industrial production expectations analyzed earlier (see Tomczyk [2005]).

Heavy share of the "no change" category is typical for analysis of expectations contingency tables. Concentration of responses in this category suggests that entrepreneurs select it because option "I don't know" is not available. This interpretation seems to be confirmed by the fact that whenever respondents attempt to point to the direction of expected change in prices, they are almost always wrong.

On the basis of results obtained in this paper, a few directions of further research could be suggested:

1. Considering other levels of analysis next to forecast horizon and ownership structure (for example, industrial sector or enterprise size).

2. Testing hypothesis of rationality of expectations of individual respondents using microeconometric models.

3. Analyzing interdependence between results of tests based on contingency tables and results obtained through traditional tests of Rational Expectations Hypothesis, based on aggregated data.

4. Generalizing the results for the population of Polish industrial enterprises (which would require non-classical methods of statistical inference, as standard normality assumptions are not fulfilled).

References

Gourieroux C., Pradel J. [1986] *Direct test of the rational expectations hypothesis*, European Economic Review 30:265–284

Łyziak T. [2003] *Consumer inflation expectations in Poland*, European Central Bank Working Paper No. 287

Muth J. F. [1961] *Rational expectations and the theory of price movement*, Econometrica 29:315–335

Osińska M. [2000] *Ekonometryczne modelowanie oczekiwań gospodarczych*, Wydawnictwo Uniwersytetu Mikołaja Kopernika w Toruniu

Shiller R. J. [1978] *Rational expectations and the dynamics structure of macroeconomic models: a critical review*, Journal of Monetary Economics 4:1–44

Tomczyk E. [2004 a] *Polscy przedsiębiorcy na rynku pracy: racjonalność oczekiwań na temat zatrudnienia*, Decyzje 2: 67-84

Tomczyk E. [2004 b] *Racjonalność oczekiwań. Metody i analiza danych jakościowych*, Monografie i Opracowania nr 529, Oficyna Wydawnicza SGH

Tomczyk E. [2005] *Ocena racjonalności oczekiwań respondentów testu koniunktury na podstawie tablic częstości*, w: A. Orłowski (red.) *Metody ilościowe w badaniach ekonomicznych V*, Wydawnictwo SGGW, Warszawa 2005

Appendix 1　　　　　　　**Monthly RIED questionnaire for industrial enterprises**

		Observed within last month	Expected for next 3 – 4 months
01	Level of production (value or physical units)	up	will increase
		unchanged	will remain unchanged
		down	will decrease
02	Level of orders	up	will increase
		normal	will remain normal
		down	will decrease
03	Level of export orders	up	will increase
		normal	will remain normal
		down	will decrease
		not applicable	not applicable
04	Stocks of finished goods	up	will increase
		unchanged	will remain unchanged
		down	will decrease
05	Prices of goods produced	up	will increase
		unchanged	will remain unchanged
		down	will decrease
06	Level of employment	up	will increase
		unchanged	will remain unchanged
		down	will decrease
07	Financial standing	improved	will improve
		unchanged	will remain unchanged
		deteriorated	will deteriorate
08	General situation of the economy regardless of situation in your sector and enterprise	improved	will improve
		unchanged	will remain unchanged
		deteriorated	will deteriorate

Appendix 2   Empirical results

The following notation is used:

T   – condition described by equation (6) is fulfilled,

N (1)   – condition described by equation (6) is not fulfilled because of category number 1
              (which means that among enterprises expecting increase in prices, more enterprises
              later observed decrease or no change in prices than actual increase),

N (2)   – condition described by equation (6) is not fulfilled because of category number 2,

N (3)   – condition described by equation (6) is not fulfilled because of category number 3.

month. year	$h = 3$			month. year	$h = 4$		
	public sector	private sector	all firms		public sector	private sector	all firms
04.1997	N (1, 3)	N (1, 3)	N (1, 3)	04.1997	N (1, 3)	N (1, 3)	N (1, 3)
05.1997	N (1, 3)	N (1)	N (1, 3)	05.1997	N (1)	N (1, 3)	N (1, 3)
06.1997	N (1, 3)	N (1, 3)	N (1, 3)	06.1997	N (1, 3)	N (1, 3)	N (1, 3)
07.1997	N (3)	N (1, 3)	N (1, 3)	07.1997	N (1, 3)	N (1, 3)	N (1, 3)
08.1997	N (1, 3)	N (1)	N (1, 3)	08.1997	N (1, 3)	N (1, 3)	N (1, 3)
09.1997	N (1, 3)	N (1, 3)	N (1, 3)	09.1997	N (1, 3)	N (1, 3)	N (1, 3)
10.1997	N (1)	N (1, 3)	N (1, 3)	10.1997	N (1, 3)	N (1)	N (1, 3)
11.1997	N (1, 3)	N (1, 3)	N (1, 3)	11.1997	N (1, 3)	N (1, 3)	N (1, 3)
12.1997	N (1)	N (1)	N (1)	12.1997	N (1)	N (1)	N (1)

month. year	h = 3			month. year	h = 4		
	public sector	private sector	all firms		public sector	private sector	all firms
01.1998	**N (1)**	**N (1)**	**N (1)**	01.1998	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
02.1998	**N (1)**	**N (1)**	**N (1)**	02.1998	**N (1, 3)**	**N (1)**	**N (1, 3)**
03.1998	**N (1, 3)**	**N (1)**	**N (1, 3)**	03.1998	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
04.1998	**N (1, 3)**	**N (1)**	**N (1, 3)**	04.1998	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
05.1998	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**	05.1998	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
06.1998	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**	06.1998	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
07.1998	**N (1, 3)**	**N (1)**	**N (1, 3)**	07.1998	**N (1, 3)**	**N (1)**	**N (1, 3)**
08.1998	**N (1, 3)**	**N (1)**	**N (1)**	08.1998	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
09.1998	**N (1, 3)**	**N (1)**	**N (1)**	09.1998	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
10.1998	**N (1, 3)**	**N (1)**	**N (1, 3)**	10.1998	**N (1)**	**N (1, 3)**	**N (1, 3)**
11.1998	**N (1)**	**N (1, 3)**	**N (1, 3)**	11.1998	**N (1)**	**N (1, 3)**	**N (1, 3)**
12.1998	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**	12.1998	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
01.1999	**N (1)**	**N (1, 3)**	**N (1, 3)**	01.1999	**N (1)**	**N (1, 3)**	**N (1, 3)**
02.1999	**N (1)**	**N (1, 3)**	**N (1, 3)**	02.1999	**N (1)**	**N (1)**	**N (1)**
03.1999	**N (1)**	**N (1)**	**N (1)**	03.1999	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
04.1999	**N (1)**	**N (1)**	**N (1)**	04.1999	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
05.1999	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**	05.1999	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
06.1999	**N (1, 3)**	**N (3)**	**N (1, 3)**	06.1999	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
07.1999	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**	07.1999	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
08.1999	**N (1, 3)**	**N (3)**	**N (1, 3)**	08.1999	**N (1, 3)**	**N (3)**	**N (1, 3)**
09.1999	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**	09.1999	**N (3)**	**N (1, 3)**	**N (1, 3)**
10.1999	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**	10.1999	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
11.1999	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**	11.1999	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
12.1999	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**	12.1999	**N (1)**	**N (1, 3)**	**N (1, 3)**

month. year	h = 3			month. year	h = 4		
	public sector	private sector	all firms		public sector	private sector	all firms
01.2000	**N (1)**	**N (1, 3)**	**N (1, 3)**	01.2000	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
02.2000	**N (1)**	**N (1, 3)**	**N (1, 3)**	02.2000	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
03.2000	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**	03.2000	**N (1, 3)**	**N (1)**	**N (1, 3)**
04.2000	**N (1, 3)**	**N (1)**	**N (1, 3)**	04.2000	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
05.2000	**N (1, 3)**	**N (1)**	**N (1, 3)**	05.2000	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
06.2000	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**	06.2000	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
07.2000	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**	07.2000	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
08.2000	**N (1)**	**N (1, 3)**	**N (1, 3)**	08.2000	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
09.2000	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**	09.2000	**N (1, 3)**	**N (1)**	**N (1, 3)**
10.2000	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**	10.2000	**N (1)**	**N (1, 3)**	**N (1, 3)**
11.2000	**N (1)**	**N (1, 3)**	**N (1)**	11.2000	**N (1)**	**N (1, 3)**	**N (1)**
12.2000	**N (1)**	**N (1, 3)**	**N (1)**	12.2000	**N (1)**	**N (1)**	**N (1)**
01.2001	**N (1)**	**N (1)**	**N (1)**	01.2001	**N (1)**	**N (1)**	**N (1)**
02.2001	**N (1, 3)**	**N (1)**	**N (1)**	02.2001	**N (1, 3)**	**N (1)**	**N (1)**
03.2001	**N (1)**	**N (1)**	**N (1)**	03.2001	**N (1)**	**N (1)**	**N (1)**
04.2001	**N (1)**	**N (1)**	**N (1)**	04.2001	**N (1)**	**N (1)**	**N (1)**
05.2001	**N (1, 3)**	**N (1)**	**N (1)**	05.2001	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
06.2001	**N (1, 3)**	**N (1)**	**N (1, 3)**	06.2001	**N (1)**	**N (1)**	**N (1)**
07.2001	**N (1)**	**N (1, 3)**	**N (1, 3)**	07.2001	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
08.2001	**N (1)**	**N (1)**	**N (1)**	08.2001	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
09.2001	**N (1, 3)**	**N (1)**	**N (1)**	09.2001	**N (1, 3)**	**N (1)**	**N (1)**
10.2001	**N (1, 3)**	**N (1)**	**N (1)**	10.2001	**N (1)**	**N (1)**	**N (1)**
11.2001	**N (1)**	**N (1)**	**N (1)**	11.2001	**N (1)**	**N (1, 3)**	**N (1, 3)**
12.2001	**N (1)**	**N (1)**	**N (1)**	12.2001	**N (1)**	**N (1, 3)**	**N (1, 3)**

month. year	$h = 3$			month. year	$h = 4$		
	public sector	private sector	all firms		public sector	private sector	all firms
01.2002	**N (1)**	**N (1, 3)**	**N (1, 3)**	01.2002	**N (1)**	**N (1, 3)**	**N (1, 3)**
02.2002	**N (1)**	**N (1)**	**N (1)**	02.2002	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
03.2002	**N (1)**	**N (1)**	**N (1)**	03.2002	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
04.2002	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**	04.2002	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
05.2002	**N (1)**	**N (1, 3)**	**N (1, 3)**	05.2002	**N (1)**	**N (1, 3)**	**N (1, 3)**
06.2002	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**	06.2002	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
07.2002	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**	07.2002	**N (1, 3)**	**N (1)**	**N (1, 3)**
08.2002	**N (1)**	**N (1, 3)**	**N (1, 3)**	08.2002	**N (1, 3)**	**N (1)**	**N (1)**
09.2002	**N (1, 3)**	**N (1)**	**N (1)**	09.2002	**N (1, 3)**	**N (1)**	**N (1, 3)**
10.2002	**N (1, 3)**	**N (1)**	**N (1, 3)**	10.2002	**N (1, 3)**	**N (1)**	**N (1)**
11.2002	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**	11.2002	**N (1, 3)**	**N (1)**	**N (1, 3)**
12.2002	**N (1, 3)**	**N (1)**	**N (1)**	12.2002	**N (1, 3)**	**N (1)**	**N (1)**
01.2003	**N (1, 3)**	**N (1)**	**N (1)**	01.2003	**N (1, 3)**	**N (1)**	**N (1, 3)**
02.2003	**N (1, 3)**	**N (1)**	**N (1)**	02.2003	**N (1, 3)**	**N (1)**	**N (1)**
03.2003	**N (1)**	**N (1)**	**N (1)**	03.2003	**N (1)**	**N (1, 3)**	**N (1, 3)**
04.2003	**N (1)**	**N (1, 3)**	**N (1, 3)**	04.2003	**N (1)**	**N (1, 3)**	**N (1, 3)**
05.2003	**N (1, 3)**	**N (1)**	**N (1, 3)**	05.2003	**N (1)**	**N (1, 3)**	**N (1, 3)**
06.2003	**N (1)**	**N (1, 3)**	**N (1, 3)**	06.2003	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
07.2003	**N (1, 3)**	**T**	**N (1)**	07.2003	**N (1)**	**N (1)**	**N (1)**
08.2003	**N (3)**	**N (3)**	**N (3)**	08.2003	**N (3)**	**N (1, 3)**	**N (1, 3)**
09.2003	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**	09.2003	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
10.2003	**N (1, 3)**	**N (1)**	**N (1, 3)**	10.2003	**N (1, 3)**	**N (1, 3)**	**N (1, 3)**
11.2003	**N (3)**	**N (3)**	**N (3)**	11.2003	**N (3)**	**N (1, 3)**	**N (1, 3)**
12.2003	**N (1)**	**N (1, 3)**	**N (1, 3)**	12.2003	**N (1)**	**N (1, 3)**	**N (1)**

		$h = 3$				$h = 4$	
month. year	public sector	private sector	all firms	month. year	public sector	private sector	all firms
01.2004	N (3)	N (1, 3)	N (1, 3)	01.2004	N (1)	N (1, 3)	N (1, 3)
02.2004	N (3)	N (1, 3)	N (1, 3)	02.2004	N (1, 3)	N (1, 3)	N (1, 3)
03.2004	N (1, 3)	N (1, 3)	N (1, 3)	03.2004	N (1)	N (1, 3)	N (1)
04.2004	N (1)	N (1, 3)	N (1, 3)	04.2004	N (1, 3)	N (1, 3)	N (1, 3)
05.2004	N (1, 3)	N (1, 3)	N (1, 3)	05.2004	N (1, 3)	N (1, 3)	N (1, 3)
06.2004	N (1, 3)	N (1, 3)	N (1, 3)	06.2004	N (1, 3)	N (1, 3)	N (1, 3)
07.2004	N (1, 3)	N (1, 3)	N (1, 3)	07.2004	N (1, 3)	N (1)	N (1)
08.2004	N (1, 3)	N (1)	N (1)	08.2004	N (1)	N (1)	N (1)
09.2004	N (1)	N (1)	N (1)	09.2004	N (1)	N (1)	N (1)
10.2004	N (1, 3)	N (1)	N (1)	10.2004	N (1, 3)	N (1)	N (1)
11.2004	N (1)	N (1)	N (1)	11.2004	N (1)	N (1, 3)	N (1, 3)
12.2004	N (1, 3)	N (1)	N (1, 3)	12.2004	N (1)	N (1)	N (1)
01.2005	N (1)	N (1)	N (1)	01.2005	N (1, 3)	N (1, 3)	N (1, 3)
02.2005	N (1)	N (3)	N (1)	02.2005	N (1)	N (1)	N (1)
03.2005	N (1, 3)	N (1)	N (1, 3)	03.2005	N (1, 3)	N (1, 3)	N (1, 3)
04.2005	N (1)	T	T	04.2005	T	N (1)	T
05.2005	N (1, 3)	N (1)	N (1)	05.2005	N (1, 3)	N (3)	N (1, 3)
06.2005	N (1, 3)	N (3)	N (1, 3)	06.2005	N (3)	N (1, 3)	N (1, 3)
07.2005	N (3)	N (1, 3)	N (1, 3)	07.2005	N (1, 3)	N (1, 3)	N (1, 3)
08.2005	N (1, 3)	N (1)	N (1, 3)	08.2005	N (3)	N (1, 3)	N (1, 3)
09.2005	T	N (1, 3)	N (1)	09.2005	T	N (1)	N (1)
10.2005	N (1, 3)	N (1)	N (1)	10.2005	N (1)	N (1)	N (1)
11.2005	N (3)	N (1)	N (1, 3)	11.2005	N (3)	N (1, 3)	N (1, 3)
12.2005	N (1, 3)	N (1)	N (1, 3)	12.2005	N (1, 3)	N (1, 3)	N (1, 3)

month. year	$h = 3$				month. year	$h = 4$		
	public sector	private sector	all firms			public sector	private sector	all firms
01.2006	N (1, 3)	N (1, 3)	N (1, 3)		01.2006	N (1, 3)	N (1, 3)	N (1, 3)
02.2006	N (1, 3)	N (1)	N (1)		02.2006	N (1, 3)	N (1, 3)	N (1, 3)
03.2006	N (1, 3)	N (1, 3)	N (1, 3)		03.2006	N (1, 3)	N (1, 3)	N (1, 3)
04.2006	N (1, 3)	N (1, 3)	N (1, 3)		04.2006	N (1, 3)	N (3)	N (1, 3)
05.2006	N (1, 3)	N (3)	N (1, 3)		05.2006	N (1, 3)	N (1, 3)	N (1, 3)
06.2006	N (1)	N (3)	N (1, 3)		06.2006	T	N (1, 3)	N (1, 3)
07.2006	N (1)	N (1, 3)	N (1, 3)		07.2006	N (1)	N (1, 3)	N (1, 3)