**Achtergronddocument bij DNBulletin "Gunstige groeiverwachting tempert investeringsterugval bij rentestijging "**

## Empirical analysis

*Data*

Data come from the EC/ECB Survey on the access to finance of SMEs (SAFE), which was held in 2009 for the first time and conducted bi-annually since then. Our sample covers five survey waves conducted in the period 2014-2016 since the question on investment was included in the survey only in 2014. The survey covers "micro" (less than 10 employees), "small" (less than 50 employees), "medium" (less than 250 employees) and "large" firms (250 employees or more). It also provides detailed information on firms' age, country of origin, financial autonomy, branch of economic activity[1], etc.

*Methodology*

Our dependent variable is qualitative and ordinal. For this reason, we use an ordered logit model in our estimation. Firms report whether their investment in fixed assets has changed in the previous six months by choosing one of the three following options: "increased", "remained unchanged", or "deteriorated", labeled respectively by 3, 2, and 1. This labeling is strictly ordinal. The probability that firm n reports at time t that its "investment" was in the j*th* "investment" class is given by the following expression:[2]

$$\Pr(investment_{n,t} = j \mid x_{n,t}, \alpha, \beta) = F\left(\alpha_{j+1} - x'_{n,t}\beta + v_n\right) - F\left(\alpha_j - x'_{n,t}\beta + v_n\right),$$

$$j \in \{0,1,2\}, \alpha_0 = -\infty, \alpha_j \leq \alpha_{j+1}, \alpha_3 = \infty \qquad (1)$$

In the expression above, the vector of observed firm specific characteristics is given by $x_{n,t}$ and the unobserved random effect is given by $v_n$. Structural

[1] "Industry" includes "manufacturing", "mining and quarrying", "electricity, gas and water supply"; "trade" includes "wholesale and retail trade"; "services" include "hotels and restaurants", "transport, storage and communication", "real estate, renting and business activities", "education", "health and social work", and "other community, social and personal service activities".

[2] We apply the same methodology as in B. Öztürk and M. Mirkaic (2014), "SMEs' Access to Finance in the Euro Area; What Helps or Hampers?", IMF Working Papers, No 14/7.

parameters are denoted by $\beta$; $\alpha$ is a vector of thresholds that partition the real line into categories corresponding to different levels of "investment", and probabilities are assigned to outcomes based on a cumulative distribution function F. For more details about this methodology please refer to Cameron and Trivedi (2005).[3]

When estimating equation (1), we control for firms' future growth expectations, changes in profitability, turnover, and leverage (debt-to-assets ratios) as well as other firm-specific characteristics such as firm size, firm age, and the sector of activity. For the baseline analyses, we proxy firms' growth expectations with changes in turnover and use the question on growth expectations as a robustness check as well as in interaction with interest rate changes.[4] This is because the question on growth prospects is included in only two of the five survey waves that we use and its inclusion halves the sample size. We also control for changes in firms' need for bank loans to account for unobserved shifts in investment opportunities, although this might not be a perfect proxy. Country and survey wave dummies are also included. Table 1 below summarizes the results.

*Variables*

The dummy variables capturing interest rate changes are created as follows: The "interest up" dummy equals to 1 if a firm reported an increase in the interest rate and 0 otherwise; "interest down" dummy equals to 1 if a firm reported a decline in the interest rate and 0 otherwise; and "interest same" dummy equals to 1 if a firm reported no change in the interest rate and 0 otherwise.[5] All other dummy variables for changes in leverage, need for bank loans, profits, and turnover are constructed in similar fashion. In addition, the dummy "growthprosp." equals to 1 for firms that reported substantial growth prospects as well as for those that reported moderate growth prospects, and 0 otherwise. The dummy "fin. constrained" equals to 1 for firms that assigned a value higher than 5 to access to finance as an important problem in a scale from 0 to 10, and 0 otherwise. For more

[3] Cameron A. C. and P.K. Trivedi (2005), "Microeconometrics: Methods and Applications", Cambridge University Press, pages 519-520.
[4] The correlation coefficient between growth expectations and changes in turnover is 0.38. Running the regressions with growth expectations yields similar results.
[5] Answers coded with "DK" are disregarded.

details about the survey please consult the questionnaire at https://www.ecb.europa.eu/stats/ecb_surveys/safe/html/index.en.html.

**Table 1. Estimation results**

| | (1) | (2) | (3) | (4) | (5) | (6) Replace turnover in Column 1 with "growthprosp." as an extra robustness check |
|---|---|---|---|---|---|---|
| interest up | -0.27*** | -0.36*** | -0.41*** | -0.0 | -0.15 | -0.19** |
| interest down | 0.35*** | 0.45*** | 0.29** | 0.30*** | 0.53*** | 0.36*** |
| interest up X micsmall | | 0.11 | | | | |
| interest down X micsmall | | -0.17* | | | | |
| interest up X growthprosp. | | | 0.34** | | | |
| interest down X growthprosp. | | | 0.10 | | | |
| interest up X fin. constrained | | | | -0.33** | | |
| interest down X fin. constrained | | | | 0.05 | | |
| profit up | 0.09 | 0.09 | 0.07 | 0.09 | 0.09 | 0.29*** |
| profit down | -0.75*** | -0.75*** | -0.69*** | -0.72*** | -0.75*** | -0.92*** |
| turnover up | 0.57*** | 0.57*** | 0.52*** | 0.57*** | 0.58*** | |
| turnover down | -0.52*** | -0.53*** | -0.41*** | -0.51*** | -0.53*** | |
| need up | 0.60*** | 0.61*** | 0.63*** | 0.63*** | 0.60*** | 0.64*** |
| need down | -0.20*** | -0.19*** | -0.20** | -0.21*** | -0.20*** | -0.22*** |
| lever up | 0.32*** | 0.32*** | 0.35*** | 0.35*** | 0.31*** | 0.35*** |
| lever down | -0.21*** | -0.21*** | -0.15** | -0.20*** | -0.21*** | -0.15** |
| micro ("medium" omitted) | -0.24*** | | -0.29*** | -0.22*** | -0.28*** | -0.30*** |
| small | -0.07 | | -0.15* | -0.05 | -0.09 | -0.14* |
| large | 0.00 | | -0.11 | 0.00 | -0.01 | -0.09 |
| age | -0.22*** | -0.19*** | -0.22*** | -0.22*** | -0.22*** | -0.24*** |
| industry ("trade" omitted) | -0.03 | -0.01 | -0.08 | -0.02 | -0.04 | -0.05 |
| construction | -0.42*** | -0.41*** | -0.40*** | -0.42*** | -0.42*** | -0.37*** |
| services | 0.12** | 0.12** | -0.02 | 0.12** | 0.11* | 0.01 |
| micsmall | | -0.07 | | | | |
| fin. constrained | | | | -0.28*** | | |
| growthprosp. | | | 0.23** | | | 0.51*** |
| Observations | 11,295 | 11,295 | 6,389 | 11,295 | 11,295 | 6,389 |
| Controls | yes | yes | yes | yes | yes | yes |

Robust standard errors (in parentheses) are adjusted for clustering at the firm level; *** p<0.01, ** p<0.05, * p<0.1

**Notes**: Country and survey wave dummies are not shown here. All regressions include control variables (dummies) for profitability, turnover, need for loans, leverage, firm size, sector, country and survey waves.