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**Abstract**

In Chapter 1, which is joint with Filippo Natoli[1], we propose a consumption-based model that allows for an inverted term structure of real and nominal risk-free rates. In equilibrium, real interest rates depend not only on shocks to consumption growth but also on expectations about future consumption growth volatility. In bad states, a high uncertainty makes agents more willing to accumulate precautionary savings and to rebalance their bond portfolios towards longer maturities, pushing the equilibrium short-term yields above long-term ones. Pricing time-varying volatility risk is essential to obtain the inversion of the real curve and allows to price the average level and slope of the nominal one.

Chapter 2 is based on a joint work with Tiziano Ropele[2]. In this paper I empirically investigate the relationship between firms' inflation expectations and their willingness to invest. Using survey data on Italian firms I find that higher inflation expectations do exert a favourable effect on business investment decisions. While I document a minor role of the firm-level nominal borrowing cost, other determinants of investment expectations are significant, such as the credit markets' access conditions and the expected liquidity position of firms. These results bear important implications for policymakers as they offer support to measures aimed at engineering higher inflation expectations in order to stimulate the economy.

[1]Bank of Italy and LUISS Guido Carli
[2]Bank of Italy

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All errors are and remain my own.

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# Chapter 1

# Consumption volatility risk and the inversion of the yield curve

## 1.1 Introduction

The inversion of the term structures of interest rates, which happens when short-term yields are above long-term ones, is an occasional, yet not rare event. Looking at postwar US data on the 10-to-1 year term spread, ten relevant episodes of inversion are observed, accounting for about 10% of total daily observations (see Figure 1.1). The dynamics of the term spread gives insights on the transmission of monetary policy, on possible recession signals (Estrella and Hardouvelis, 1991) and on optimal portfolio strategies, therefore many different literatures have been investigating their determinants and implications.

Empirical evidence supports the role of the real component of the term structure during inversions. Data on US TIPS (i.e., inflation-protected securities) and nominal bonds from Gurkaynak et al. (2007, 2010) suggest that the real term spread fluctuates substantially over time, and that it has inverted during the last 10 years; moreover, fluctuations in the real component contribute significantly to the volatility of nominal yields at both short and long maturities. Still, there is no widely accepted theory explaining the basic mechanics of an inversion.

We propose a parsimonious consumption-based model of the term structure of interest rates that allows the inversion of the real component. We build on the classic frameworks of Campbell and Cochrane (1999) and Wachter (2006), which have been successful in reproducing a wide variety of asset pricing phenomena such as the procyclicality of stock prices, the size of equity premia and the long-run predictability of excess returns, among others. In these models, a representative agent has consumption preferences with respect to a habit level, and variations in the surplus over habit drive both the desire to smooth consumption over time and to accumulate precautionary savings, the latter depending on changes in risk aversion. These two forces have opposite effects on the implied equilibrium risk-free rate, and, potentially, on the slope of the real term structure via both the level and volatility of consumption growth. Assuming log-normal consumption growth, Campbell and Cochrane (1999) offset them to produce a constant risk free rate, while Wachter (2006) makes consumption smoothing motive always prevail such that reasonable estimates of consumption growth volatility do not allow the implied yield curve to invert.

Our framework features time-varying volatility of consumption growth and learning. Consumption growth is a Markov switching process in which unobservable volatility switches between two regimes; agents update risk perception only gradually, and, in equilibrium, real interest rates depend not only on a series of shocks to consumption growth, but also on expected volatility. The perceived macroeconomic risk can be high such that the precautionary saving motive prevails, with saving propensity shifting from the short to the long-run. In terms of bond pricing, a high perceived rollover risk makes investors incline to lock-in bond portfolios, allowing equilibrium prices of long-term bonds to be higher with respect to short-term ones, i.e. an inversion of the yield curve.

Our model is mainly inspired by three studies. The key feature of consumption growth volatility being unobservable and time-varying is taken from Boguth and Kuehn (2013), who explored the connection between macroeconomic uncertainty and asset prices finding consumption growth volatility predicting returns for risk-exposed firms; the emphasis on long- vs. short-run risk is in the spirit of Bansal and Yaron (2004), that propose plausible solutions to asset pricing puzzles based on a persistent component in expected growth and on fluctuating uncertainty; lastly, our point of the importance of expected volatility in the long-run with respect to that in the short-run is in line with the intuition that the entire volatility term structure is relevant in the pricing of the yield curve (Breeden et al., 2015). The latter paper notes that, in 2005-2006, the US yield curve inverted amid no expected decline in growth and, at the same time, the term structure of volatilites (proxied by the 2-year/3-month spread of S&P 500 implied volatilities) was substantially positive indicating risk tilted to the long-run; the authors claim that an upward-sloping volatility term structure can help explain cases of a downward sloping yield curve that are not necessarily related to expected declines in growth.

The heteroskedasticity of consumption growth has been first documented by Ferson and Merrick (1987), Whitelaw (1990), and Bekaert and Liu (2004); more generally, economic uncertainty has been introduced in the analysis of stock prices and risk premia by Kandel and Stambaugh (1990), among others. Our work is in the spirit of Bekaert et al. (2009), who explicitly model the stand-alone importance of investor's uncertainty about fundamentals with respect to risk aversion in a five-factor asset pricing framework. From a different perspective, Kurmann and Otrok (2013) analyze movements in the slope of the term structure in the sample 1959-2005, claiming that news about future total factor productivity (TFP) are the main factors behind the inversion of the curve; as suggested by the authors, time-varying consumption growth volatility is "an additional important ingredient in the long-run risk story", and that the investigation of the correspondence between TFP news shocks and volatility shocks is a "promising avenue of future research".

This paper is organized as follows. Section 1.2 describes the benchmark model and lays out some empirical findings on the relation between real rates and consumption. Section 1.3 presents the model of the real short rate with regime switches in the volatility of the surplus-

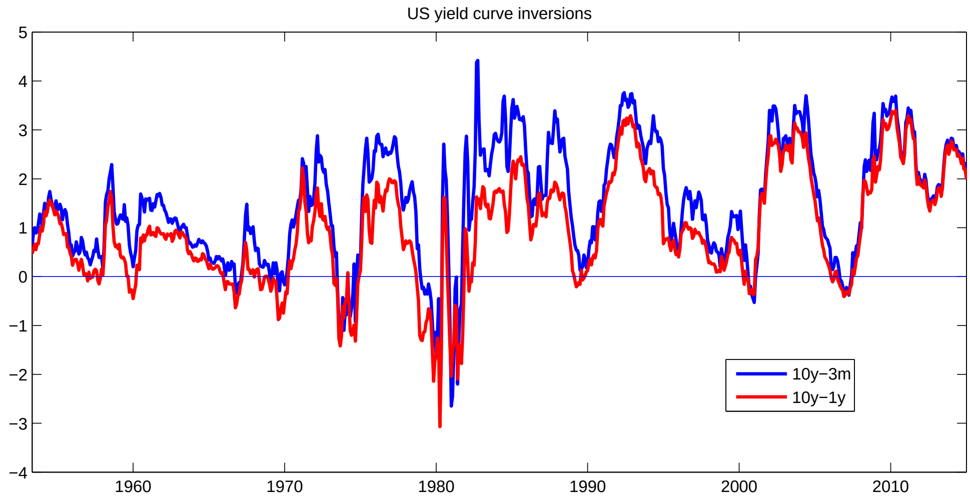


Figure 1.1: Two measures of the slope of the US Government yield curve.

The figure shows 10-year minus 3-month rates (blue line) and 10-year minus 1-year yields (red line).

consumption ratio and explains the mechanics of the inversion of the real and nominal term structures. Section 1.4 describes the empirical analysis and Section 1.5 concludes.

## 1.2 Benchmark model and stylized facts

Throughout this chapter, we explain the main arguments that motivate our research. First, we describe the features of the model proposed by Campbell and Cochrane (1999) (CC henceforth) that we take as a benchmark, focusing on the equilibrium risk-free rate; then, we make the point of the instability of the relationship between real short rates and consumption.

### 1.2.1 Benchmark model

Representative agents have preferences over consumption with respect to a slow-moving reference level $X_t$, that is an exogenous habit level:

$$E_t \sum_{t=0}^{\infty} \beta^t \frac{(C_t - X_t)^{1-\gamma} - 1}{1-\gamma} \tag{1.1}$$

where $\beta$ is the subjective time discount factor and $\gamma$ the utility curvature. The surplus-consumption ratio is defined as the excess consumption over the consumption level $C_t$:

$$S_t = \frac{C_t - X_t}{C_t} \tag{1.2}$$

Consumers' relative risk aversion is time-varying and countercyclical:

$$\xi_t = \frac{\gamma}{S_t} \tag{1.3}$$

Assuming a lognormal i.i.d. consumption growth, the lognormal stochastic discount factor allows to derive the equilibrium risk-free rate in closed form. Denoting with $\{g, \sigma, \psi\}$ mean consumption growth, standard deviation of consumption growth and habit persistence, and being $\bar{S}$ the average level (i.e., steady state value) of surplus-consumption ratio, $s_t = \log(S_t)$ and $\bar{s} = \log(\bar{S})$, one can prove that the real one-period risk-free rate is proportional to deviations of $s_t$ from $\bar{s}$:

$$r_{t,t+1} = \bar{r} - b(s_t - \bar{s}) \tag{1.4}$$

where

$$\bar{r} = -\ln\delta + \gamma g - \frac{\gamma^2\sigma^2}{2\bar{S}^2} \tag{1.5}$$

and

$$b = \gamma(1-\psi) - \frac{\gamma^2\sigma^2}{\bar{S}^2} \tag{1.6}$$

Substituting Equations 1.5 and 1.6 into 1.4 we get

$$r_{t,t+1} = -\ln\delta + \gamma g - \gamma(1-\phi)(s_t - \bar{s}) - \frac{\gamma^2\sigma^2}{2}\left[1 + \lambda(s_t)\right]^2 \tag{1.7}$$

For a more detailed description of the benchmark model, see Appendix A.1. Importantly, being $\{\beta, \gamma, g, \sigma, \psi\}$ all constant parameters, it follows that $b$ is constant over time. The sign of the latter is crucial in order to determine the response of the real rate to surplus consumption. If $b > 0$, then the intertemporal substitution effect dominates: in good times (i.e., high surplus consumption over habits), agents' willingness to save to smooth consumption over time drives the equilibrium risk-free rate down. On the contrary, if $b < 0$, then the precautionary saving effect dominates: in good times, a less-risk averse agent wants to borrow to consume more today driving up the equilibrium interest rate.[1]

In CC's framework, $b$ is 0 to completely offset these two effects. Instead, Wachter (2006) parameterizes $b$ as a positive constant, so that the inter-temporal substitution effect always wins out: positive consumption shocks increasing the surplus drive the equilibrium risk-free rate down. Note that the term $b$ determines not only the level, but also the slope of the equilibrium term structure of risk free rates: if $b > 0$, then the dominance of the intertemporal substitution motive is such that, in bad times, agents value consumption today more than consumption tomorrow and the equilibrium term structure is always upward sloping.

In the next Section we empirically test the importance of consumers' expectations and uncertainty in determining the level of interest rates; we now complete a preliminary analysis by having a closer look at the relationship between $s_t$ and $r_t$.

### 1.2.2 Real rates and surplus consumption

We have previously shown that, in standard consumption-based models featuring habit, the equilibrium real risk-free rate is either constant or a negative function of the surplus-

[1] In bad times, on the contrary, the consumption smoothing propensity drives the equilibrium interest rate up, while precautionary saving motive drives it down.

consumption ratio. Assuming Government bond rates in the United States as risk free, we investigate this issue empirically by comparing the historical dynamics of the real rate to that of the surplus-consumption ratio. Real rates – that cannot be proxied by TIPS in this analysis due to data availability – are estimated as the difference between the 3-month T-Bill rate and 3-month expected inflation, with the latter proxied by inflation forecasts made from an estimated autoregressive process (see Appendix A.2 for details); the surplus-consumption ratio is instead constructed as the weighted average of past consumption growth with decreasing weights, as in Wachter (2006).[2] Figure 1.2 displays the two series on a quarterly frequency from 1962 to 2014.

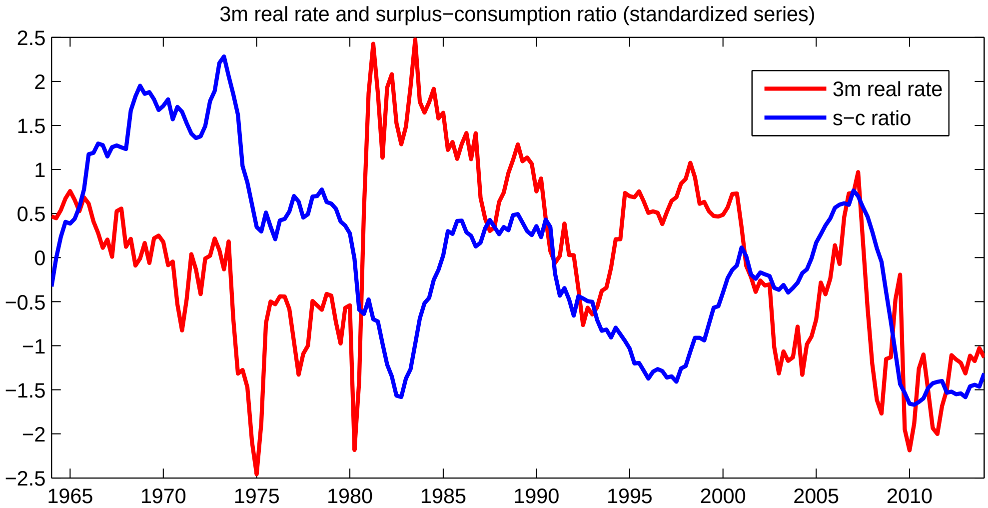


Figure 1.2: Real 3-month rate and surplus-consumption ratio.

A quick graphical inspection suggests that the co-movement between the two is not stable over time: correlation seems positive between late 60's and late 70's, then negative during the 80's and 90's, unclear on the rest of the sample. To analyze this relationship more formally, we estimate a time-varying $b$ by making rolling regressions of the real 3-month rate on a constant and on our surplus-consumption proxy on 10-year windows. The equation is

$$r_{t,t+1} = a_t + b_t \sum_{j=1}^{40} \phi^j \Delta c_{t-j} + \epsilon_{t+1} \tag{1.8}$$

The estimated coefficients $\hat{a}_t$ and $\hat{b}_t$ are displayed in Figure 1.3.

Two things are worth to be mentioned: first of all, both the slope and the intercept exhibit large time variations, ranging from negative to positive values; secondly, the two rolling estimates are strongly negatively correlated: a high positive intercept is coupled with a highly negative load on surplus consumption. This entails two thoughts: (a) real rates depends positively by the surplus-consumption in some part of the sample, negatively in some others; (b) a specific, time-varying, component seems to be embedded in both coefficients with opposite signs.

[2]While surplus-consumption is theoretically influenced by all its own past values, we choose 40 quarters as the cut-off point.

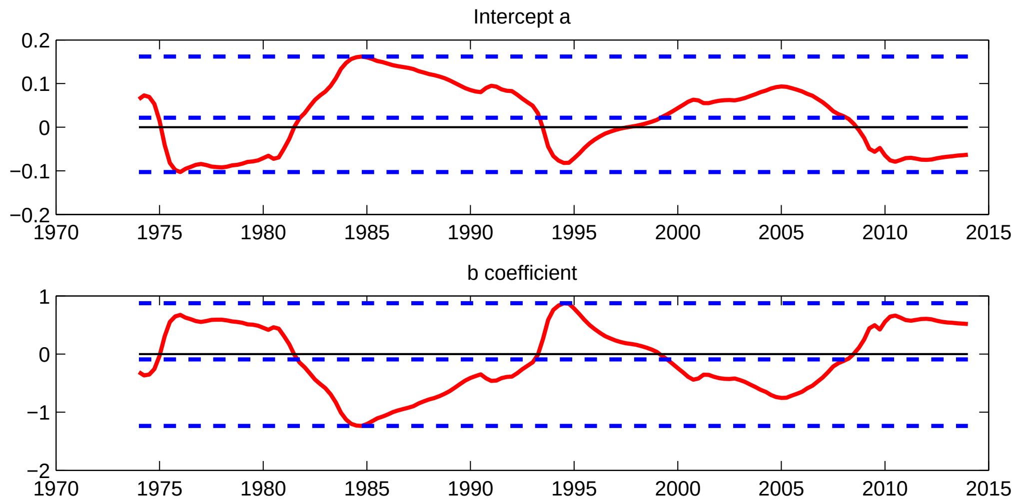


Figure 1.3: Rolling OLS estimate of $a$ and $b$.

## 1.3 Model

Throughout this chapter we explain our entire framework. First, we introduce a Markov switching process for the consumption growth and derive the new stochastic discount factor (Subsection 1.3.1); second, we discuss the behaviour of the equilibrium risk-free rate and the equilibrium term structure (Subsection 1.3.2); third, we include inflation to explain the implication of the model for the nominal yield curve (Subsection 1.3.3).

### 1.3.1 Markov switching consumption growth and equilibrium risk-free rate

We adopt the same set of preferences as CC and keep the same notation throughout the Section. We assume that, instead of being lognormal, consumption growth is a Markov switching process, in which volatility switches between two regimes.[3] Denoting with $g$ the non-switching drift, the process of log consumption growth $\Delta c_{t+1}$ is

$$\Delta c_{t+1} = g + \sigma_{\zeta_{t+1}} \epsilon_{t+1}, \quad \epsilon_{t+1} \sim N(0,1) \tag{1.9}$$

with $\sigma_{\zeta_t}$ being either $\sigma_h$ (high) or $\sigma_l$ (low), with $\sigma_h > \sigma_l$. Volatility is unobservable, depending on a latent variable $\zeta_t$ indicating the state of the economy. Agents infer the state of the economy from observable consumption data. Denote by $\mathbf{P}$ the transition probability of being in state $j = h, l$ coming from state $i = h, l$

$$\mathbf{P} = \begin{bmatrix} p_{hh} & p_{hl} \\ p_{lh} & p_{ll} \end{bmatrix}, \tag{1.10}$$

[3]Given that the trade off between intertemporal substitution and precautionary saving does not depend on the drift of consumption growth, to keep the model as parsimonious as possible we do not impose latent states for it.

which is given and known to the agents at each point in time; new incoming information updates the likelihood of each state

$$\eta_t = \begin{bmatrix} f(\Delta c_t | s_t = 1, \mathbf{X}_{t-1}) \\ f(\Delta c_t | s_t = 2, \mathbf{X}_{t-1}) \end{bmatrix},$$

where $\mathbf{X}_{t-1}$ represents all information at time $t-1$. Then, updated likelihoods and transition probabilities are used to form the *posterior probability* of being in each state based on the available data: call $\xi_{t|t-1} \in \mathbb{R}^2$ the posterior belief vector at time $t-1$, Bayes' Law implies that

$$\xi_{t+1|t} = \mathbf{P}' \frac{\xi_{t|t-1} \odot \eta_t}{\mathbf{1}'(\xi_{t|t-1} \odot \eta_t)}$$

where $\odot$ denotes element-by-element product and $\mathbf{1}$ is a 2-by-1 vector of ones.

As consumption growth, autoregressive surplus consumption is also Markov switching:

$$s_{t+1} = (1-\phi)\bar{s} + \phi s_t + \lambda(s_t)\sigma_{\zeta_{t+1}}\epsilon_{t+1} \tag{1.11}$$

where $\phi$ is the AR coefficient. $\lambda(s_t)$, called *sensitivity function*, is a negative function of $s_t$: the higher the surplus consumption, the lower the sensitivity of $s$ to innovations in consumption growth; moreover, $\lambda(s_t)$ is inversely proportional to the long run steady state level $\bar{S}$.

The stochastic discount factor (SDF) is a function of the surplus consumption:

$$M_{t+1} = \delta \left( \frac{C_{t+1}}{C_t} \frac{S_{t+1}}{S_t} \right)^{-\gamma} = \delta \exp \left\{ -\gamma [g + (1-\phi)(\bar{s} - s_t) + (\lambda(s_t) + 1)\sigma_{\zeta_{t+1}}\epsilon_{t+1}] \right\} \tag{1.12}$$

Solving for the equilibrium risk-free rate involves the computation of the expectation of the SDF as a function of the two stochastic components of $s_t$, i.e. $\{\epsilon, \zeta\}$. After some algebra, we get

$$r_{t+1} = \ln \frac{1}{E_t^{(\epsilon,\zeta)}(M_{t+1})} = -\ln \delta + \gamma g - \gamma(1-\phi)(s_t - \bar{s}) - \ln E_t^{(\epsilon,\zeta)} \left( e^{-\gamma[\lambda(s_t)+1]\sigma_{\zeta_{t+1}}\epsilon_{t+1}} \right) \tag{1.13}$$

where the last term on the right hand side is

$$-\ln E_t^{(\epsilon,\zeta)} \left( e^{-\gamma[\lambda(s_t)+1]\sigma_{\zeta_{t+1}}\epsilon_{t+1}} \right) = -\ln \sum_{j \in \{h,l\}} \xi_{t+1|t}(j) E_t^{(\epsilon)} \left( e^{-\gamma[\lambda(s_t)+1]\sigma_j \epsilon_{t+1}} | \sigma_{\zeta_{t+1}} = \sigma_j, \xi_{t+1|t} \right) \tag{1.14}$$

Equation 1.14 tells that, in a Markov switching world, agents have expectations about the future states – that can be characterized by high or low volatility – and weight them by the posterior probability (i.e., the belief they have at time $t$) that such state will be a high or a low volatility state. We interpret it as a *precationary saving effect*, provided that Equation 1.13 differs from 1.7 only for that. In the extreme cases in which $\xi_{t+1|t}(\sigma_h) = 0$ or $\xi_{t+1|t}(\sigma_h) = 1$, the formula for the equilibrium risk free rate collapses to CC's one.

The key result of our model is that the intensity of the precautionary saving effect depends not only on the current state, but also on agent's beliefs and, precisely, on the posterior probability attached to the two states. Assume that $\sigma_l$ is low enough to let the intertemporal substitution effect dominate on precautionary saving, and let $\sigma_h$ high enough to allow the opposite. Provided that $\xi_{t+1|t}$ weights the two conditional expectations, a high $\xi_{t+1|t}(\sigma_h)$ can made the $\sigma_h$ scenario dominate: in that case, the precautionary saving term overcomes the intertemporal substitution.

To summarize, the equilibrium one-period interest rate depends on the combination of the current state and beliefs over next period. Indeed, states in which $s_t$ is high might no longer be perceived as good states if $\sigma$ is also expected to be high: taken $s_t$ as given, when $\xi_{t+1|t}(\sigma_h)$ is higher than $\xi_{t+1|t}(\sigma_l)$, the equilibrium risk-free rate is driven up. Therefore, the combination of high $s_t$ and low $\xi_{t+1|t}(\sigma_h)$ defines good states, while bad states are those with low $s_t$ and high $\xi_{t+1|t}(\sigma_h)$. $\xi_{t+1|t}$ evolves based on the updated likelihood of the two states. Intuitively, agents follow a learning process: a sequence of large shocks to consumption growth slowly induce agents to weight more the high volatility state, while a sequence of small shocks slowly push them towards the low volatility state.

By introducing Markov switching consumption growth, we make the trade-off between intertemporal substitution and precautionary saving motives endogenous. The flexibility of this specification allows to match the fact that the correlation between real short rates and surplus consumption is time-varying, and provides a rationale for the periods of positive correlations that appear from the empirical estimation of Equation 1.8.

### 1.3.2 The term structure of real risk-free rates

In the previous subsection, we have highlighted the key features underlying this model: time-varying posterior beliefs allow both the inter-temporal and precautionary saving motives to dominate in different times, making the correlation of $r_t$ with $s_t$ also time-varying. Let's now turn to the pricing of real risk-free bonds with maturities beyond one period to infer the behaviour of the entire term structure of interest rates.

The price at time $t$ of a real bond maturing after $n$ periods ($P_{n,t}$) is computed as the expectation of the future compounded SDFs until maturity. From the Euler equation:

$$\begin{aligned} P_{n,t} &= E_t\left[M_{t+1}P_{n-1,t+1}\right] \\ &= E_t[e^{\ln\delta-\gamma g+\gamma(1-\phi)(s_t-\bar{s})-\gamma[\lambda(s_t)+1]\sigma_{\zeta_{t+1}}\epsilon_{t+1}}P_{n-1,t+1} \\ &= \sum_{j\in\{h,l\}}\xi_{t+1|t}(j)E_t[e^{\ln\delta-\gamma g+\gamma(1-\phi)(s_t-\bar{s})-\gamma[\lambda(s_t)+1]\sigma_j\epsilon_{t+1}}P_{n-1,t+1}|\sigma_{\zeta_{t+1}}=\sigma_j,\xi_{t+1|t}] \end{aligned} \tag{1.15}$$

with boundary condition $P_{0,t}=1$; the yield-to-maturity is

$$y_{n,t} = -\frac{1}{n}\ln P_{n,t} \tag{1.16}$$

As described in Equation 1.15, the real bond price is obtained by iterating forward one-period expectations of the bond price for $n$ periods. While future states of the economy are not known at time $t$, agents can only make expectations conditional on the available information at time $t$. In order to account for all possible future states for both $\epsilon$ and the posterior beliefs $\xi$ for $n$ periods, the bond price is solved numerically on a grid.

As explained in the previous Section, if we assume $\sigma_h$ to be high enough to let the precautionary saving effect dominate, cases in which the posterior beliefs are biased towards $\sigma_h$ are such that this scenario applies. In those cases, the precautionary saving motive implies agents' willingness to save long-term, because they know that high volatility states have a limited duration and eventually the volatility will go back to the low level: in this case, the "term structure of agents' beliefs" is downward sloping. In terms of bond pricing, a high perceived rollover risk makes investors incline to lock-in bond portfolios, allowing equilibrium prices of long-term bonds to be higher with respect to short-term ones, i.e. an inversion of the yield curve.

### 1.3.3 Nominal yield curve

Denote by $\pi_t = \ln \Pi_t$ the natural logarithm of the price level and introduce inflation $\Delta\pi_t$ as a first order autoregressive, exogenous state process (AR(1)) following Cox et al. (1985) and Bekaert et al. (2004):

$$\Delta\pi_{t+1} = \eta_0 + \psi_0 \Delta\pi_t + \sigma_{\Delta\pi} v_{t+1} \tag{1.17}$$

Denote also by $\rho$ the linear correlation between $v_{t+1}$ and $\epsilon_{t+1}$ (i.e., the innovation in consumption growth). The nominal bond price is equal to the expected discounted nominal payoff.:

$$P^{\$}_{n,t} = E_t\left[M^{\$}_{t+1} P^{\$}_{n-1,t+1}\right] = F^{\$}_n(s_t) e^{A_n + B_n \Delta\pi_t} \tag{1.18}$$

with

$$\begin{aligned} F^{\$}_n(s_t) &= E_t[e^{\rho(B_{n-1}-1)\sigma_{\Delta\pi}\epsilon_{t+1}} M_{t+1} F^{\$}_{n-1}(s_{t+1})] \\ A_n &= A_{n-1} + (B_{n-1}-1)\eta_0 + \frac{1}{2}(B_{n-1}-1)^2 \sigma^2_{\Delta\pi}(1-\rho^2) \\ B_n &= (B_{n-1}-1)\psi_0 \end{aligned}$$

The SDF of the nominal security ($M^{\$}$) is the ratio between the SDF of the real bond and the one-period gross inflation:

$$M^{\$}_{t+1} = e^{-\Delta\pi_{t+1}} M_{t+1} \tag{1.19}$$

After some algebra, the nominal bond price becomes

$$P^{\$}_{n,t} = const * \sum_{j\in\{h,l\}} \xi_{t+1|t}(j) E^{(\epsilon)}_t \left[M_{t+1} e^{\rho(B_{n-1}-1)\sigma_{\Delta\pi}\epsilon_{t+1}} F^{\$}_{n-1,t+1} | \sigma_{\zeta_{t+1}} = \sigma_j, \xi_{t+1|t}\right] \tag{1.20}$$

with

$$const = e^{A_{n-1} + (B_{n-1}-1)(\eta_0 + \psi_0 \Delta\pi_t) + 0.5(B_{n-1}-1)^2 \sigma^2_{\Delta\pi}(1-\rho^2)}$$

and

$$M_{t+1} = e^{\ln\delta - \gamma g + \gamma(1-\phi)(s_t - \bar{s}) - \gamma[\lambda(s_t)+1]\sigma_{\zeta_{t+1}}\epsilon_{t+1}}$$

Appendix A.3 reports the proof of the nominal bond pricing formula; note that, assuming correlated innovations of the two state processes, the expected value in Equation 1.20 can be expressed as a function of $\epsilon$ only. The yield-to-maturity of the nominal bond is

$$y^{\$}_{n,t} = -\frac{1}{n}\ln P^{\$}_{n,t} \tag{1.21}$$

The nominal bond price has two additional components with respect to the real bond price: a scale factor that depends on inflation volatility (in $const$) and an extra term in the expectation part of Equation 1.20, i.e. $\exp\{\rho(B_{n-1}-1)\sigma_{\Delta\pi}\epsilon_{t+1}\}$. The extra term is key to get the intuition for the role of inflation. This term is a positive function of the product between $\rho$, $\psi_0$ (through $B$) and $\sigma_{\Delta\pi}$. If $\rho$ is negative, as reflecting the existing negative correlation between consumption growth and inflation, the extra term adds to the precautionary saving effect in its impact on the level and the slope of the term structure. Indeed, the agents' willingness to make precautionary savings now depends not only on beliefs of the future consumption volatility states, but also on inflation volatility: the higher the volatility of inflation, the higher the need for precautionary savings.

With respect to the real term structure, we do not need posterior beliefs that are as biased towards $\sigma_h$ to have precautionary savings prevail; if $\sigma_{\Delta\pi}$ is sufficiently high, the nominal yield curve can invert even though posterior beliefs are such that the real one is upward sloping.

We also compute the nominal risk premium up to a constant term, which once again depends on surplus consumption and agents' posterior probabilities:

$$\begin{aligned} E_t\Big(r^{\$}_{n,t+1} - r^{\$}_{1,t+1}\Big) &= const + E_t\Big(\ln F^{\$}_{n-1}(s_{t+1})\Big) - \ln F^{\$}_n(s_t) - \\ &- \gamma(1-\phi)(\bar{s}-s_t) + \ln \sum_{j\in\{h,l\}} \xi_{t+1|t}(j) e^{\frac{1}{2}(-\gamma[\lambda(s_t)+1]\sigma_j - \rho\sigma_{\Delta\pi})^2} \end{aligned} \tag{1.22}$$

Proof is in Appendix A.4.

## 1.4 Empirical analysis

This Section covers the application of the model described in Section 1.3 to US consumption and inflation data. The estimation of the parameters of the Markov switching process is carried out in Subsection 1.4.1. Then, we solve the model and discuss the behaviour of the slope of the term structure in Subsection 1.4.2. Finally we simulate from the model and report descriptive statistics in in Subsection 1.4.3.

### 1.4.1 Parameter estimation

We estimate the parameters of the Markov switching model by maximum likelihood. Real per capita consumption expenditures on nondurable goods and services are taken from the US Bureau of Economic Analysis. Following Yogo (2006), we restrict our sample to post 1952 data to avoid the exceptionally high consumption growth that followed World War II. Results are reported in Table 1.1; sample data are from 1952Q1 to 2016Q3.

| $\Delta c$ | $\mu$ | $\sigma_l$ | $\sigma_h$ | $p_{ll}$ | $p_{hh}$ |
|---|---|---|---|---|---|
| | 0.491 | 0.223 | 0.556 | 0.884 | 0.930 |
| | ( 0.029) | ( 0.014) | ( 0.045) | ( 0.280) | ( 0.284) |

| $\Delta\pi$ | $\eta_0$ | $\eta_1$ | $\sigma_\pi$ |
|---|---|---|---|
| | 0.265 | 0.696 | 0.573 |
| | ( 0.058) | ( 0.036) | ( 0.035) |

Table 1.1: Parameter estimates of the consumption growth and inflation processes.

Values are in percentage points. Non-annualized quarterly growth rates of consumption are computed using data on real consumption expenditures on nondurable goods and services taken from the US Bureau of Economic Analysis; inflation is constructed as quarter-on-quarter log returns, where quarterly CPIs are values of the last month of the quarter. CPI data are from the Bureau of Labor Statistics.

Average consumption growth is estimated at 0.49 per cent per quarter, while volatility equals 0.22 per cent in the low state and 0.56 per cent in the high state (i.e., the latter is 2.5 times bigger than the previous). The low volatility state is slightly less persistent: the probability that high consumption growth volatility will persist next period is 0.93, while for the low volatility state such probability is 0.88. Consumption growth and posterior probabilities are depicted in Figure 1.4.

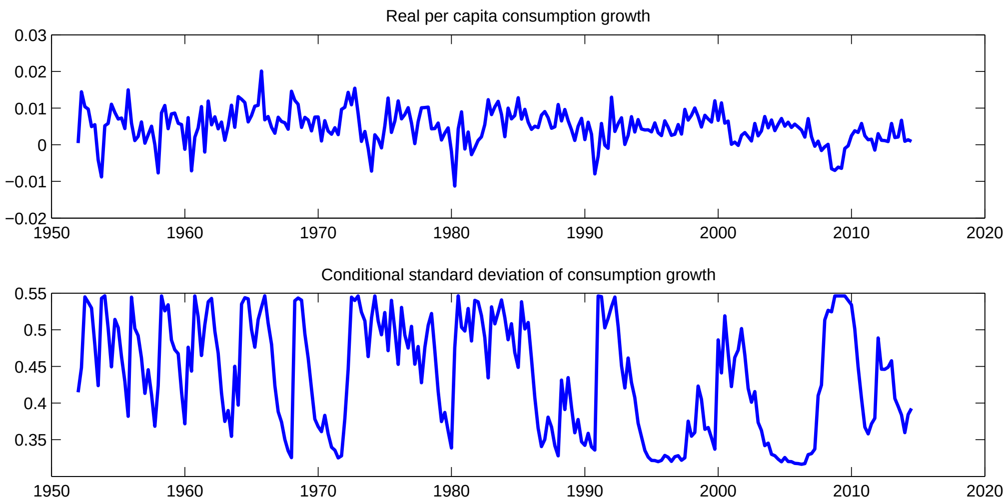


Figure 1.4: Output of the Markov switching estimate.

Top panel: real per capita consumption growth. Bottom panel: expected volatility of consumption growth.

Data on the monthly CPI index are taken from the Bureau of Labor Statistics database; inflation is constructed as quarter-on-quarter log returns, where quarterly CPI are values of the last month of the quarter. Estimates of the three parameters of the AR(1) process for inflation are reported in the bottom panel of Table 1.1. The long-term mean of the autoregressive process is 0.85 per cent, and inflation volatility is 0.82 per cent, higher than the volatility of consumption growth in high state. The correlation with consumption growth is estimated to be equal to -0.11.

### 1.4.2 Model solution

The pricing of nominal and real bonds is obtained from the Euler equations; for numerical computations, the series method of Wachter (2005) is preferred to the fixed-point method of CC. Bond prices are computed numerically on a quadratic grid including combinations of a grid for $s_t$ and a grid for $\xi_{t+1|t}$. Figure 1.5 plots the short term real rate and the implied real yield spread with respect to a grid of values for the surplus-consumption ratio given the posterior probabilities $\xi_{t+1|t} = (1, 0)$ (left panels) and $\xi_{t+1|t} = (0, 1)$ (right panels).

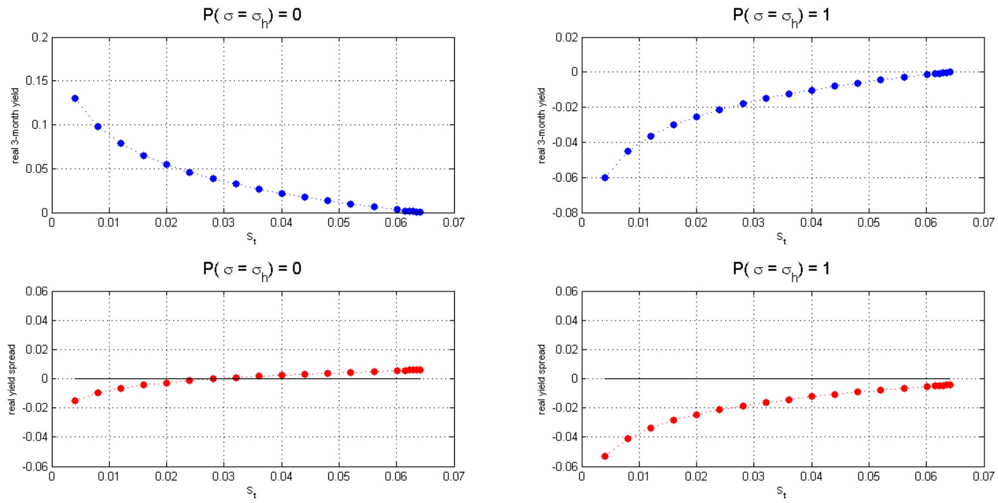


Figure 1.5: Continuously compounded yields on real bonds as a function of the surplus-consumption ratio.

Implied by the posterior probabilities $P(\sigma = \sigma_h) = 0$ (left panels) and $P(\sigma = \sigma_h) = 1$ (right panels) and the parameters in Table 1.1 and Table 1.2.

Figure 1.5 shows that a time-varying consumption growth volatility in habit models is sufficient to allow the real term structure to invert.

If agents expect a low volatility state with probability one, the short-term real yield is a decreasing function of the surplus-consumption ratio so the model can accommodate countercyclical real short-term rates (upper left panel); moreover, the equilibrium real term structure is inverted for values of $S_t$ below a certain threshold (lower left panel). If the agent instead thinks that in the short-term the volatility of consumption growth is going to be high, precautionary saving is always prevailing on intertemporal substitution: the short-term real yield is procyclical (upper right panel) and the real term structure is inverted for all possible $S_t$.

Figure 1.6 shows how the short- and long-term real yields change as a function of the posterior probability to be in the low volatility state ($P(\sigma = \sigma_l)$ given a low $S_t$ (left panel) or a high $S_t$ (right panel). Both short- and long-term real yields are increasing with the probability

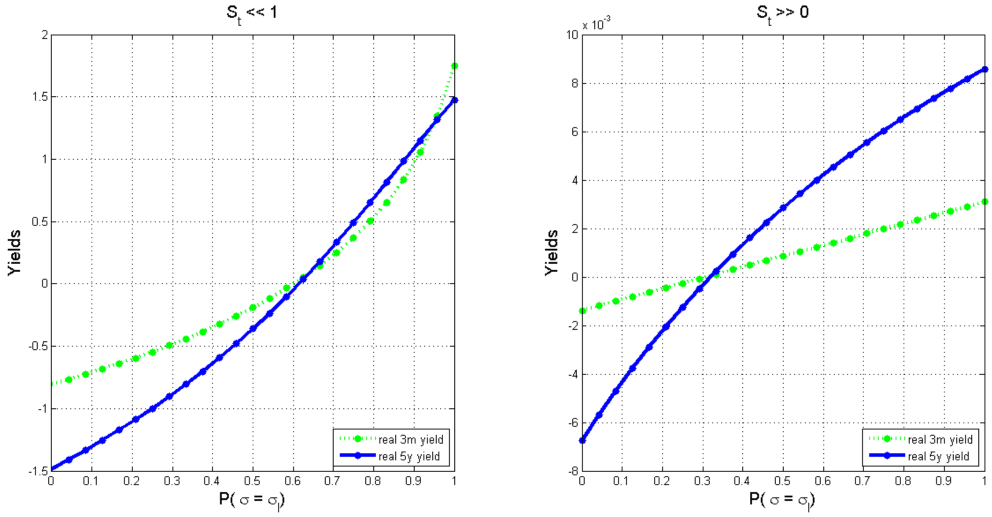


Figure 1.6: Continuously compounded yields on real bonds as a function of the posterior probability to be in the low volatility state.

Implied by a low $S_t$ (left panel) and a high $S_t$ (right panel) and the parameters in Table 1.1 and Table 1.2. The solide blue line represents the 5y yields; The dashed green line denotes 3m yields.

of a low volatility state. The term structure is inverted when the agent is confident that next period's volatility will be either high or low ( $P(\sigma = \sigma_l) = 0$ or $P(\sigma = \sigma_l) = 1$), or if he thinks that high volatility will be more likely (i.e., $P(\sigma = \sigma_l) < 0.5$)); with high $S$ (right panel) the real yield curve is inverted only if the probability of high volatility in the short term is higher than a certain threshold.

Figure 1.7 depicts the short-term nominal and real yields as a function of $S_t$ when the agent expects low volatility state (left panel) or high volatility state (right panel) with probability one. Note that nominal yields are always above real yields due to the effect of expected inflation.

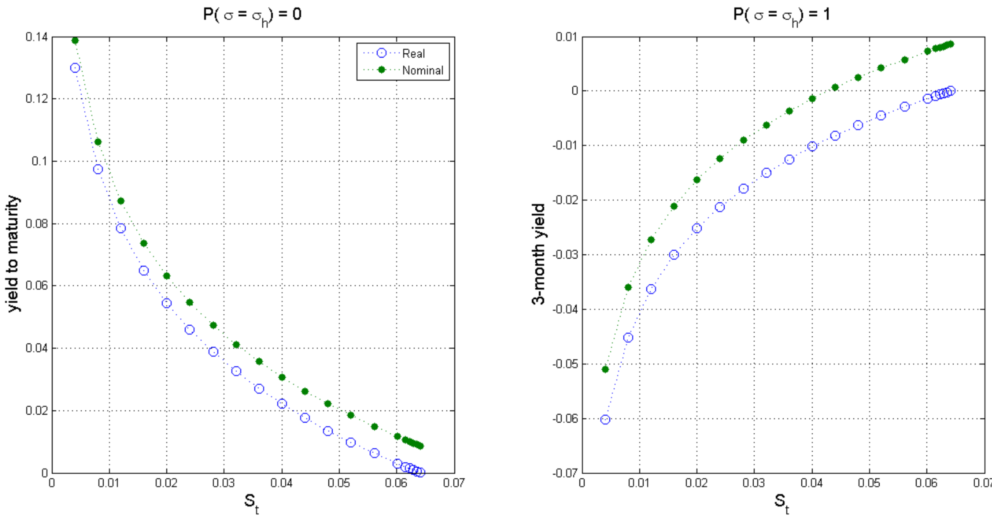


Figure 1.7: Continuously compounded short-term yields on real and nominal bonds as a function of the surplus-consumption ratio.

Implied by the posterior probabilities $P(\sigma = \sigma_h) = 0$ (left panel) and $P(\sigma = \sigma_h) = 1$ (right panel) and the parameters in Table 1.1 and Table 1.2. The blue line represents the real yield; The green line denotes the nominal yield.

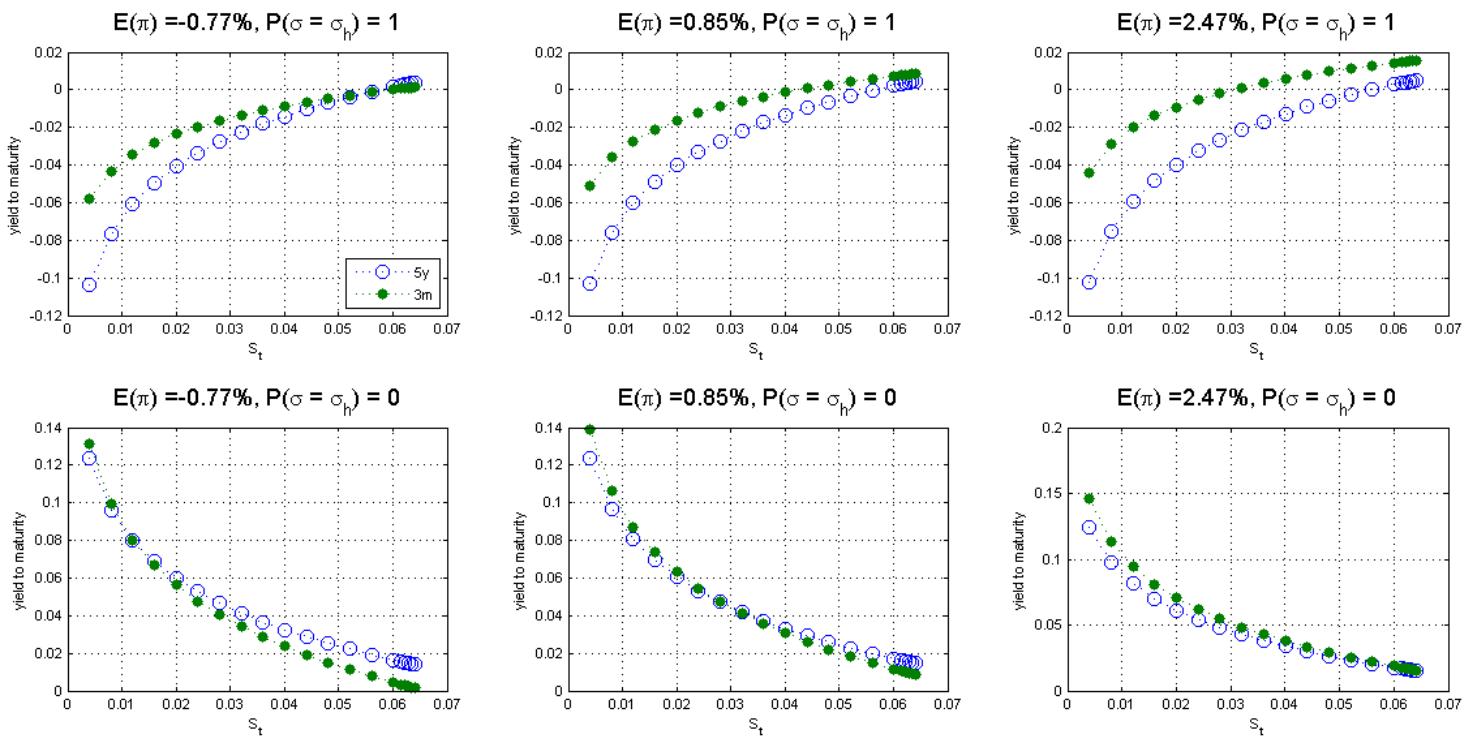


Figure 1.8: Nominal continuously compounded bond yields as a function of the surplus-consumption ratio for different values of expected inflation.

Implied by the posterior probabilities $P(\sigma = \sigma_h) = 1$ (upper panels) and $P(\sigma = \sigma_h) = 0$ (lower panels) and the parameters in Table 1.1 and Table 1.2: long-term expectation (middle panels), long-term expectation minus and plus two standard deviations (left and right panels). Blue lines represent 5y yields; green lines denote 3m yields.

We now focus on the nominal curve, studying its sensitivity to different calibrations of the long-term mean of the inflation process. Figure 1.8 displays 3-month and 5-year nominal yields for different levels of expected inflation when the agent expects a low volatility state (lower panels) or high volatility states (upper panels). We consider expected inflation equal to its long-run mean (0.85 per cent, middle panels), and to plus and minus two unconditional standard deviations (right and left panels, respectively).

The equilibrium nominal yield curve is very sensitive to changes in expected inflation. If the agent expects low volatility (lower panels), the higher the long-term inflation expectations, the larger the level of the surplus consumption that yields an inverted nominal curve: for the case of a long-run mean of 0.85 per cent, the yield curve inverts for values of the $S_t$ grid below 0.3 (lower middle panel); for the extreme cases of negative or highly positive long-term inflation expectations, the term structure inverts for lower or higher values of the surplus consumption, respectively (lower left and lower right panel). In other words, it takes a higher surplus consumption for the agents to feel in a good state.

Provided that inflation expectations are mean reverting, variations in short-term yields are the main responsible for the inversion. This is coherent with the mechanics explained, in a different setup, by Kurmann and Otrok (2013). If instead the agent expects high volatility states (top panels), the nominal yield curve is inverted for almost every values of the surplus consumption ratio; moreover, the higher the long-term inflation expectations, the larger the gap between long- and short-term yields (top panels, from left to right). This suggests expected inflation is an important driver of the inversion of the nominal term structure, which is allowed to invert even when the real term structure does not.

### 1.4.3 Simulation

In order to replicate the path of interest rates observed in the US market during the sample period, we simulate 100,000 observations of quarterly consumption growth and inflation. The model is calibrated using the parameters in Table 1.1 and Table 1.2. Mean and standard deviations of 3-month, 1-year, 3-year and 5-year zero yields are reported in Table 1.3.

Model-implied values are very close, on average, to the observed ones (the largest difference is around 30 basis points, in absolute value). The mean of 3-month estimated nominal yields is 5.10 per cent, while the observed ones are on average 4.80 per cent; 5-year implied and observed nominal yields are equal to 5.89 and 5.91 per cent, respectively. The average positive slope of the time series is therefore matched. Real yields are much smaller than nominal ones, meaning that the inflation component is, on average, quite sizable. Simulated yields, both real and nominal, are less volatile than the market rates.

## 1.5 Conclusion

In this paper, we propose a consumption-based asset pricing model that allows not only the nominal, but also the real term structure of interest rates to invert. The main ingredients are time-varying volatility and the learning behaviour of agents, both implied in the Markov

| Parameters | Value |
|---|---|
| Utility Curvature $\gamma$ | 2.00 |
| Habit persistence $\phi$ | 0.97 |
| **Derived Parameters** | |
| Discount rate $\delta$ | 0.98 |
| Long-run mean of log surplus consumption $\bar{s}$ | -3.25 |
| Maximum value of log surplus consumption $s_{max}$ | -2.75 |

Table 1.2: Assumptions on the parameters of the investor's utility function

| Maturity | Mean | | | St. Dev. | | |
|---|---|---|---|---|---|---|
| | Real | Nominal | Data | Real | Nominal | Data |
| 1 | 1.60 | 5.10 | 4.80 | 1.43 | 2.20 | 3.15 |
| 4 | 1.71 | 5.23 | 5.21 | 1.46 | 1.68 | 3.28 |
| 8 | 1.86 | 5.39 | 5.44 | 1.51 | 1.61 | 3.20 |
| 12 | 2.02 | 5.56 | 5.62 | 1.56 | 1.64 | 3.11 |
| 20 | 2.35 | 5.89 | 5.91 | 1.67 | 1.73 | 2.94 |

Table 1.3: Means and standard deviations of continuously compounded zero-coupon bond yields in the model and in the data.

3-month, 1-year, 3-year and 5-year implied yields are compared with data from 1952Q1 to 2016Q3.

switching model of consumption growth. Agents form posterior beliefs over future states of the economy. The perceived short-term macroeconomic risk can be so high that, in the trade-off between making intertemporal consumption smoothing and precautionary saving, the latter prevails, with saving propensity shifting from the short to the long-run. In terms of bond pricing, a high perceived rollover risk makes investors incline to lock-in bond portfolios, allowing equilibrium prices of long-term bonds to be higher with respect to short-term ones

The estimated stochastic discount factor could, in principle, be used to price other type of assets. The impact of macroeconomic risk on equity pricing is investigated by Lettau et al. (2008) among others. The application on corporate bond pricing or derivative pricing can be an avenue of future research. This model is designed for default-free economies: another interesting avenue of research could be that of investigating the evolution of a bond term structure containing a risk premium related to the default of the bond's issuer. Equilibrium yield curves of different countries with different default risks could in this way be compared.

# Chapter 2

# Business Investment Plans and Inflation Expectations

## 2.1 Introduction

Nearly a decade after the outburst of the global financial crisis in 2007, the economic recovery in the Euro area remains anemic and with inflation expected to stay at low levels for a prolonged period of time. At the same time, with the nominal interest rate close to the effective lower bound, central bankers have intensified the use of various unconditional monetary policy measures in order to guide financial markets. Among these measures, policymakers have introduced or reinforced forward guidance and, in the current debate, there have been suggestion to use it to boost inflation expectations in order to stimulate firms' investment.

Setting aside the issue on *how* policymakers can affect inflation expectations, the goal of this paper is to empirically evaluate *whether* and *to what extent* business inflation and investment expectations are related. To the best of our knowledge, this is the first study to investigate the nexus between business inflation expectations and investment plans using firm-level data. The use of microdata is crucial to carry on our study. Undoubtedly, the relation between inflation expectations and investment plans is central in the macroeconomic literature, nevertheless pinning down the nature of this relation is notoriously hard. That's because most of the evidence we possess on it is aggregate, while the theory points at firm-level effects. At the aggregate level, the big challenge to overcome is reverse causation, which arises because inflation expectations and investment plans are usually determined simultaneously and this could lead to biased estimates. It is much harder to advocate that this co-determination is present when one uses cross-sectional microdata as in our case, given that individual decisions on investment are unlikely to influence the aggregate price level and therefore the expectations of that same agent about aggregate inflation.

In our analysis we use the firm-level data contained in the Italian *Survey of Inflation and Growth Expectations* (SIGE, henceforth), which is a quarterly business survey run by the Bank of Italy since December 1999 in collaboration with the daily financial newspaper *Il Sole 24 Ore*. SIGE is an extremely rich survey that contains business evaluations on a wide array of macroeconomic matters as well as on matters regarding respondents' own business. In particular, it is since the inception of the survey that firms report a *quantitative* 12-month ahead forecast of the annual growth rate of the harmonized index of consumer price whereas it is only since December 2012 that they also provide a *qualitative* forecast about their expected annual variation in fixed investment expenditure. We use the information coming from the responses to these two questions to assess whether there exists a relationship between the two variables[1].

In addition to information on inflation and investment expectations, SIGE contains other questions that allows us to control for determinants that previous empirical studies documented as relevant drivers of investment expenditure such as firms' access conditions to credit markets and firms' liquidity position and their expected change in workforce (e.g. Fazzari et al. (1988); Fazzari and Petersen (1993); Kaplan and Zingales (1997); Gaiotti (2013)). Furthermore, firms are asked to rate the current economic outlook in Italy. This is an extremely important question as it captures the firms' perception about the macroeconomic outlook. The idea the firm has about the general economic environment is likely to influence firm's inflation expectations and possibly its investment plans (think about an intrinsic optimistic or pessimistic firm), so this evaluation should be (positively) correlated with our variables of interest and its exclusion could bias the estimates. Moreover, SIGE contains a number of individual characteristics - such as the sector of economic activity (industry, services, construction), the geographical location (North-West, North-East, Center, South and Islands), the size (number of employees), and the degree of openness (share of sales revenues from exports) - that can help explaining the cross-sectional variability in investment expectations.

Finally, in order to address the issue on whether the relationship between inflation expectations and investment works through the real rates, we retrieve the firm-level nominal borrowing cost from the Italian Credit Register to build an *ex-ante* real interest rate in which we replace the contemporary borrowing cost with the rate the company has paid in the past[2] (which is an average rate charged on loans outstanding of each company).

We estimate a set of ordered probit regressions by pooling the data across firms and time. Depending on the exclusion or inclusion of the borrowing cost among the regressors, the number of observations varies considerably, roughly $7,000$ in the former case and $4,000$ in the latter.

Our main finding is that firms that display higher (lower) inflationary expectations are more (less) willing to invest. In the most general specification (that includes all controls but the firm-level borrowing cost), a one percentage point increase in the 12-month ahead expected inflation raises (reduces) firms' predicted probability of having a positive (negative) attitude towards investing by about 2.5 percentage points. These results are robust to a number of checks such as the use of shorter-term (6-month ahead) or longer-term inflation expectations (2-year ahead

[1]Few other authors use the information from SIGE. Cesaroni and Iezzi (2015) provide a complete characterization of the business cycle properties of survey data and conclude that SIGE business indicators anticipate the turning points of corresponding national account reference series. Cova and Ferrero (2015) use the SIGE data to measure the effect of the Eurosystem's asset purchase programme on the Italian economy.

[2]From the data we collected we are not able to build an effective real rate because we do not have the contemporary borrowing cost, that is what the firm would pay in the same quarter in which it reports the inflation expectations.

and 2-year 2-year ahead), the sub-sample estimation (performed with data from March 2014 through December 2015 that is when firms' inflation expectations exhibit a marked degree of cross-sectional dispersion) and the random effects ordered probit estimation.

Several other results are worth noting. First, we measure the sensitivity of expected investment to changes in real rates, which we build using three distinct nominal borrowing costs. When we include in the regression the firm-level ex-ante real borrowing cost (and remove the measure of access conditions to credit market) we find that only in one case the coefficient is weakly statistically significant. Even including the nominal borrowing cost by itself, the outcomes do not change much: we find that it is never statistically significant. Furthermore, the relevance of firms' inflation expectations somewhat weakens.

Second, we provide new evidence on determinants of firms' investment decisions. Everything else equal, firms that expect to expand rather than reduce the workforce are more likely to increase investment spending: the predicted probability rises by 26 percentage points. Likewise, firms whose access conditions to credit market improve compared to the previous three months or perceive better investment conditions are also more likely to report higher investment expectations: the predicted probabilities increase by 14.2 and 16.7 percentage points, respectively. Somewhat, smaller marginal effects show up for firms displaying more favorable expected liquidity conditions, or which are more confident about the current state of the economy in Italy. The estimates also indicate that the predicted probability of reporting higher investment increases for firms whose share of revenues from exports exceeds 66%.

Overall, our econometric results indicate that higher inflationary expectations *do* exert favorable effects on business investment decisions and thus provide support for the recent monetary policy measures aimed at raising inflation and inflation expectations. Quantitatively, however, our results suggest that these effects alone *might not be very large*[3]. Furthermore, while we do not find a significant interest rate sensitivity of investment expectations, a more general improvement in access conditions to credit or firms' liquidity position might contribute substantially in stimulating business investment expectations.

**Literature review.** Our paper is related to several strands of the extensive literature on investment. It is connected to the empirical works that seek to estimate the elasticity of capital formation with respect to the user cost of capital (e.g., Chirinko et al. (2002); Chatelain et al. (2001); Gaiotti and Generale (2002)) or that investigate the long-run nexus between inflation and investment (e.g., Fischer (1993); Khan et al. (2006); Bullard and Keating (1995); Barro (1995)). Several recent studies have also examined the determinants of investment plans (e.g. Gennaioli et al. (2015); Sharpe and Suarez (2013)). Our paper also contributes to the recent strand of research that uses business surveys to elicit firm's inflation expectations (e.g., Bryan et al. (2014); Kumar et al. (2015); Richards and Verstraete (2016)).

Several recent papers are closely related to ours. Bachmann et al. (2015) investigate the

[3]Given the qualitative nature of our data, we were not able to derive an elasticity of expected investment to inflation expectations. However, in Appendix B.1, we exploit other data sources to check that the information we derive from our willingness to invest variable is reflected in firms' actual future investment.

relationship between consumers' expected inflation and their spending attitudes on durables using the microdata from the Michigan Survey of Consumers over the period 1984-2012. They find that the impact of higher inflation expectations on the reported readiness to spend is generally small and statistically insignificant, and significantly negative when the economy is at the zero lower bound. Burke and Ozdagli (2013) confirm these findings using data from the New York Fed/ RAND-American Life Panel household expectations survey. Ichiue and Nishiguchi (2015) find that Japanese households that expect higher inflation plan to decrease their future consumption spending, but have increased their spending in the past. Using German microdata, Weber et al. (2015) find a relation between inflation expectations and readiness to spend on durables and conclude that monetary and fiscal policies that increase inflation expectations can therefore successfully spur aggregate consumption in the short run.

With our empirical analysis we complement these papers by providing new evidence on the nexus between firms' inflation expectations and their investment attitudes using a novel Italian dataset.

The rest of the paper is organized as follows. Section 2.2 presents the data and discuss some preliminary descriptive statistics. Section 2.3 lays out our empirical strategy. Section 2.4 report the main empirical findings while Section 2.6 show the results of various robustness checks. Finally, Section 2.7 concludes.

## 2.2 Data

In this Section we first describe the Survey on Inflation and Growth Expectations and the main questions we use in our econometric analysis; then, we briefly discuss how we measure the firm-level borrowing cost using the information from the Italian Central Credit Register; finally, we illustrate some preliminary descriptive statistics.

### 2.2.1 Survey on Inflation and Growth Expectations

Most of the firm-level data used in this paper come from the Survey on Inflation and Growth Expectations, run quarterly since December 1999 by the Bank of Italy in collaboration with the daily economic newspaper *Il Sole 24 Ore*. The survey is distributed to a sample of about 1,000 Italian firms with at least 50 employees. The sample is stratified by number of employees ($50-199$, $200-999$, 1000 and over), sector of economic activity (industrial, services and construction[4]) and geographical area (North-West, North-East, Centre, South and Islands[5]). The questionnaire is distributed to corporate managers who are best informed about the topics covered in the survey and is compiled online using a purpose-designed interface or submitted by fax. The response rate has been on average about 45%. The collected data are subject to

[4]Construction firms have been included in the survey since December 2012.

[5]The North–West area includes: Piemonte, Valle d'Aosta, Lombardia and Liguria; the North-East area includes: Veneto, Trentino Alto-Adige, Friuli Venezia Giulia and Emilia Romagna; the Centre area includes: Toscana, Umbria, Marche and Lazio; and, finally, the South and Island area includes Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicilia and Sardegna.

an initial quality check to correct mistakes (such as typing errors) or fix outliers and missing data[6].

Firms are asked to provide forecasts both on macroeconomic matters, such as developments in the consumer price inflation and the general state of the productive economy in Italy, and on issues regarding their own business. In some cases, the forward-looking opinions are accompanied by current-looking assessments and, where possible, there are indications of the factors underlying the reported or expected developments. Some questions have remained virtually unchanged since the inception of the survey whereas others have been added later to address specific economic matters (e.g. firms' expectations on investment expenditure or firms' access conditions to credit markets).

Throughout the analysis, we concentrate on two main questions of SIGE, which we illustrate below.

**Question on investment expectations.** As of December 2012 firms participating to SIGE report expectations about their investment expenditure[7]. In March, June and September of each year the question reads as:

**Q:** *What do you expect will be the nominal expenditure on (tangible and intangible) fixed investment in the current year compared with that of last year? ☐ much lower; ☐ a little lower; ☐ about the same; ☐ a little higher; ☐ much higher.*

In the December round of the survey the question is formulated as follows:

**Q:** *What do you expect will be the nominal expenditure on (tangible and intangible) fixed investment next year compared with that in the current year? ☐ much lower; ☐ a little lower; ☐ about the same; ☐ a little higher; ☐ much higher.*

Several remarks are in order. First, in either formulation firms indicate their expected change in (tangible and intangible) fixed investment expenditure on an annual basis. Yet, the *actual* forecasting horizon varies considerably throughout the year, being 9-, 6-, 3- and 12-month ahead respectively in March, June, September and December. Hence, throughout the year firms forecast their investment expenditure over an average horizon of 9 months ahead. To account for this, in the later econometric analysis we will use in turn firms' 12-month and 6-month ahead inflation expectations[8]. Second, firms respond to the investment question by choosing among five qualitative and ordinal alternatives ranging from *much lower* to *much higher.* A footnote attached to the question (not reported here) clarifies that the *responses "much higher" and "much lower" also apply when, in the two periods compared, investments in the previous period were zero.* Third, it is worth noting that the investment question refers to the firm's expectation of its nominal expenditure on fixed investment. Hypothetically, a firm could then indicate an expected change in its nominal expenditure entirely driven by the price of investment

[6] Further methodological notes on data collection and treatment can be found in the Appendix A of the Survey on Inflation and Growth Expectations at https://www.bancaditalia.it/pubblicazioni/indagine-inflazione/index.html

[7] In 2013 Q3 the investment question was not included in the questionnaire.

[8] In the robustness section we also consider longer-term inflation expectations.

goods. Unfortunately, with the available information from SIGE we cannot do much to address this concern as it does not contain information (neither forward-looking nor backward-looking) about investment goods price inflation. Fourth, our results on the relationship between expected inflation and investment plans carries over to actual investment depending on how the last two variables are related. In particular, one may wonder if the information we derive from our willingness to invest variable is reflected in the firms' actual future investment. We tackle this issue in Appendix B.1, exploiting the quantitative information contained in the Survey of Industrial and Service Firms conducted annually by the Bank of Italy.

**Question on consumer price inflation expectations**. Another question contained in SIGE that is central to our analysis concerns firms' expectations of the Italian consumer price inflation. In particular, a *quantitative* forecast of the harmonized index of consumer price inflation – in terms of the annual percentage change 1-year ahead – has been asked since 1999. In the past few years, the question has been enriched so as to consider the annual consumer price inflation expectations at other horizons, namely 6-month and 2-year ahead and also 2-year 2-year ahead. In December 2015 (the last available round in our sample) the question was formulated as follows:

**Q:** *In October consumer price inflation, measured by the 12-month change in the harmonized index of consumer prices was* 0.3 *per cent in Italy and* 0.1 *per cent in the euro area. What do you think it will be in Italy in: June 2016? ...December 2016? ...December 2017? ...on average between December 2018 and December 2020?*

Firms provide their numerical forecasts with up to one decimal digit of precision. It is worth noting that to channel respondents' answers towards plausible figures, a nominal anchor is proposed in the question, in the form of the latest definitive (hence referred to two months earlier) official HICP figure for Italy as well as for the Euro area. To realize a uniform informational framework, interviews are started just after the announcement of the latest provisional HICP figure referred to the preceding month. In September 2013 the inflation question in the survey has been slightly modified to assess the possible effects of giving the nominal anchor to the firms. In particular, the sample of firms has been split in two groups: 65% of the firms were given the anchor while the remaining fraction of firms were not. Interestingly enough, the anchored formulation does not bias the average response while it significantly reduces its dispersion[9].

**Other questions**. SIGE contains other questions that are relevant for our empirical analysis, whose responses are generally coded into categories. For completeness, Table B.3 in the Appendix reports these questions together with the numerical code used to represent the response categories.

One question asks firms to state whether their total number of employees in the upcoming three months will be lower, unchanged or higher compared with current levels, thus giving us an idea of whether the business will be likely to expand. Also, SIGE asks firms to report whether current access conditions to bank financing are better, unchanged, or worse with respect to

[9]See *Survey on Inflation and Growth Expectations, Supplements to the Statistical Bulletin*, No. 1, 2016.

the previous three months. Closely related to this question, firms are also asked to evaluate whether the firm's liquidity situation in the next three months, given the expected change in the access conditions to credit, will be insufficient, sufficient or more than sufficient. As discussed in Section 2.3, the information regarding the potential presence of credit supply restrictions or internal liquidity shortages represents a crucial determinant of firms' investment expenditure and this is even more for the case of Italy where the banking system notably plays a pivotal role in firm financing ( see Bugamelli et al. (2012)).

Furthermore, two other relevant questions ask firms to rate whether their current conditions for investment and more in general Italy's current economic situation are better, the same, or worse compared with the previous three months. We use the answer to the former question as an indicator of the firm-specific belief about its current investment opportunities, while the answer to the latter as measure of the firm-level perception of the macroeconomic outlook. Both information are important, as they that might positively correlate with firm investment plans and inflation expectations.

Finally, SIGE contains information regarding a number of firm-individual characteristics that, as discussed in Section 2.3, can explain the cross-sectional variability in firm investment and inflation expectations. In particular we consider the size of the firm, the sector of economic activity, the geographical area and the degree of openness. With respect to these latter characteristics, firms indicate the share of sales revenues coming from exports and may choose among four categories: *i*) more than 2/3, *ii*)between 1/3 and 2/3, *iii*) up to 1/3 and more than zero, and *iv*) zero.

The Survey contains many other interesting questions that could be used. Notwithstanding, we decided not to use them as their inclusion in the Survey is very recent and thus we would end up with a small sample size.

SIGE does not contain any direct measure of the firm-level borrowing cost and thus we must recur to another data source, which we describe in the next Section.

### 2.2.2 Central Credit Register

To measure the firm-level borrowing cost we use the Italian Central Credit Register and in particular the sub-section TAXIA, which contains detailed information provided by a representative sample of financial intermediaries (about 200 Italian banks and 10 branches and subsidiaries of foreign banks) on their granted loans. Only borrowers whose total debt from a single bank exceeds $75,000$ euro are registered. Data on the annual percentage rate (inclusive of fees and commissions) applied to individual loans are available at quarterly frequency.

In this paper we employ three alternative measures of firm-level borrowing cost relating to *i*) term loans, *ii*) matched loans (mainly consisting of advances on invoices and on bills and documents representing commercial credits) and *iii*) revocable loans (mainly consisting of current account overdrafts). In either case, we consider the average interest rate on the outstanding amount of firm credit. We are aware that using the interest rate on outstanding amounts might overlook the general fall in interest rates on new business loans under way since early 2012. We decided not to use quarterly information on new business loans as in this case the resulting dataset would have had a large number of missing entries. This is likely due to the fact that during the financial crisis not only banks tightened their credit supply standards, but also firms cut on their investments and did not demand for new loans.

### 2.2.3 Descriptive statistics

In this Section we discuss some key descriptive statistics of our dataset. As the question on firms' investment expectations has been included in SIGE since December 2012, all statistics presented here are computed starting from this date.

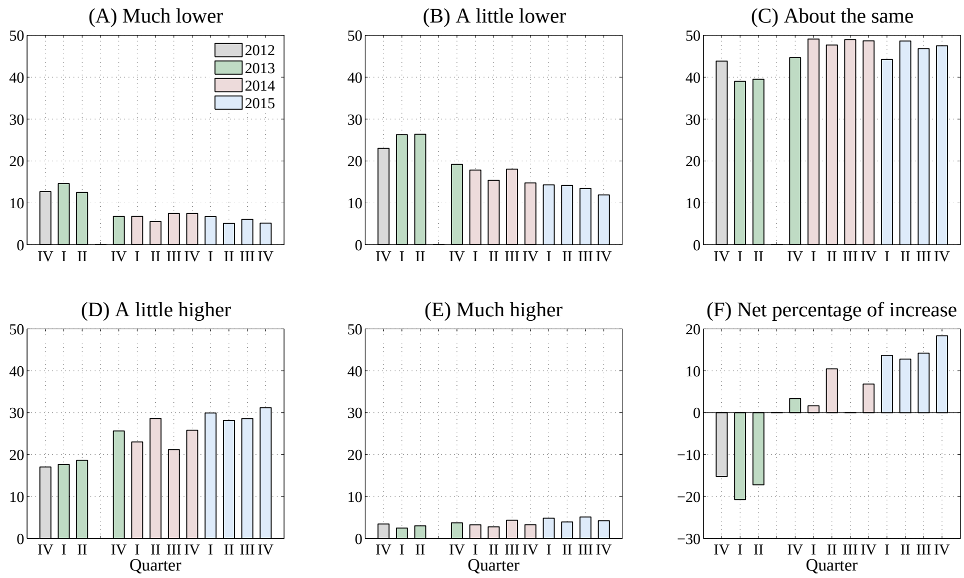


Figure 2.1: Firms' expectations of investment expenditure.

Panels A to E show the time evolution of the percentage responses (5 categories) to the expected investment equation. Panel F shows the net percentage of increase, calculated as the difference between the sum of the percentage responses of *much higher* and *a little higher* and the sum of the percentage responses of *much lower* and *a little lower*. Values are expressed in percentages. *Source*: Survey on Inflation and Growth Expectations.

Panels A to E of Figure 2.1 show the percentage responses to the expected investment equation distinguishing among the five response categories. It turns out that throughout the sample nearly half of the firms indicate investment expenditure plans basically unchanged. The share of firms reporting "a little lower" investment expectations decline over time (from 25% to 10%), in contrast with the increase for those expecting "a little higher" plans (from about 20% to 30%). The percentage of firms reporting "much lower" prospects stay at high levels until mid-2013 (roughly 15%), likely reflecting the then markedly adverse macroeconomic situation, and then halve. A roughly constant, but rather small (around 4%), fraction of firms signal "much higher" investment expectations.

Given the small shares of firms in the boundary categories, we proceed transforming the expected investment question into a trichotomous question, i.e. we consolidate the responses "much lower" and "a little lower" in "lower" and the responses "much higher" and "a little higher” in “higher”.

Another way to analyze the responses is to construct the *net percentage of increase*, i.e. the difference between the share of firms reporting “higher” and “lower” investment expectations. As shown in Panel F, the net percentage varies considerably in the sample. After being negative until mid-2013 the net percentage turns positive gaining momentum during 2015. This pattern broadly mirrors the observed fixed investment development in Italy, where the contraction in business investment slowed during 2013 and 2014 and a slight recovery was registered in 2015.

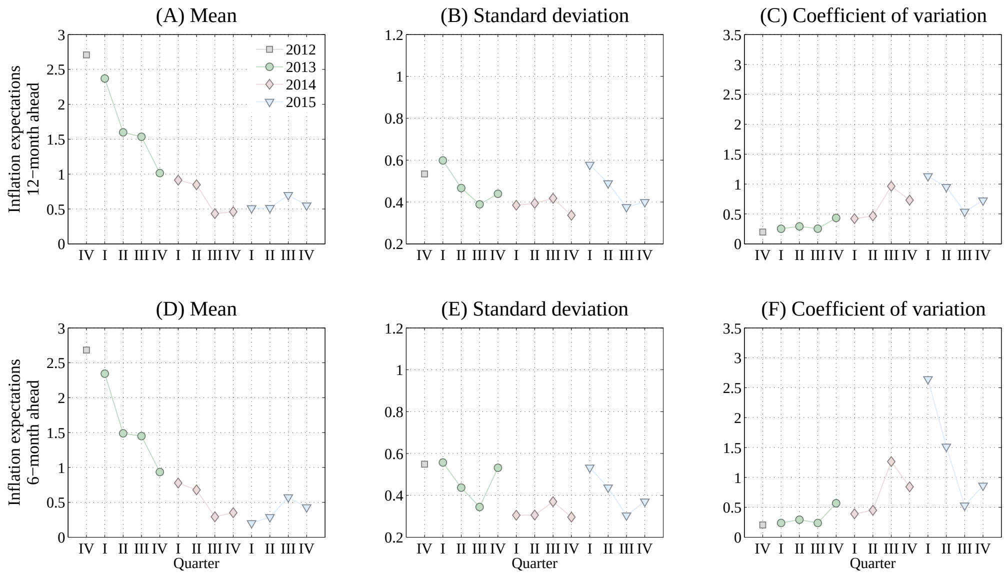


Figure 2.2: Firms’ expectations of Italy’s annual consumer price inflation.

Top and bottom panels refer to inflation expectations 12-month and 6-month ahead, respectively. Cross-sectional mean and standard deviation are calculated on equally-weighted data. Values are expressed in percentages. *Source*: Survey on Inflation and Growth Expectations.

Next, we turn to firms’ inflation expectations. Figure 2.2 shows the evolution of the (unweighted, cross-sectional) mean, standard deviation and coefficient of variation of inflation expectations 12-month ahead (top panels) and 6-month ahead (bottom panels). Several remarks are in order. First, regardless of the forecasting horizon, mean inflation expectation declines up to the third quarter of 2014. Thereafter, it settles down to historically very low levels, about 0.5 and 0.3% for the 12-month and 6-month ahead expectations, respectively. Second, firms’ inflation expectations exhibit a remarkable dispersion as indicated by the (unweighted, cross-sectional) standard deviation and the coefficient of variation. In particular, when considering this latter indicator, the dispersion increases significantly since mid-2014, reaching values about three times larger than those registered in the earlier part of the sample.

As shown in Figure 2.3, the evolution of the (unweighted, cross-sectional) mean, standard deviation and coefficient of variation of firm-level interest rates on term loans (top panels), matched loans (middle loans) and revocable loans (bottom panels) display qualitative developments similar to those for inflation expectations. Since mid-2014 for term loans and

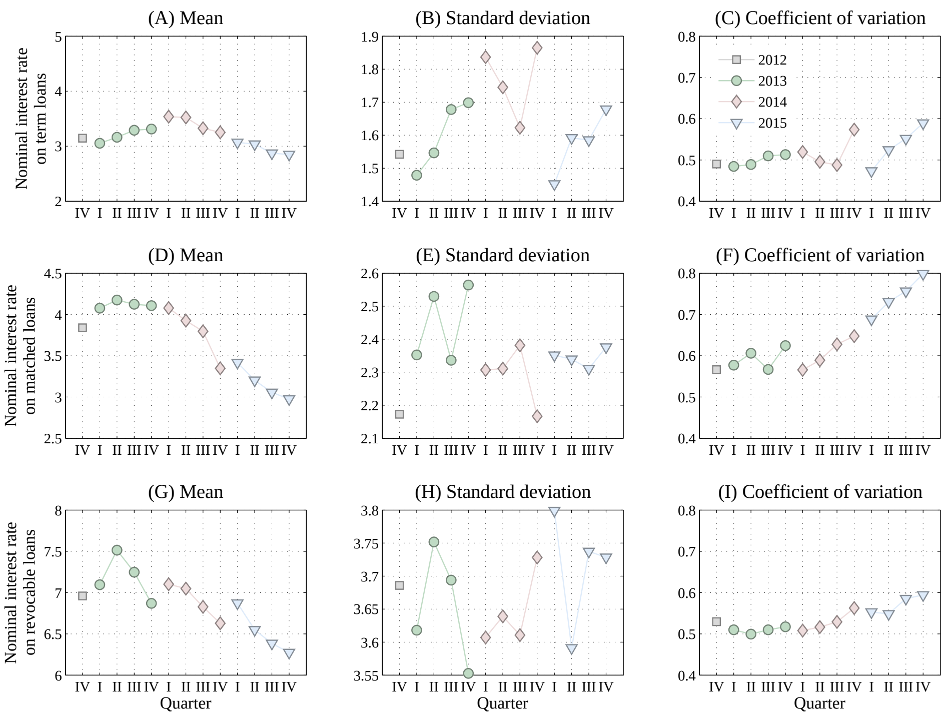


Figure 2.3: Statistics on firm-specific interest rates on outstanding amount of bank loans.

Top, middle and bottom panels refer to interest rates on term loans, matched loans and revocable loans, respectively. Cross-sectional mean and standard deviation are calculated on equally-weighted data. Values are expressed in percentages. *Source*: Italian Central Credit Register.

one year earlier for matched and revocable loans, mean interest rates start declining, reflecting the expansionary monetary policy of the ECB and the attenuation of sovereign debt tensions; interest rate dispersion gradually rises and more visibly so in the case of matched and revocable loans.

After describing the time evolution of firms' inflation expectations and borrowing costs, it is interesting to see how these variables relate to firms' investment expectations. To this end, Figure 2.4 reports the (unweighted, cross-sectional) mean inflation expectations 12-month and 6-month ahead (in panels A and B, respectively) and mean interest rates on term loans, matched loans and revocable loans (in panels C, D and E, respectively) distinguishing between firms reporting higher (solid line) and lower (dotted line) investment expectations. Several results are worth highlighting. First, it appears that there exists a positive correlation between inflation and investment expectations: firms that report higher (lower) investment plans are also those that predict higher (lower) inflation. On average the difference in inflation expectations is roughly 15 basis points.[10] Second, the relation between investment expectations and borrowing cost appears instead negative. Firms that indicate higher investment plans pay on average lower interest rates by about 40, 70 and 60 basis points on term loans, matched loans and revocable loans, respectively.

As for the other possible determinants of firms' investment expectations, Table 2.1 provides some preliminary statistics. For each question, the answers are grouped by whether the firms predicted higher, lower or about the same expected investments. Panel A reports the mean value of the answers to each question within each subgroup. Comparing firms predicting higher rather than lower investment expenditure, it turns out that the former firms on average indicate better prospects regarding their workforce and liquidity position, more favorable conditions concerning current investment opportunities and access to credit markets and a more optimistic sentiment on the current general economic outlook for Italy. Furthermore, firms indicating higher investment plans are on average bigger and more export-oriented. In terms of sector of economic activity and geographical area, there appear not to be significant differences. Finally, Panel B reports the relative frequency of response for each question. As more thoroughly explained in Section 2.3 we will use the modal response to compute the marginal effects.

## 2.3 Econometric methodology

In this section we first describe our empirical model, discussing some of the issues it addresses, and then we carefully explain how to implement the analysis.

### 2.3.1 Empirical model

We derive our baseline specification building on the previous empirical literature on the nexus between inflation expectations and future spending by households (see Bachmann et al. (2015) or Weber et al. (2015)).

[10]From December 2012 through September 2013, the relation between investment and inflation expectations is not so clear-cut.

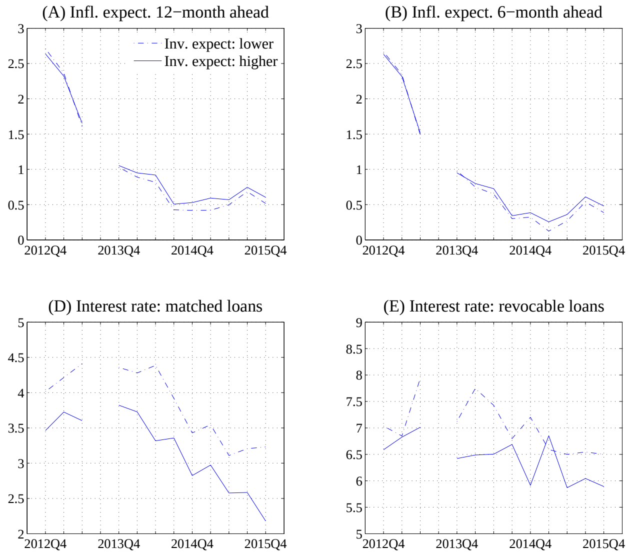


Figure 2.4: Developments of mean inflation expectations and borrowing cost.

Panels A and B show the (unweighted, cross-sectional) 12-month and 6-month ahead mean inflation expectations, respectively. Panels C, D and E report the mean interest rates on term loans, matched loans and revocable loans. The figure shows firms reporting higher (solid line) and lower (dotted line) investment expectations. *Sources*: Survey on Inflation and Growth Expectations and Italian Central Credit Register.

| Other main SIGE questions | (A) Investment plans | | | (B) Relative frequency of responses | | | |
|---|---|---|---|---|---|---|---|
| | lower | about the same | higher | (1) | (2) | (3) | (4) |
| a) Total employees (next 3 months) | 1.68 | 1.90 | 2.09 | 22.7 | **65.0** | 12.3 | n/a |
| b) Current conditions to invest | 1.71 | 1.92 | 2.09 | 19.8 | **68.8** | 11.4 | n/a |
| c) Current credit access conditions | 1.75 | 1.93 | 2.05 | 16.0 | **76.1** | 7.9 | n/a |
| d) Liquidity conditions (next 3 months) | 1.77 | 1.92 | 2.09 | 23.0 | **61.1** | 15.8 | n/a |
| e) Sentiment on Italy‘s current outlook | 1.65 | 1.87 | 2.02 | 27.1 | **60.1** | 12.8 | n/a |
| f) Size (nr. of employees) | 1.56 | 1.51 | 1.69 | **56.8** | 28.8 | 14.4 | n/a |
| g) Sector of economic activity | 1.81 | 1.81 | 1.70 | **40.9** | 40.5 | 18.6 | n/a |
| h) Openness to export | 1.87 | 1.96 | 2.12 | **47.1** | 22.0 | 16.6 | 14.3 |
| i) Geographical area | 2.36 | 2.41 | 2.37 | **28.5** | 27.2 | 21.5 | 22.7 |

Table 2.1: Descriptive statistics.

Panel A reports (unweighted) average response to the listed questions distinguishing across firms indicating lower, about the same and higher investment expectations. Panel B reports for each question the relative frequency of responses (values are in percentages). See Table B.3 in Appendix for the complete formulation of questions and the numerical codes used to represent the categories of response.

Empirically, there are two issues to be discussed. The first concern is that the regression might be endogenous, that is, there could be variables which influence both inflation expectations and investment plans of the firm, while the second problem, which arises because we analyse firms instead of households, is a reverse causality issue. Let's deal with the latter matter first. As we already pointed out, usually inflation expectations and investment plans are determined simultaneously, making it difficult to elicit the causality in their relation and therefore the rightfulness of the regression we want to carry on. Given the nature of our data, which are at micro level, and the answers to the questions that we focus on in SIGE, firms' expected plans of *their own* investment and firms' expectations of the *aggregate* price level, we believe our analysis will not suffer from this reverse causality issue, as we think it is unlikely that firms' individual decisions of future investments will influence the expectations on future aggregate Italian consumer price inflation. To solve the endogeneity problem, we borrow the solution from the previous empirical papers and augment the regression with a handful of controls which can potentially take care of this issue. Luckily, SIGE offers a variety of information we can exploit; for example, we have the firm's evaluation of the economic environment, the forecasts on its future workforce and on its own liquidity and access to markets conditions, as well as time dummies to catch the change of common macroeconomic variables and firm-specific determinants to help us detect fixed effects. Moreover, we will control for a number of firm-level characteristics (size, sector of economic activity, geographical area and openness to export). Our baseline model will be

$$I^p = c + \beta\Pi^e + \gamma'\mathbf{X} + \varepsilon \tag{2.1}$$

where, for each firm $i$ in period $t$, $I^*$ are its investment plans, $\Pi^e$ are its inflation expectations, $\mathbf{X}$ is a vector of controls and $\varepsilon$ is an error term assumed to be normally distributed (with mean zero and unitary variance).

### 2.3.2 Implementation: An ordered probit model

In our econometric analyses we use as dependent variable the ordered, trichotomous categorical response to the question on firms' investment expectations. It is well known that with categorical dependent variables the standard linear probability model is not well-suited as, among other things, it may yield predictions outside the admissible range of values. Hence, we estimate an ordered probit model.[11]

More specifically, let us assume there exists an unobserved continuous measure of a firm's readiness to invest, $I^*$, for which we are able to observe the discrete outcome. The first step in the econometric modelling is to establish a map between the $k$ observed ordinal categories of $I^p$ and the continuous latent variable $I^*$. The generic category $k$ is observed if the latent variable lies within a specific range defined by certain cut-off points, that is:

$$I^p = k \qquad \text{if} \qquad c_{k-1} < I^* \leq c_k \tag{2.2}$$

[11] In the robustness Section we examine the sensitivity of our results using the original 5-category formulation.

where $k = \{1, 2, 3\}$ and $c_0 < c_1 < \cdots < c_k$ with $c_0 = -\infty$ and $c_k = \infty$. So, with our trichotomous dependent variable there are two cut-off points.

The ordered probit model assumes that the conditional mean of the unobserved continuous dependent variable $I^*$ is a linear function of several observed explanatory variables $\mathbf{X}$ according to

$$I^* = \gamma'\mathbf{X} + \varepsilon \tag{2.3}$$

where $\gamma$ is a vector of coefficients to be estimated and $\varepsilon$ is an error term assumed to be normally distributed (with mean zero and unitary variance). The probability of observing the category $k$ is then:

$$\begin{aligned} \Pr\left(I^p = k|\mathbf{X}\right) &= \Pr\left(c_{k-1} < I^* \leq c_k\right) \\ &= \Phi\left(c_k - \gamma'\mathbf{X}\right) - \Phi\left(c_{k-1} - \gamma'\mathbf{X}\right) \end{aligned} \tag{2.4}$$

where $\Phi(\cdot)$ denotes the standard cumulative normal distribution function and $\gamma$ is a vector of regression coefficients. The parameters of the model (i.e. $\gamma$, $c_1$, $c_2$) are estimated via maximum likelihood with robust standard errors. With respect to the regressors $\mathbf{X}$, we will consider all the variables presented in Section 2.2 as well as (quarter-specific) time dummies to control for macroeconomic factors that may have occurred over our sample period.

Next, it is worth spending few words on how to calculate the *marginal effects*. The first thing to say is that, like any nonlinear regression model, the estimated regression coefficients $\gamma$ cannot be interpreted as marginal effects. Indeed, for a continuous explanatory variable $\mathbf{x}_i$ (such as firms' inflation expectations or borrowing cost) it holds true that

$$\frac{\partial \Pr\left(I^p = k|\mathbf{x}_{j\neq i}\right)}{\partial \mathbf{x}_i} = \left[\phi\left(c_k - \gamma'\mathbf{X}\right) - \phi\left(c_{k-1} - \gamma'\mathbf{X}\right)\right]\gamma_i \tag{2.5}$$

where $\phi(\cdot)$ denotes the normal density function. Hence, the above partial derivative not only depends on $\gamma_i$ but also on the values of $\mathbf{X}$.

For the categorical explanatory variables the marginal effect is instead calculated as the discrete first-difference from the base category. For example the marginal effect for a bivariate categorical variable would be:

$$\frac{\Delta \Pr\left(I^p = k|\mathbf{x}_{j\neq i}\right)}{\Delta\left(\mathbf{x}_i\right)} = \Pr(I^p = k|\mathbf{x}_i = 2, \mathbf{x}_{j\neq i}) - \Pr(I^p = k|\mathbf{x}_i = 1, \mathbf{x}_{j\neq i}) \tag{2.6}$$

Unless otherwise specified, in what follows we will compute the marginal effects at the sample means for the continuous variables and at the modal category for the other regressors.

One last consideration before moving to the estimation results. The ordered probit model is estimated pooling the data across firms and quarters. Unfortunately, the panel structure of the data set is highly unbalanced. We come back to this issue in Section 2.6 on robustness check.

## 2.4 Results

In this Section, we present the main results from the ordered probit estimation. First, we focus on the marginal effect of inflation expectations on the predicted probability to invest and then on the marginal effects of the nominal and real borrowing cost. Next, we consider the marginal effects of the other explanatory variables. Unless otherwise specified, the marginal effects are evaluated at the sample means for inflation expectations and borrowing cost and at the modal categories for the other predictors.

### 2.4.1 Marginal effects of inflation expectations

The upper part of Table 2.2 reports (in bold) the marginal effects of inflation expectations (12-month and 6-month ahead in Panel A and B, respectively) on the predicted probability to invest, distinguishing among the three possible outcomes: *lower*, *about the same* and *higher*. In these baseline specifications the firm-level nominal borrowing cost is not included. Nevertheless, we use control variables that to some extent take into account the external financing conditions. We refer in particular to the question on the firms' current access conditions to credit market as well as the question pertaining the expected liquidity conditions for the firm. Also, the inclusion of time dummies could to some extent capture the fall in bank lending rates that to a large extent reflected a common driver, namely the accommodative monetary policy stance.

As shown in Table 2.2, the marginal effect of inflation expectations (regardless of the horizon) is statistically significant (at 5%) for the boundary categories (*lower* and *higher*). A one percentage point increase in inflation expectations – that roughly corresponds to a one standard deviation of the empirical distribution of firms' inflation expectations – is associated with a fall (rise) by nearly 2.5 percentage points in the predicted probability of lower (higher) investment expectations.

We obtain these marginal effects when the ordered probit model basically includes all the controls. Tables B.4 and B.5 (reported in Appendix B.3) report the results when the controls are instead added one by one to the basic specification. To save space, we let the demographics controls (number of employees, sector of economic activity, share of revenues from exports and geographical area) and the time dummies be always present in the model and only show the results for the boundary categories. The estimates indicate that the marginal effect of inflation expectations (statistically significant at 1%) is virtually unchanged across all specifications: the effect on the predicted probability of *lower* investment plans varies between $-0.034$ and $-0.029$ whereas that of *higher* investment expectations between 0.026 and 0.031.

Next, we investigate whether the previous results are affected by the evaluation points around which the marginal effect is calculated. As documented in Section 2.2, firms' inflation expectations showed a downward trend for a large part of the sample and exhibited a great deal of variation. Hence, evaluating the marginal effect at the sample mean could be not fully informative. Likewise, it is worthwhile exploring the marginal effects of inflation expectations when the other control variables are evaluated off modal categories.

| Explanatory variables | Dependent variable: firms' investment plans | | | | | |
|---|---|---|---|---|---|---|
| | Panel A | | | Panel B | | |
| | Lower | About the same | Higher | Lower | About the same | Higher |
| **Inflation expectations 12-m ahead** | **-0.023**** | **-0.001** | **0.024**** | | | |
| **Inflation expectations 6-m ahead** | | | | **-0.025**** | **-0.001** | **0.026**** |
| Number of employees (next 3 months): | | | | | | |
| Lower (*base category*) | | | | | | |
| Unchanged | -0.113*** | 0.019*** | 0.094*** | -0.112*** | 0.019*** | 0.094*** |
| Higher | -0.232*** | -0.029* | 0.260*** | -0.231*** | -0.028* | 0.259*** |
| Liquidity conditions (next 3 month): | | | | | | |
| Worse (*base category*) | | | | | | |
| The same | -0.033*** | 0.001 | 0.032*** | -0.034*** | 0.001 | 0.032*** |
| Better | -0.065*** | -0.003 | 0.068*** | -0.067*** | -0.003 | 0.069*** |
| Current economic outlook in Italy: | | | | | | |
| Worse (*base category*) | | | | | | |
| The same | -0.039*** | 0.002 | 0.038*** | -0.040*** | 0.002 | 0.038*** |
| Better | -0.072*** | -0.002 | 0.074*** | -0.073*** | -0.002 | 0.075*** |
| Current investment conditions: | | | | | | |
| Worse (*base category*) | | | | | | |
| The same | -0.097*** | 0.014** | 0.083*** | -0.096*** | 0.014** | 0.083*** |
| Better | -0.166*** | -0.001 | 0.167*** | -0.165*** | -0.001 | 0.167*** |
| Current credit access conditions: | | | | | | |
| Worse (*base category*) | | | | | | |
| The same | -0.071*** | 0.007 | 0.064*** | -0.072*** | 0.007 | 0.064*** |
| Better | -0.136*** | -0.006 | 0.142*** | -0.137*** | -0.006 | 0.142*** |
| Number of employees: | | | | | | |
| 50-199 (*base category*) | | | | | | |
| 200-999 | -0.017* | -0.001 | 0.019* | -0.017* | -0.001 | 0.019* |
| over 999 | -0.010 | -0.001 | 0.010 | -0.010 | -0.001 | 0.011 |
| Sector: | | | | | | |
| Industry (*base category*) | | | | | | |
| Service | -0.016 | -0.001 | 0.018 | -0.016 | -0.001 | 0.018 |
| Construction | -0.003 | -0.000 | 0.003 | -0.002 | -0.000 | 0.003 |
| Revenues from exports: | | | | | | |
| 0 (*base category*) | | | | | | |
| 0-33% | -0.017 | -0.001 | 0.018 | -0.017 | -0.001 | 0.018 |
| 33-66% | -0.012 | -0.001 | 0.012 | -0.013 | -0.001 | 0.014 |
| 66-100% | -0.063*** | -0.012*** | 0.075*** | -0.063*** | -0.012*** | 0.075*** |
| Geographical area: | | | | | | |
| North-West (*base category*) | | | | | | |
| North-East | 0.008 | 0.000 | -0.008 | 0.007 | 0.000 | -0.007 |
| Centre | 0.017 | 0.000 | -0.017 | 0.017 | -0.000 | -0.017 |
| South and Islands | -0.037*** | -0.005* | 0.042*** | -0.037*** | -0.005* | 0.042*** |
| Pseudo $R^2$ | 0.071 | | | 0.071 | | |
| Number of observations | 7344 | | | 7344 | | |

Note: *, **, and *** denote statistical significance at the 10%, 5% and 1% critical level, respectively.

Table 2.2: Baseline estimates from ordered probit model: marginal effects on predicted probability of investment expectations.

The Table reports the marginal effects for each response category of the dependent variable (Lower, About the same and Higher) and considering separately firms' inflation expectations 12-month ahead (Panel A) and 6-month ahead (Panel B). Beyond the explanatory variables shown, both specifications also controls for time fixed effects (not reported). Marginal effects for continuous and discrete variables are calculated as explained in Section 2.3.

| Evaluation point | Response categories: Lower | About the same | Higher |
|---|---|---|---|
| $\pi^e = 0.0\%$ | -0.024** | 0.001 | 0.022** |
| $\pi^e = 0.2\%$ | -0.024** | 0.001 | 0.023** |
| $\pi^e = 0.4\%$ ($\simeq 25^{th}$ percentile) | -0.023** | 0.001 | 0.023** |
| $\pi^e = 0.6\%$ | -0.023** | 0.000 | 0.023** |
| $\pi^e = 0.8\%$ ($\simeq$ median) | -0.023** | -0.000 | 0.023** |
| $\pi^e = 1.0\%$ ($\simeq$ mean) | -0.023** | -0.001 | 0.024** |
| $\pi^e = 1.2\%$ | -0.023** | -0.001 | 0.024** |
| $\pi^e = 1.4\%$ | -0.022** | -0.002 | 0.024** |
| $\pi^e = 1.6\%$ ($\simeq 75^{th}$ percentile) | -0.022** | -0.002 | 0.024** |
| $\pi^e = 1.8\%$ | -0.022** | -0.003 | 0.024** |
| $\pi^e = 2.0\%$ | -0.022*** | -0.003 | 0.025** |
| $\pi^e = 2.2\%$ | -0.021*** | -0.003 | 0.025** |
| $\pi^e = 2.4\%$ | -0.021*** | -0.004 | 0.025** |
| $\pi^e = 2.6\%$ ($\simeq 95^{th}$ percentile) | -0.021*** | -0.004 | 0.025** |
| $\pi^e = 2.8\%$ | -0.021*** | -0.005 | 0.025** |
| $\pi^e = 3.0\%$ | -0.020*** | -0.005 | 0.026** |

Note: *, **, and *** denote statistical significance at the 10%, 5% and 1% critical level, respectively.

Table 2.3: Baseline estimates from ordered probit model: marginal effects of firms' inflation expectations 12-month ahead on predicted probability of investment expectations when evaluated at various levels of inflation expectations.

The Table reports the marginal effects of firms' inflation expectations 12-month ahead when evaluated at levels of inflation expectations ranging from 0 to 3. The specification of the ordered probit model (not reported) is as in Table 2.2.

In Table 2.3 we report the marginal effect of 12-month ahead inflation expectations evaluated for levels of inflation expectations ranging from 0.0 to 3.0% and keeping the other predictors at their modal category. Interestingly, the results are virtually unchanged compared with those reported in Table 2.2. A closer inspection of the estimates reveals that when evaluated at higher levels of inflation expectations the marginal effect on the predicted probability of higher investment slightly increases; the pattern appears reversed when looking at the predicted probability of lower investment expectations. These effects are quantitatively modest and might depend on the fact that inflation expectations are allowed to lie in a small range of variation (consistent with what observed in our sample period).

Next, we turn to a complementary exercise. We calculate the marginal effect of inflation expectations off modal categories for the control variables and for different levels of inflation expectations, namely 0.4% (i.e. the $25^{th}$ percentile), 1.0% (i.e. the mean), 1.6% (i.e. $75^{th}$ percentile) and 2.6% (i.e. the $95^{th}$ percentile). Table 2.4 reports the results. Several remarks are in order. First, the marginal effect of inflation expectations is always statistically significant for the boundary categories and in some cases also for response category *about the same*. Second, no matter the level of inflation expectations, the marginal effect appears particularly sensitive to the expected number of firms' employees in the next three months, the firms' perception of current investment conditions and current credit access conditions. As a matter of fact, when the evaluation is set at the *worse*, *about the same* or *better* category of these latter variables (i.e. at category 1, 2 or 3), the marginal effect on the predicted probability of *higher* (*lower*) investment expectations increases substantially. For instance, in the case of the expected number

| Evaluation point | | Panel A: $\Pi^e = 0.4\%$ lower | about the same | higher | Panel B: $\Pi^e = 1.0\%$ lower | about the same | higher |
|---|---|---|---|---|---|---|---|
| Nr. empl. (next 3 months) | = 1 | -0.028** | 0.010** | 0.017** | -0.027** | 0.009** | 0.018** |
| Nr. empl. (next 3 months) | = 2 | -0.023** | 0.001 | 0.023** | -0.023** | -0.001 | 0.024** |
| Nr. empl. (next 3 months) | = 3 | -0.016** | -0.012** | 0.028** | -0.015** | -0.013** | 0.028** |
| Liq. cond. (next 3 months) | = 1 | -0.025** | 0.004 | 0.021** | -0.024** | 0.002 | 0.022** |
| Liq. cond. (next 3 months) | = 3 | -0.022** | -0.003 | 0.025** | -0.021** | -0.004* | 0.025** |
| Current outlook (in Italy) | = 1 | -0.025** | 0.004 | 0.021** | -0.025** | 0.003 | 0.022** |
| Current outlook (in Italy) | = 3 | -0.022** | -0.003 | 0.025** | -0.021** | -0.004 | 0.025** |
| Current investment cond. | = 1 | -0.027** | 0.009** | 0.018** | -0.027** | 0.008** | 0.019** |
| Current investment cond. | = 3 | -0.020** | -0.007** | 0.026** | -0.019** | -0.008** | 0.027** |
| Current credit access cond. | = 1 | -0.026** | 0.007* | 0.019** | -0.026** | 0.006* | 0.020** |
| Current credit access cond. | = 3 | -0.020** | -0.006** | 0.026** | -0.019** | -0.008** | 0.027** |
| Current nr. empl. | = 2 | -0.023** | -0.001 | 0.024** | -0.022** | -0.003 | 0.024** |
| Current nr. empl. | = 3 | -0.023** | -0.000 | 0.023** | -0.022** | -0.002 | 0.024** |
| Sector of activity | = 2 | -0.023** | -0.001 | 0.024** | -0.022** | -0.002 | 0.024** |
| Sector of activity | = 3 | -0.023** | 0.000 | 0.023** | -0.023** | -0.001 | 0.024** |
| Revenues from exports | = 2 | -0.023** | -0.001 | 0.024** | -0.022** | -0.002 | 0.024** |
| Revenues from exports | = 3 | -0.023** | -0.001 | 0.024** | -0.022** | -0.002 | 0.024** |
| Revenues from exports | = 4 | -0.020** | -0.006** | 0.026** | -0.019** | -0.007** | 0.026** |
| Geographical area | = 2 | -0.024** | 0.001 | 0.023** | -0.023** | -0.000 | 0.023** |
| Geographical area | = 3 | -0.024** | 0.002 | 0.022** | -0.024** | 0.001 | 0.023** |
| Geographical area | = 4 | -0.022** | -0.003* | 0.025* | -0.021** | -0.004* | 0.025** |

| Evaluation point | | Panel C: $\Pi^e = 1.6\%$ lower | about the same | higher | Panel D: $\Pi^e = 2.5\%$ lower | about the same | higher |
|---|---|---|---|---|---|---|---|
| Nr. empl. (next 3 months) | = 1 | -0.027** | 0.008*** | 0.019** | -0.026*** | 0.006*** | 0.020** |
| Nr. empl. (next 3 months) | = 2 | -0.022** | -0.002 | 0.024** | -0.021*** | -0.004 | 0.025** |
| Nr. empl. (next 3 months) | = 3 | -0.014** | -0.014** | 0.029** | -0.013*** | -0.016** | 0.029** |
| Liq. cond. (next 3 months) | = 1 | -0.024** | 0.001 | 0.023** | -0.023*** | -0.001 | 0.024** |
| Liq. cond. (next 3 months) | = 3 | -0.020** | -0.005* | 0.026** | -0.019*** | -0.007 | 0.026** |
| Current outlook (in Italy) | = 1 | -0.024** | 0.002 | 0.022** | -0.023*** | -0.000 | 0.023** |
| Current outlook (in Italy) | = 3 | -0.020** | -0.005 | 0.026** | -0.019*** | -0.007 | 0.027** |
| Current investment cond. | = 1 | -0.026** | 0.006** | 0.020** | -0.025*** | 0.005** | 0.021** |
| Current investment cond. | = 3 | -0.018** | -0.009** | 0.027** | -0.017*** | -0.011* | 0.028** |
| Current credit access cond. | = 1 | -0.025** | 0.004* | 0.021** | -0.024*** | 0.002 | 0.022** |
| Current credit access cond. | = 3 | -0.018** | -0.009* | 0.027** | -0.017*** | -0.011* | 0.028** |
| Current nr. empl. | = 2 | -0.021** | -0.004 | 0.025** | -0.020*** | -0.006 | 0.026** |
| Current nr. empl. | = 3 | -0.022** | -0.003 | 0.025** | -0.021*** | -0.005 | 0.026** |
| Sector of activity | = 2 | -0.021** | -0.004 | 0.025** | -0.020*** | -0.006 | 0.026** |
| Sector of activity | = 3 | -0.022** | -0.002 | 0.024** | -0.021*** | -0.004 | 0.025** |
| Revenues from exports | = 2 | -0.021** | -0.004 | 0.025** | -0.020*** | -0.006 | 0.026** |
| Revenues from exports | = 3 | -0.021** | -0.003 | 0.025** | -0.020*** | -0.005 | 0.026** |
| Revenues from exports | = 4 | -0.018** | -0.009** | 0.027** | -0.017*** | -0.010* | 0.028** |
| Geographical area | = 2 | -0.023** | -0.001 | 0.024** | -0.021*** | -0.003 | 0.025** |
| Geographical area | = 3 | -0.023** | -0.001 | 0.023** | -0.022*** | -0.003 | 0.024** |
| Geographical area | = 4 | -0.020** | -0.006* | 0.026** | -0.019*** | -0.008 | 0.026** |

Response categories

Note: *, **, and *** denote statistical significance at the 10%, 5% and 1% critical level, respectively.

Table 2.4: Baseline estimates from ordered probit model: marginal effects of firms' 12-month ahead inflation expectations on predicted probability of investment expectations when evaluated at different levels for the explanatory variables.

The Table reports the marginal effects of firms' 12-month ahead inflation expectations when evaluated at different levels for the explanatory variables and for various levels of inflation expectations, namely 0.4, 1.0, 1.6 and 2.6respectively in Panels A, B, C and D. The specification of the ordered probit model (not reported) is as in Table 2.2.

of employees the marginal effect on the predicted probability of higher investment expectations becomes 1.7, 2.3 and 2.8% (with inflation expectations set at 0.4%); the marginal effect on the predicted probability of lower investment expectations is instead −2.8, −2.3 and −1.6%. Similar quantitative results are reported with reference to the current investment and credit access conditions. As for the other control variables, the marginal effects are virtually unchanged. Third, looking at the Table entries by row - as to highlight the possible implications of varying inflation expectations - it turns out that the marginal effects are practically unaffected thus confirming the previous findings.

| | Dependent variable: business investment expectations | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Panel A** | | | **Panel B** | | | **Panel C** | | |
| **Explanatory variables** | Lower | About the same | Higher | Lower | About the same | Higher | Lower | About the same | Higher |
| **Ex-ante real borrowing cost: term loans** | **0.000** | **0.000** | **-0.000** | | | | | | |
| **Ex-ante real borrowing cost: matched loans** | | | | **0.005*** | **0.001** | **-0.006*** | | | |
| **Ex-ante real borrowing cost: revocable loans** | | | | | | | **0.000** | **0.000** | **-0.001** |
| Number of employees (next 3 months) | | | | | | | | | |
| Lower (*base category*) | | | | | | | | | |
| Unchanged | -0.105*** | 0.010 | 0.095*** | -0.114*** | 0.010 | 0.104*** | -0.107*** | 0.011 | 0.096*** |
| Higher | -0.224*** | -0.051* | 0.276*** | -0.233*** | -0.061* | 0.295*** | -0.236*** | -0.061*** | 0.297*** |
| Liquidity conditions (next 3 month) | | | | | | | | | |
| Worse (*base category*) | | | | | | | | | |
| The same | -0.052*** | 0.000 | 0.052*** | -0.052*** | -0.001 | 0.053*** | -0.058*** | 0.001 | 0.057*** |
| Better | -0.094*** | -0.009 | 0.104*** | -0.063** | -0.003 | 0.067** | -0.093*** | -0.006 | 0.100*** |
| Current economic outlook in Italy | | | | | | | | | |
| Worse (*base category*) | | | | | | | | | |
| The same | -0.028* | -0.001 | 0.030* | -0.030* | -0.002 | 0.032* | -0.038** | -0.001 | 0.039** |
| Better | -0.072*** | -0.011 | 0.084*** | -0.068*** | -0.012 | 0.080*** | -0.079*** | -0.010 | 0.089*** |
| Current investment conditions | | | | | | | | | |
| Worse (*base category*) | | | | | | | | | |
| The same | -0.142*** | 0.022 | 0.120*** | -0.116*** | 0.011 | 0.105*** | -0.119*** | 0.014 | 0.105*** |
| Better | -0.204*** | 0.004 | 0.200*** | -0.192*** | -0.019 | 0.211*** | -0.195*** | -0.011 | 0.206*** |
| Number of employees | Yes | | | Yes | | | Yes | | |
| Sector of economic activity | Yes | | | Yes | | | Yes | | |
| Revenues from exports | Yes | | | Yes | | | Yes | | |
| Geographical area | Yes | | | Yes | | | Yes | | |
| Time dummy | Yes | | | Yes | | | Yes | | |
| Pseudo $R^2$ | 0.073 | | | 0.069 | | | 0.073 | | |
| Number of observations | 4388 | | | 3680 | | | 4284 | | |

Note: *, **, and *** denote statistical significance at the 10%, 5% and 1% critical level, respectively.

Table 2.5: Baseline estimates from ordered probit model: marginal effects on predicted probability of investment expectations.

The Table reports the marginal effects for each response category of the dependent variable (Lower, About the same and Higher) and considering among the explanatory variables the firm-level ex-ante real interest rate, calculated as the difference between the borrowing cost and the 12-month ahead inflation expectation. Panels A, B and C report the firm-level ex-ante real borrowing cost on term loans, matched loans and revocable loans, respectively. Marginal effects for continuous and discrete variables are calculated as explained in Section 2.3.

| Explanatory variables | Dependent variable: firms' investment plans | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Panel A | | | Panel B | | | Panel C | | |
| | Lower | About the same | Higher | Lower | About the same | Higher | Lower | About the same | Higher |
| **Inflation expectations 12-m ahead** | **-0.015** | **-0.002** | **0.017** | **-0.027**** | **-0.004** | **0.031**** | **-0.020*** | **-0.002** | **0.022*** |
| **Borrowing cost: term loans** | **-0.001** | **-0.000** | **0.001** | | | | | | |
| **Borrowing cost: matched loans** | | | | **0.004** | **0.001** | **-0.004** | | | |
| **Borrowing cost: revocable loans** | | | | | | | **0.000** | **0.000** | **-0.000** |
| Number of employees (next 3 months) | | | | | | | | | |
| Lower (*base category*) | | | | | | | | | |
| Unchanged | -0.105*** | 0.009 | 0.095*** | -0.114*** | 0.009 | 0.104*** | -0.107*** | 0.010 | 0.097*** |
| Higher | -0.223*** | -0.052** | 0.276*** | -0.232*** | -0.062** | 0.294*** | -0.234*** | -0.062*** | 0.296*** |
| Liquidity conditions (next 3 month) | | | | | | | | | |
| Worse (*base category*) | | | | | | | | | |
| The same | -0.053*** | -0.000 | 0.053*** | -0.053*** | -0.002 | 0.055*** | -0.058*** | 0.001 | 0.058*** |
| Better | -0.095*** | -0.010 | 0.104*** | -0.064** | -0.003 | 0.067** | -0.092*** | -0.007 | 0.099*** |
| Current economic outlook in Italy | | | | | | | | | |
| Worse (*base category*) | | | | | | | | | |
| The same | -0.028* | -0.001 | 0.029* | -0.029* | -0.002 | 0.031* | -0.038** | -0.001 | 0.039** |
| Better | -0.071*** | -0.012 | 0.082*** | -0.066*** | -0.012 | 0.078*** | -0.078*** | -0.010 | 0.088*** |
| Current investment conditions | | | | | | | | | |
| Worse (*base category*) | | | | | | | | | |
| The same | -0.141*** | 0.021* | 0.121*** | -0.116*** | 0.010 | 0.106*** | -0.119*** | 0.013 | 0.105*** |
| Better | -0.203*** | 0.002 | 0.201*** | -0.192*** | -0.020 | 0.212*** | -0.194*** | -0.012 | 0.206*** |
| Number of employees | Yes | | | yes | | | yes | | |
| Sector of economic activity | Yes | | | yes | | | yes | | |
| Revenues from exports | Yes | | | yes | | | yes | | |
| Geographical area | Yes | | | yes | | | yes | | |
| Time dummy | Yes | | | yes | | | yes | | |
| Pseudo $R^2$ | 0.073 | | | 0.069 | | | 0.073 | | |
| Number of observations | 4388 | | | 3680 | | | 4284 | | |

Note: *, **, and *** denote statistical significance at the 10%, 5% and 1% critical level, respectively.

Table 2.6: Baseline estimates from ordered probit model: marginal effects on predicted probability of investment expectations.

The Table reports the marginal effects for each response category of the dependent variable (Lower, About the same and Higher) and considering among the explanatory variables firms' 12-month ahead inflation expectations and the firm-level borrowing cost on term loans (Panel A), matched loans (Panel B) and revocable loans (Panel C). Marginal effects for continuous and discrete variables are calculated as explained in Section 2.3.

### 2.4.2 Marginal effects of the real rates

Another fundamental determinant of a firm's investment decisions should be the cost of credit (assuming the firm is not financially constrained). In this respect, we should mention that in separate regressions not reported here (but available upon request) we found that augmenting the baseline specifications in Table 2.2 with firms' borrowing cost (one of the three lending rates discussed earlier) led to statistically insignificant marginal effects of the borrowing cost itself as well as of inflation expectations. It turned out that this result likely reflected the presence in the model of two highly correlated predictors, namely the firms' borrowing cost and firms' credit access conditions, that might to a large extent capture the same economic phenomenon. In light of these considerations, we decided to proceed in our analysis removing the control variable for access to credit markets from the set of predictors.

We then consider two cases. In the first one (see Table 2.5), we construct the firm-level *ex-ante* real borrowing cost, thus imposing a restriction on the coefficients loading the firms' (nominal) borrowing cost and inflation expectations. In the second one (see Table 2.6), we let the firms' inflation expectations and the firm-level borrowing cost enter the ordered probit model as two distinct predictors. In either case, we use the three measures of borrowing cost.

Several results are worth noting. First of all, as reported in the upper part of Table 2.5, the firm-level ex-ante real interest rate is in general a poor predictor of the predicted probability to invest. As a matter of fact, only in the case of the ex-ante real interest rate on matched loans the marginal effect is weakly statistically significant. The size of the effect is also very small: a 100 basis points increase in the ex-ante real interest rate decreases (increase) the predicted probability of higher (lower) investment expectations by nearly 0.6 (0.5) percentage points[12]. While we are not the first ones to find a minor role of the borrowing cost to explain business investment decisions[13], the scarce role of the borrowing cost could reflect the fact that we are analyzing a sample period characterized for large part by tight credit supply conditions. This in turn could suggest that estimating the ordered probit model with the ex-ante real borrowing cost might not find empirical support and the correct thing to do would be to include the nominal borrowing cost and the inflation expectations as two different regressors. And this leads us to our final remarks. First, as reported in Table 2.6, the marginal effect of inflation expectations (12-month ahead) continues to be statistically significant (for the extreme outcomes) only when the borrowing cost is measured with the interest rate on matched loans (see Panel B) or on revocable loans (see Panel C). In this latter case the effect is weakly significant. Quantitatively, the marginal effects are virtually identical to those reported in Table 2.2. Second, the marginal effect of the firm-level (nominal) borrowing cost on the predicted probability to invest is never significant. It is also worth noting that in these latter cases the marginal effect of the borrowing cost is remarkably smaller than that of inflation expectations.

All in all, our results so far indicate that: 1) in our sample of roughly 7,300 Italian firms,

[12] Even adding one by one the other controls, the marginal effects of the nominal or real borrowing cost are often statistically insignificant.

[13] See Chirinko, Fazzari and Meyer (2001) Chirinko et al. (1999) for a thorough review of the empirical work seeking to estimate the elasticity of capital formation with respect to the user cost of capital.

there is evidence that business investment expectations are positively affected by inflation expectations and barely respond to the nominal borrowing cost; 2) these findings are robust to various model specifications and checks.

### 2.4.3 Discrete marginal effects of other control variables

In this Section we discuss the marginal effects of the other control variables. The baseline results are reported in Table 2.2 (where the firms' borrowing cost is omitted from the specification). As these variables are categorical, the Table entries represent the discrete marginal effects from the base category (see Section 2.3).

Several results are worth noting. For most explanatory variables the marginal effects on the predicted probability of reporting *lower* or *higher* investment expectations are (strongly) statistically significant[14]. In what follows, we comment on the marginal effect on the *higher* response category concentrating on the model specification that includes firms' 12-month ahead inflation expectations (Panel A of Table 2.2). Everything else equal, firms that expect to expand their own workforce in the next three months are more likely (compared with the base category) to indicate higher investment expectations: the predicted probability increases remarkably by 26%. Similarly, firms whose credit access conditions improve compared to the previous three months or perceive better investment conditions are also more likely to report higher investment expectations: the predicted probabilities increase by 14.2 and 16.7 percentage points, respectively. Somewhat, smaller marginal effects show up for firms displaying more favourable expected liquidity conditions, or which are more confident about the current state of the economy in Italy.

The estimates also indicate that the predicted probability of reporting higher investment increases for firms whose share of revenues from exports exceeds 66%, are located in the area *South & Island* or are medium-sized (in this latter the case the effect is only weakly significant). No differentiated effect is instead reported with respect to the sector of economic activity.

Moreover, note that the above results are virtually identical when considering firms' 6-month ahead inflation expectations (Table 2.2, Panel B), the nominal or ex-ante real borrowing cost (Tables 2.6 and 2.5) or each control one at a time (Tables B.4 and B.5 ).

## 2.5 Interpreting our results

In this section we want to take a step back and think about a possible interpretation of our results on the real rate and more in general on the borrowing cost.

These are in fact some of our most fascinating results, as our analysis seems to suggest that in reality what matters for the future investment of a firm are its expectations on inflation and not a simple real rate.

With respect to our particular sample, we have to say that it is characterized by a general tightening of lending conditions to firms, so one way to explain our result on the borrowing

[14] In several cases also the predicted probability of observing the response about the same is significant.

cost could be by thinking of a situation in which businesses have accumulated cash reserves for precautionary purposes and they can decide whether to finance the expenditure for investments via cash or by bank debt[15]. If businesses have accumulated much cash they can decide to use it for the purchase of capital and therefore they can be indifferent to the level of interest rates. Similarly, if inflation expectations rise, the purchasing power of cash decreases and then businesses may want to use it immediately (so the expected investment spending grows). In this regard it is interesting to note that in Italy, as well as in other countries, in recent years we have witnessed a great increase of liquid assets in companies' balance sheets. This "excess" liquidity may explain the low sensitivity of investment to interest rates.

Another way to interpret our results on the nominal rate is to think to constrained firms. Differently from the last case, constrained firms do not hold cash but have a lot of debt. A rise in inflation expectation could ease the burden of the outstanding debt by lowering the real interest rate, thus for a constrained firm inflation expectations could be more important than the nominal borrowing cost.

## 2.6 Robustness checks and further results

In this Section we present the results of a number of exercises: 1) we assess to what extent our previous results are robust to the use of firms' longer-term inflation expectations; 2) we investigate how results change when using the original responses to the investment equation that entails 5 possible outcomes; 3) we examine the coefficients stability by splitting the sample in two periods; 4) we attempt to estimate a panel ordered probit on a sub-sample of firms; and 5) we assess to what extent firms' investment expectation turn into realized investment.

### 2.6.1 Longer-term inflation expectations

In the past years firms participating in SIGE have been asked to provide their annual consumer price inflation expectations at longer-term horizons, namely 2-year ahead and 2-year 2-year ahead.[16] Figure B.1 in Appendix B.2 show the time evolution of the (unweighted, cross-sectional) mean longer-term inflation expectations. In this Section we see whether our previous results carry over when estimating the baseline ordered probit models with firms' longer-term inflation expectations. Table 2.7 reports the results. Panels A and B show the marginal effects of inflation expectations (2-year and 2-year 2-year ahead, respectively) and of selected control variables on the predicted probability investment expectations. Furthermore, panels C and B report the marginal effect of the (nominal) interest rate applied to firms' revocable loans. In light of our previous results, we do not consider the other measures of borrowing cost nor estimate the model with the *ex-ante* real borrowing cost. Although not shown in the Table, each specification includes all the control variables as in Table 2.2.

[15] There is in fact evidence that bank debt and accumulation of cash by companies are substitutes. See Ferreira and Vilela (2004)

[16] The question on the 2-year 2-year ahead inflation expectations has been included in the Survey only since March 2014.

| Explanatory variables | Dependent variable: firms' investment plans | | | | | |
|---|---|---|---|---|---|---|
| | **Panel A** | | | **Panel B** | | |
| | Lower | About the same | Higher | Lower | About the same | Higher |
| **Infl. expectations 2-y ahead** | **-0.016**** | **-0.001** | **0.016**** | | | |
| **Infl. expectations 2-y 2-y ahead** | | | | **-0.020***** | **-0.003** | **0.023***** |
| Nr. of employees (next 3 months) | | | | | | |
| Unchanged | -0.113*** | 0.019*** | 0.095*** | -0.089*** | 0.004 | 0.085*** |
| Higher | -0.232*** | -0.029* | 0.261*** | -0.198*** | -0.063*** | 0.261*** |
| Liquidity conditions (next 3 month) | | | | | | |
| The same | -0.033*** | 0.001 | 0.032*** | -0.038*** | -0.003 | 0.041*** |
| Better | -0.065*** | -0.003 | 0.068*** | -0.063*** | -0.009 | 0.072*** |
| Current economic outlook in Italy | | | | | | |
| The same | -0.040*** | 0.002 | 0.038*** | -0.066*** | -0.000 | 0.066*** |
| Better | -0.072*** | -0.002 | 0.074*** | -0.101*** | -0.010 | 0.111*** |
| Current investment conditions | | | | | | |
| The same | -0.097*** | 0.014** | 0.083*** | -0.123*** | 0.013 | 0.110*** |
| Better | -0.166*** | -0.002 | 0.167*** | -0.178*** | -0.006 | 0.184*** |
| Current credit access conditions | | | | | | |
| The same | -0.072*** | 0.007 | 0.065*** | -0.051** | -0.002 | 0.053*** |
| Better | -0.137*** | -0.006 | 0.143*** | -0.114*** | -0.025** | 0.139*** |
| Pseudo $R^2$ | 0.071 | | | 0.067 | | |
| Number of observations | 7344 | | | 5008 | | |

| Explanatory variables | **Panel C** | | | **Panel D** | | |
|---|---|---|---|---|---|---|
| | Lower | About the same | Higher | Lower | About the same | Higher |
| **Infl. expectations 2-y ahead** | **-0.006** | **-0.001** | **0.006** | | | |
| **Infl. expectations 2-y 2-y ahead** | | | | **-0.007** | **-0.002** | **0.009** |
| **Borrowing cost: revocable loans** | **0.000** | **0.000** | **-0.000** | **0.000** | **0.000** | **-0.000** |
| Nr. of employees (next 3 months) | | | | | | |
| Unchanged | -0.107*** | 0.010 | 0.097*** | -0.089*** | -0.007 | 0.096*** |
| Higher | -0.235*** | -0.062*** | 0.296*** | -0.200*** | -0.111*** | 0.311*** |
| Liquidity conditions (next 3 month) | | | | | | |
| The same | -0.058*** | 0.001 | 0.058*** | -0.049*** | -0.009 | 0.058*** |
| Better | -0.094*** | -0.007 | 0.100*** | -0.085*** | -0.026* | 0.110*** |
| Current economic outlook in Italy | | | | | | |
| The same | -0.038** | -0.001 | 0.039** | -0.054** | -0.009 | 0.063*** |
| Better | -0.079*** | -0.010 | 0.089*** | -0.102*** | -0.034** | 0.136*** |
| Current investment conditions | | | | | | |
| The same | -0.119*** | 0.014 | 0.105*** | -0.155*** | 0.009 | 0.146*** |
| Better | -0.195*** | -0.012 | 0.206*** | -0.211*** | -0.024 | 0.234*** |
| Pseudo $R^2$ | 0.073 | | | 0.073 | | |
| Number of observations | 4284 | | | 2842 | | |

Note: *, **, and *** denote statistical significance at the 10%, 5% and 1% critical level, respectively.

Table 2.7: Robustness check: marginal effects on predicted probability of investment expectations using longer-term firms' inflation expectations.

The Table reports the marginal effects for each response category of the dependent variable (Lower, About the same and Higher) and considering among the explanatory variables firms' longer-term inflation expectations (Panels A and B) and also the firm-level borrowing cost on revocable loans (Panels C and D). Although not reported the specification of the ordered probit model also include: number of employees, sector of economic activity, revenues from exports, geographical area and time fixed effects. Marginal effects for continuous and discrete variables are calculated as explained in Section 2.3.

The table entries quite clearly indicate that our previous results are largely confirmed. In Panel A, the marginal effects of the 2-year ahead inflation expectations are somewhat smaller than in the baseline case: a 100 basis point increase in inflation expectations rises the predicted probability of higher investment expectations by 1.6 percentage points (2.4 in the baseline). Conversely, in Panel B the marginal effects estimated using the 2-year 2-year ahead inflation expectations turn out to be pretty much in line with the baseline (in this case however the number of observations is considerably reduced). Also, the marginal effects of the other control variables are virtually unchanged compared to the baseline. When adding the borrowing cost (panels C and D) the marginal effects of inflation expectations and of the interest rate are not statistically significant, thus confirming our previous results according to which - at least in our sample period - the borrowing cost does not seem to be a good predictor of firms' investment expectations.

### 2.6.2 Original 5-category investment question

As discussed in Section 2.2.1, SIGE asks firms to provide their expectations on investment expenditure by choosing among five possible answers: *much lower*, *a little lower*, *about the same*, *a little higher* and *much higher*. For the reasons explained we conducted all our baseline analysis recoding the answers to the investment expectations question in three categories. In this Section we then check to what extent our previous results change when estimating the ordered probit model using the original 5-category formulation. Table 2.8 reports the marginal effects of the two key variables of our analysis, namely the inflation expectations and the borrowing cost[17].

Two remarks are in order. First, it turns out that even considering the 5-category dependent variable all our previous results are confirmed. In models (1a)-(4a) the marginal effect of higher inflation expectation (at any forecasting horizon) significantly increases (decreases) the predicted probability of higher (lower) investment expectations. When considering the model with the (nominal) borrowing cost, the marginal effects lose significance except in the case of matched loans, where, in particular with 12-month ahead inflation expectations, the marginal effects (weakly significant) display the sign of the coefficients in the baseline regression. Second, we would have expected larger marginal effects of inflation expectations for the extreme categories *much lower* and *much higher* than for the categories *a little lower* and *a little higher* but, as shown in the Table, this is not the case.

### 2.6.3 Sub-sample estimation

In this Section we explore the sensitivity of our baseline results (focusing on the marginal effects of inflation expectations and borrowing cost) when the ordered probit model is estimated over the period 2014Q1 − 2015Q4. We consider this particular sub-sample for several reasons. First, as documented in Section 2.2, since the beginning of 2014 the cross-sectional dispersion among

[17]Needless to say, all the other control variables (as in Table 2.2) are always included in the model specification. We estimate a total of 16 ordered probit models

| Model | Selected regressors | Dependent variable: firms' investment plans | | | | |
|---|---|---|---|---|---|---|
| | | Much lower | A little lower | About the same | A little higher | Much higher |
| (1a) | Infl. expectations 6-month ahead | -0.009** | -0.014** | -0.002 | 0.020** | 0.005** |
| (2a) | Infl. expectations 12-month ahead | -0.007** | -0.011** | -0.002 | 0.016** | 0.004** |
| (3a) | Infl. expectations 2-year ahead | -0.005** | -0.009** | -0.001 | 0.013** | 0.003** |
| (4a) | Infl. expectations 2-year 2-year ahead | -0.007*** | -0.012*** | -0.004** | 0.018*** | 0.004*** |
| (1b) | Infl. expectations 6-month ahead | -0.004 | -0.007 | -0.002 | 0.010 | 0.003 |
| | Borrowing cost: term loans | -0.000 | -0.001 | -0.000 | 0.001 | 0.000 |
| (2b) | Infl. expectations 12-month ahead | -0.004 | -0.007 | -0.002 | 0.010 | 0.003 |
| | Borrowing cost: term loans | -0.000 | -0.001 | -0.000 | 0.001 | 0.000 |
| (3b) | Infl. expectations 2-year ahead | -0.002 | -0.004 | -0.001 | 0.005 | 0.002 |
| | Borrowing cost: term loans | -0.000 | -0.001 | -0.000 | 0.001 | 0.000 |
| (4b) | Infl. expectations 2-year 2-year ahead | -0.003 | -0.006 | -0.004 | 0.009 | 0.003 |
| | Borrowing cost: term loans | 0.000 | 0.001 | 0.000 | -0.001 | -0.000 |
| (1c) | Infl. expectations 6-month ahead | -0.007 | -0.013 | -0.004 | 0.019 | 0.005 |
| | Borrowing cost: matched loans | 0.002* | 0.003* | 0.001 | -0.004* | -0.001* |
| (2c) | Infl. expectations 12-month ahead | -0.007* | -0.013* | -0.004 | 0.018* | 0.005 |
| | Borrowing cost: matched loans | 0.002* | 0.003* | 0.001 | -0.004* | -0.001* |
| (3c) | Infl. expectations 2-year ahead | -0.003 | -0.006 | -0.002 | 0.008 | 0.002 |
| | Borrowing cost: matched loans | 0.001* | 0.003* | 0.001 | -0.004* | -0.001* |
| (4c) | Infl. expectations 2-year 2-year ahead | -0.003* | -0.008* | -0.005 | 0.013* | 0.004 |
| | Borrowing cost: matched loans | 0.001* | 0.003* | 0.002* | -0.006* | -0.002* |
| (1d) | Infl. expectations 6-month ahead | -0.006 | -0.010 | -0.003 | 0.015 | 0.004 |
| | Borrowing cost: revocable loans | 0.000 | 0.001 | 0.000 | -0.001 | -0.000 |
| (2d) | Infl. expectations 12-month ahead | -0.006 | -0.010 | -0.003 | 0.015 | 0.004 |
| | Borrowing cost: revocable loans | 0.000 | 0.001 | 0.000 | -0.001 | -0.000 |
| (3d) | Infl. expectations 2-year ahead | -0.002 | -0.004 | -0.001 | 0.006 | 0.001 |
| | Borrowing cost: revocable loans | 0.000 | 0.001 | 0.000 | -0.001 | -0.000 |
| (4d) | Infl. expectations 2-year 2-year ahead | -0.003 | -0.005 | -0.003 | 0.009 | 0.002 |
| | Borrowing cost: revocable loans | 0.000 | 0.000 | 0.000 | -0.000 | -0.000 |

Note: *, **, and *** denote statistical significance at the 10%, 5% and 1% critical level, respectively.

Table 2.8: Robustness check: marginal effects on predicted probability of investment expectations using the 5-category response.

The Table reports the marginal effects for each of the five response category of the dependent variable (Much Lower, A little lower, About the same, A little higher and Much higher) and considering among the explanatory variables firms' inflation expectations (6-month, 12-month, 2-year and 2-year 2-year ahead) and the firm-level borrowing cost on term loans, matched loans and revocable loans. Although not reported the specification, the ordered probit model include all the control variables as in Table 2.2. Marginal effects for continuous variables are calculated as explained in Section 2.3.

firms' inflation expectations rose significantly. Measured by the coefficient of variation, the dispersion roughly doubled compared with the previous period. It thus makes sense to look at this more recent period, characterized by a larger variation in inflation expectations. Second, also the net percentage of firms reporting higher investment expectations becomes positive and progressively increases during 2014 and 2015; in earlier periods the latter is remarkably negative (around −15%) possibly reflecting the political instability that characterized those years. Third, since roughly 2014, access conditions to bank credit started to improve. This is not only confirmed by the answers given in SIGE, but also from the information stemming from other surveys[18].

| | | **Dependent variable: predicted probability of investing** | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Panel A: sample 2014Q1-2015Q4** | | | **Panel B: baseline (*per memo*)** | | |
| **Model** | **Selected regressors** | Lower | About the same | Higher | Lower | About the same | Higher |
| (1a) | Infl. expectations 6-month ahead | -0.051*** | -0.008* | 0.059*** | -0.025** | -0.001 | 0.026** |
| (1b) | Infl. expectations 12-month ahead | -0.034*** | -0.005 | 0.039*** | -0.023** | -0.001 | 0.024** |
| (2a) | Infl. expectations 12-month ahead | -0.024* | -0.008 | 0.032* | -0.015 | -0.002 | 0.017 |
| | Borrowing cost: term loans | 0.001 | 0.000 | -0.001 | -0.001 | -0.000 | 0.001 |
| (3a) | Infl. expectations 12-month ahead | -0.045*** | -0.016** | 0.061*** | -0.027** | -0.004 | 0.031** |
| | Borrowing cost: matched loans | 0.005* | 0.002 | -0.007* | 0.004 | 0.001 | -0.004 |
| (4a) | Infl. expectations 12-month ahead | -0.027* | -0.009 | 0.036* | -0.020* | -0.002 | 0.022* |
| | Borrowing cost: revocable loans | 0.000 | 0.000 | -0.000 | 0.000 | 0.000 | -0.000 |

Note: *, **, and *** denote statistical significance at the 10%, 5% and 1% critical level, respectively.

Table 2.9: Robustness check: sub-sample estimation of marginal effects on predicted probability of investment expectations.

The Table reports the marginal effects for each response category of the dependent variable (Lower, About the same and Higher) estimated using data from March 2014 to December 2015 (Panel A). For memo, baseline estimates are reported in Panel B. Marginal effects for continuous variables are calculated as explained in Section 2.3.

Panel A of Table 2.9 reports the marginal effects for the sub-sample regression (the baseline results are in Panel B). Also in this case several remarks are worth making. First, in models (1a) and (1b), which do not include the borrowing cost, the marginal effects of inflation expectations (either 6-month or 12-month ahead) on the extreme outcomes turn out to be remarkably larger than in the baseline case (roughly twice as big) and also statistically significant at 1%. A 100 basis points rise in firms' 6-month or 12-month ahead inflation expectations increases the net predicted probability of reporting higher investment expectations by about 11 and 7 percentage points. Second, the results somewhat improve with respect to the baseline also when we include in the model the borrowing cost (and exclude the regressor relative to firms' access conditions to credit) . The marginal effect of inflation expectations is always statistically significant, though weakly significant in the cases of term loans (model 2a) and revocable loans (model 4a). Again,

[18] See for instance the replies by the Italian banks participating in the Bank Lending Survey or by the Italian firms interviewed by Istat (Bank of Italy, Economic Bulletin (2016)).

the marginal effects are roughly twice as large than those shown in Panel B. Third, even with the shorter sample period, the marginal effect of the borrowing cost is generally not statistically significant; the only exception is in model (3a) where the borrowing cost (on matched loans) is weakly significant.

### 2.6.4 Random-effects ordered probit estimation

So far we have estimated the ordered probit models by pooling the data across firms and time. In this Section we attempt to fit a panel ordered probit model whose main advantage is the ability to better control for time-invariant individual heterogeneity. We have not pursued this empirical strategy in our baseline estimation for two main reasons. First, the panel structure of our data is rather unbalanced. Our dataset counts $1,273$ individual firms and 12 individual quarters: 50% of firms are observed for 6 quarters or less and 25% for at least 10 quarters (only 5% for the entire sample length). The severity of this problem somewhat decreases when starting from $2014Q1$. In this case the number of individual firms is $1,121$ and the number of individual quarters is 8; furthermore, 50% of firms are observed for 5 quarters or less and 25% for at least 7 quarters (only 5% for the entire sample length). Second, the orthogonality condition between the unobserved heterogeneity across firms (that the random-effect estimation accounts for) and the other observed variables might be violated in our current context. As a matter of fact, most of our explanatory variables are qualitative attaining to firms' expectations of various economic matters and thus are likely to correlate with individual specific (random) effect. This would than lead to inconsistent estimates.

With these caveats in mind and in light of our previous findings, we estimate a panel ordered probit model with random effects over the period 2014Q1-2015Q4, excluding from the model specification those explanatory variables whose marginal effects were mostly statistically insignificant (current number of employees, sector of economic activity, share of revenues from exports and geographical area).

Results are reported in Table 2.10. Again, it turns out that all our previous findings are largely confirmed. The marginal effects of 12-month ahead inflation expectations are only weakly significant (for the extreme categories), while those of 6-month ahead inflation expectations remain significant at 5% (for all outcomes). Also, the marginal effect of the firm-level borrowing cost is not statistically significant (not shown).

## 2.7 Conclusions

In this paper we use Italian business survey data to provide new evidence on the nexus between firms' inflation expectations and their attitude to invest. We document that such relation exists and is positive: in the most general econometric specification, a one percentage point increase in the 12-month ahead expected inflation raises (reduces) firms' predicted probability of having a positive (negative) attitude towards investing by about 2.5 percentage points. These results are robust to several checks (use of shorter-term or longer-term inflation expectations, sub-sample estimation or random effects ordered probit estimation). We also provide new evidence on other

| Explanatory variables | Panel A: Lower | Panel A: About the same | Panel A: Higher | Panel B: Lower | Panel B: About the same | Panel B: Higher |
|---|---|---|---|---|---|---|
| | **Dependent variable: predicted probability of investing** | | | | | |
| **Infl. expectations 6-m ahead** | -0.030** | -0.010** | 0.040** | | | |
| **Infl. expectations 12-m ahead** | | | | -0.019* | -0.007 | 0.025* |
| Number of employees (next 3 months) | | | | | | |
| Unchanged | -0.063*** | -0.008** | 0.071*** | -0.063*** | -0.008** | 0.071*** |
| Higher | -0.146*** | -0.080*** | 0.226*** | -0.146*** | -0.081*** | 0.227*** |
| Liquidity conditions (next 3 months) | | | | | | |
| The same | -0.059*** | -0.011*** | 0.070*** | -0.059*** | -0.011*** | 0.070*** |
| Better | -0.083*** | -0.024*** | 0.107*** | -0.083*** | -0.024*** | 0.107*** |
| Current economic outlook in Italy | | | | | | |
| The same | -0.054*** | -0.008*** | 0.062*** | -0.054*** | -0.008*** | 0.062*** |
| Better | -0.102*** | -0.037*** | 0.139*** | -0.102*** | -0.037*** | 0.139*** |
| Current investment conditions | | | | | | |
| The same | -0.103*** | -0.004 | 0.107*** | -0.103*** | -0.004 | 0.107*** |
| Better | -0.137*** | -0.024** | 0.161*** | -0.138*** | -0.024** | 0.161*** |
| Current credit access conditions | | | | | | |
| The same | -0.031 | -0.007** | 0.038* | -0.030 | -0.007** | 0.037* |
| Better | -0.081*** | -0.037*** | 0.118*** | -0.080*** | -0.036*** | 0.116*** |
| Time dummy | Yes | Yes | Yes | Yes | Yes | Yes |

Note: *, **, and *** denote statistical significance at the 10%, 5% and 1% critical level, respectively.

Table 2.10: Robustness check: random-effects ordered probit estimation.

The Table reports the marginal effects on predicted probability of investment expectations distinguishing between firms' 6-month inflation expectations (Panel A) and firms' 12-month inflation expectations (Panel B). Marginal effects are calculated as explained in Section 2.3.

determinants of firms' investment decisions and find that business investment attitude is largely unrelated to the firm-level nominal borrowing cost and to the ex-ante real interest rate.

Our findings offer support to policy measures aimed at engineering higher inflation expectations (through expansionary monetary and/or fiscal policies) in order to stimulate aggregate investment.

Notwithstanding, this policy result must be taken with some caution. First, we are providing reduced-form estimates and thus our findings are subject to the Lucas critique. Second, our empirical analysis covers a specific sample period, which includes part of the sovereign debt crisis and the aftermaths, and thus our results may not obtain in other phases of the business cycles or in other circumstances. In this regards, our empirical results alone do not justify the proposition that central banks should commit to higher inflation targets (to raise inflation expectations) but rather to drive business inflation expectations towards the target.

# Bibliography

Abel, A. (1990). Asset prices under habit formation and catching up with the joneses. *American Economic Review 80*, 38–42.

Bachmann, R., T. O. Berg, and E. R. Sims (2015, February). Inflation Expectations and Readiness to Spend: Cross-Sectional Evidence. *American Economic Journal: Economic Policy 7*(1), 1–35.

Bansal, R. and M. Yaron (2004). Risks for the long run: a potential resolution of asset pricing puzzles. *Journal of Finance 59*, 1481–1509.

Barro, R. J. (1995, October). Inflation and Economic Growth. Nber working papers, National Bureau of Economic Research, Inc.

Bekaert, G., E. Engstrom, and S. Grenadier (2004). Stock and bond returns with moody investors. *Journal of Empirical Finance 17*, 867–894.

Bekaert, G., E. Engstrom, and Y. Xing (2009). Risk, uncertainty, and asset prices. *Journal of Financial Economics 91*, 59–82.

Bekaert, G. and J. Liu (2004). Conditioning information and variance bounds on pricing kernels. *Review of Financial Studies*.

Boguth, O. and L.-A. Kuehn (2013). Consumption volatility risk. *Journal of Finance LXVIII (6)*, 2589–2615.

Bound, J., C. Brown, and N. Mathiowetz (2001). Measurement error in survey data. *Handbook of econometrics 5*, 3705–3843.

Breeden, D. T., R. H. Litzenberger, and T. Jia (2015). Consumption-based asset pricing, part 1: Classic theory and tests, measurement issues, and limited participation. *Annual Review Financ. Econ. 7*, 35–83.

Bryan, M. F., B. Meyer, and N. B. Parker (2014). The inflation expectations of firms: what do they look like, are they accurate, and do they matter? Technical Report 2014-27, Federal Reserve Bank of Atlanta.

Bugamelli, M., L. Cannari, F. Lotti, and S. Magri (2012). The innovation gap of Italy's production system: roots and possible solutions. Questioni di Economia e Finanza (Occasional Papers) 121, Bank of Italy.

Bullard, J. and J. J. Keating (1995). The long-run relationship between inflation and output in postwar economies. *Journal of Monetary Economics 49*, 477–496.

Burke, M. A. and A. K. Ozdagli (2013). Household inflation expectations and consumer spending: evidence from panel data. Working papers, Federal Reserve Bank of Boston.

Campbell, J. and H. Cochrane (1999). By force of habit: A consumption-based explanation of aggregate stock market behavior. *The Journal of Political Economy 107*, 205–251.

Cesaroni, T. and S. Iezzi (2015, September). The predictive content of business survey indicators: evidence from SIGE. Temi di discussione (Economic working papers) 1031, Bank of Italy.

Chatelain, J.-B., A. Generale, I. Hernando, U. Von Kalckreuth, and P. Vermeulen (2001, December). Firm investment and monetary transmission in the euro area. Working paper series, European Central Bank.

Chirinko, R. S., S. M. Fazzari, and A. P. Meyer (1999). How responsive is business capital formation to its user cost?: An exploration with micro data. *Journal of Public Economics 74*(1), 53–80.

Chirinko, R. S., S. M. Fazzari, and A. P. Meyer (2002, January). That Elusive Elasticity: A Long-Panel Approach To Estimating The Price Sensitivity Of Business Capital. 10th International Conference on Panel Data, Berlin, July 5-6, 2002 B3-1, International Conferences on Panel Data.

Cova, P. and G. Ferrero (2015). The eurosystem's asset purchase programmes for monetary policy purposes. *Bank of Italy Occasional Paper* (270).

Cox, J., M. Ingersoll, and S. Ross (1985). A theory of the term structure of interest rates. *Econometrica 53*, 385–408.

Estrella, A. and G. Hardouvelis (1991). Why does the yield curve predict output and inflation? *Journal of Finance*.

Fazzari, S. M., R. G. Hubbard, and B. C. Petersen (1988). Financing Constraints and Corporate Investment. *Brookings Papers on Economic Activity 19*, 141–206.

Fazzari, S. M. and B. C. Petersen (1993). Working Capital and Fixed Investment: New Evidence on Financing Constraints. *RAND Journal of Economics 24*(3), 328–342.

Ferreira, M. A. and A. S. Vilela (2004). Why do firms hold cash? evidence from emu countries. *European Financial Management 10*(2), 295–319.

Ferson, W. and J. Merrick (1987). Non-stationarity and stage-of-the-business-cycle effects in consumption-based asset pricing relations. *Journal of Financial Economics*.

Fischer, S. (1993). The role of macroeconomic factors in growth. *Journal of Monetary Economics 32*(3), 485–512.

Gaiotti, E. (2013). Credit availability and investment: Lessons from the ï¿½great recessionï¿½. *European Economic Review 59*(C), 212–227.

Gaiotti, E. and A. Generale (2002, June). Does Monetary Policy Have Asymmetric Effects? A Look at the Investment Decisions of Italian Firms. *Giornale degli Economisti 61*(1), 29–59.

Gennaioli, N., Y. Ma, and A. Shleifer (2015). Expectations and Investment. In *NBER Macroeconomics Annual 2015, Volume 30*. National Bureau of Economic Research, Inc.

Gurkaynak, R. S., B. Sack, and J. Wright (2010). The tips yield curve and inflation compensation. *American Economic Journal: Macroeconomics 2*.

Gurkaynak, R. S., B. Sack, and J. H. Wright (2007). The u.s. treasury yield curve: 1961 to the present. *Journal of Monetary Economics 54*.

Ichiue, H. and S. Nishiguchi (2015). Inflation expectations and consumer spending at the zero bound: Micro evidence. *Economic Inquiry 53*(2), 1086–1107.

Kandel, S. and R. Stambaugh (1990). Expectations and volatility of consumption and asset returns. *Review of Financial Studies*.

Kaplan, S. N. and L. Zingales (1997). Do investment-cash flow sensitivities provide useful measures of financing constraints? *The Quarterly Journal of Economics 112*(1), 169–215.

Khan, M. S., A. S. Senhadji, and B. D. Smith (2006). Inflation And Financial Depth. *Macroeconomic Dynamics 10*(02), 165–182.

Kumar, S., H. Afrouzi, O. Coibion, and Y. Gorodnichenko (2015). Inflation Targeting Does Not Anchor Inflation Expectations: Evidence from Firms in New Zealand. NBER Working Papers 21814, National Bureau of Economic Research, Inc.

Kurmann, A. and C. Otrok (2013). News shocks and the slope of the term structure of interest rates. *American Economic Review*.

Lettau, M., S. Ludvigson, and J. Wachter (2008). The declining equity premium: What role does macroeconomic risk play? *Review of Financial Studies*.

Richards, S. and M. Verstraete (2016). Understanding Firms' Inflation Expectations Using the Bank of Canada's Business Outlook Survey. Technical report.

Sharpe, S. A. and G. A. Suarez (2013, December). The insensitivity of investment to interest rates: Evidence from a survey of CFOs. Finance and Economics Discussion Series 2014-2, Board of Governors of the Federal Reserve System (U.S.).

Wachter, J. (2005). Solving models with external habit. *Finance Research Letters 2*, 210–226.

Wachter, J. (2006). A consumption-based model of the term structure of interest rates. *Journal of Financial Economics 79*, 365–399.

Weber, M., D. Hoang, and F. D'Acunto (2015). Inflation Expectations and Consumption Expenditure. 2015 Meeting Papers 1266, Society for Economic Dynamics.

Whitelaw, R. (1990). Stock market risk and return: an equilibrium approach. *Review of Financial Studies*.

Yogo, M. (2006). A consumption-based explanation of expected stock returns. *Journal of Finance 61.*

# Appendix A

# Appendix to Chapter 1

## A.1 Reference model

The standard CC framework and its extension in Wachter (2006) are described below. Representative investors have preferences over consumption with respect to a slow-moving reference level $X_t$, that is an exogenous habit level (the "keeping up with the Joneses" features motivated in Abel (1990)). The surplus-consumption ratio is the only state variable; a lognormal stochastic discount factor is defined and the one-period risk-free rate is derived in closed form from the Euler equation.[1]

The agent maximises

$$E_t \sum_{t=0}^{\infty} \beta^t \frac{(C_t - X_t)^{1-\gamma} - 1}{1-\gamma} \tag{A.1}$$

where $C$ is consumption and $X$ is an exogenous consumption habit level. The key variable on which consumer's choices are based is the surplus-consumption ratio, defined as

$$S_t \equiv \frac{C_t - X_t}{C_t} \tag{A.2}$$

Consumption growth is assumed to be a random walk

$$\Delta c_{t+1} = g + v_{t+1}, \qquad v_{t+1} \sim N(0, \sigma_v), \tag{A.3}$$

and the log of the surplus-consumption ratio is calibrated in a way that ensures procyclicality: it is the weighted sum of a constant term, an autoregressive component and the consumption shock $v_{t+1}$ with a positive time-varying coefficient $\lambda(s_t)$. This term $\lambda(s_t)$ is a sensitivity parameter

[1] With respect to the standard Lucas (1978) framework with power utility, habit preferences introduce some conceptual differences. The closed-form risk-free rate in the standard model under uncertainty is

$$r_{t,t+1} = -\ln \delta + \gamma \mathrm{E}_t(\Delta c_{t+1}) - \frac{\gamma^2}{2} \mathrm{VAR}_t(\Delta c_{t+1})$$

While interest rates depend only on contemporaneous consumption shocks in the original framework, here the state variable is backward looking and mean-reverting, depending on past shocks other than the contemporaneous one. Secondly, risk aversion is now time varying ($\gamma/S_t$): for a constant $\gamma$, it falls during booms and increases during recessions (it is countercyclical).

defined as a square root function of past values of the process; $g$ being the average growth rate of consumption, $\gamma$ the exponential parameter of the power utility and $\phi$ the habit persistence parameter (assuming values between 0 and 1), $s_{t+1}$ follows

$$s_{t+1} = (1-\phi)\bar{s} + \phi s_t + \lambda(s_t)(\Delta c_{t+1} - g) \tag{A.4}$$

with

$$\lambda(s_t) = \begin{cases} \frac{1}{\bar{S}}\sqrt{1-2(s_t-\bar{s})} - 1 & \text{if } s \leq s_{max} \\ 0 & \text{otherwise} \end{cases} \tag{A.5}$$

and

$$s_{max} = \bar{s} + \frac{1}{2}(1-\bar{S}^2), \qquad \bar{S} = \sigma_v\sqrt{\frac{\gamma}{1-\phi}} \tag{A.6}$$

As CC shows, the functional forms of $\lambda(s_t)$ and $\bar{s} = \ln\bar{S}$ are such that: (i) the risk-free rate is constant; (ii) habit is predetermined at the steady state $s_t = \bar{s}$; (iii) habit is predetermined near the steady state and moves nonnegatively with consumption everywhere.

Wachter (2006) applies an alternative specification suggested by CC, that verifies requirements (ii) and (iii) but allows the short-term rate to be a linear function of the state. The functional form of $\lambda$ is left unchanged, but $\bar{S}$ is now calibrated in the following way:

$$\bar{S} = \sigma_v\sqrt{\frac{\gamma}{1-\phi-b/\gamma}} \tag{A.7}$$

Given this specification, the stochastic discount factor is

$$\begin{aligned} M_{t+1} &= \frac{\beta U_c(C_{t+1}-X_{t+1})}{U_c(C_t-X_t)} = \\ &= \beta\exp(-\gamma(g+(\phi-1)(s_t-\bar{s})+(1+\lambda(s_t))(\Delta c_{t+1}-g))) \end{aligned} \tag{A.8}$$

From the closed-form specification of $M_{t+1}$ it is straightforward to derive the formula of the risk-free rate, using the log normality assumption:

$$r_t^f = \ln\frac{1}{E_t M_{t+1}} = -\ln\delta + \gamma g + \gamma(\phi-1)(s_t-\bar{s}) - \frac{\gamma^2\sigma_{t+1}^2}{2}(1+\lambda(s_t))^2 \tag{A.9}$$

## A.2 Market-implied real interest rates

Professional forecasters started to produce estimates of CPI inflation expectations at the beginning of the 80's, so those can not be used to retrieve real rates (by subtracting inflation expectations from nominal rates) before that date. We instead follow the procedure proposed in Chapter 3 of the April 2014's *World Economic Outlook* of the IMF: inflation expectations are computed as out-of-sample forecasts from a simulated autoregressive process of inflation. In this way we can estimate real rates for the whole sample (up to the 1960's).

Denoting $P_t$ the monthly consumer price index at time $t$, an autoregressive model with 12 lags ($AR(12)$) is fitted on the variable $\gamma_t = lnP_t - lnP_{t-12}$; the estimation is carried out on a rolling window of 60 months in order to mitigate the effect of parameter instability. Model-based inflation expectations for horizon $j$ are computed using out-of-sample forecasts of $\gamma_t$. Real rates are then recovered as

$$r_{n,t} = r^{\$}_{n,t} - \frac{(1-g)}{(1-g^n)} \sum_{i=1}^{n} g^i E_t \pi_{t,t+1}$$

where $r_{n,t}$ and $r^{\$}_{n,t}$ are the real and nominal rates at time $t$ on a bond of maturity $n$, $E_t\pi_{t,t+i}$ is the inflation expectation at time $t$ for period $t+i$ and $g = (1+\bar{r}^{\$})^{-i}$, with $\bar{r}^{\$}$ being the average nominal rate. The real rate is therefore equal to the nominal rate minus a weighted average of the inflation expectation over the entire life of the bond.

## A.3 Pricing of real and nominal bonds

Let $P_{n,t}$ denote the price of a real bond maturing in $n$ periods, and $P^{\$}_{n,t}$ the price of a nominal bond. Prices are computed as expectations of the future compounded SDFs until maturity.

The real price is determined recursively from the Euler equation (1.15) with boundary condition $P_{0,t} = 1$. Note that $P_{n,t}$ is a function of the posterior probability $\xi_{t+1|t}$. We solve for these functional equations numerically on a grid of values for the state variable $\xi_{t+1|t}$. Conditional on $\xi_{t+1|t}$, the price of the bond is a function of $s_t$ alone, so equation (1.15) can be rewritten as

$$\begin{aligned} P_{n,t} &= E_t\left[\delta\left(\frac{C_{t+1}}{C_t}\frac{S_{t+1}}{S_t}\right)^{-\gamma} P_{n-1,t+1}\right] \\ &= E_t\left[M_{t+1}P_{n-1,t+1}\right] \\ &= \sum_{j\in\{h,l\}} \xi_{t+1|t}(j)E_t[M_{t+1}P_{n-1,t+1}|\sigma_{\zeta_{t+1}} = \sigma_j, \xi_{t+1|t}] \\ &= \sum_{j\in\{h,l\}} \xi_{t+1|t}(j)E_t[e^{\ln\delta-\gamma[g+(1-\phi)(\bar{s}-s_t)+(\lambda(s_t)+1)\sigma_j\epsilon_{t+1}]}P_{n-1,t+1}|\sigma_{\zeta_{t+1}} = \sigma_j, \xi_{t+1|t}] \end{aligned}$$

The last expectation can be solved using numerical integration on a grid of values for $s_t$, conditional on being in state $j$.

Analogously, the nominal bond price is equal to the expected discounted nominal payoff:

$$P^{\$}_{n,t} = E_t[M_{t+1}\frac{\Pi_t}{\Pi_{t+1}}P^{\$}_{n-1,t+1}] \tag{A.10}$$

In order to compute the nominal bond prices we introduce inflation as an additional state variable. Using the law of iterated expectations and conditioning on realizations of the shock to the level of the consumption growth, we can prove that

$$P^{\$}_{n,t} = F^{\$}_{n,t}\exp\{A_n + B_n\Delta\pi_t\} \tag{A.11}$$

with

$$F_{n,t}^{\$} = E_t[M_{t+1}\exp\{\rho(B_{n-1}-1)\sigma_{\Delta\pi}\epsilon_{t+1}\}F_{n-1,t+1}^{\$}]$$
$$A_n = A_{n-1} + (B_{n-1}-1)\eta_0 + 0.5(B_{n-1}-1)^2\sigma_{\Delta\pi}^2(1-\rho^2)$$
$$B_n = (B_{n-1}-1)\psi_0$$

The boundary conditions are $F_{0,t}^{\$} = 1$, $A_0 = 0$, and $B_0 = 0$.

The proof is by induction. Suppose equation (A.11) is true for $P_{n-1,t+1}^{\$}$. Then, from the Euler equation it must be that

$$\begin{aligned} P_{n,t}^{\$} &= E_t[M_{t+1}\frac{\Pi_t}{\Pi_{t+1}}\exp\{A_{n-1} + B_{n-1}\Delta\pi_{n+1}\}F_{n-1,t+1}^{\$}] \\ &= E_t[M_{t+1}\exp\{-\eta_0 - \psi_0\Delta\pi_t - \sigma_{\Delta\pi}v_{t+1} + A_{n-1} + B_{n-1}(\eta_0 + \psi_0\Delta\pi_t + \sigma_{\Delta\pi}v_{t+1})\}F_{n-1,t+1}^{\$}] \\ &= \exp\{A_{n-1} + (B_{n-1}-1)(\eta_0 + \psi_0\Delta\pi_t)\}E_t[M_{t+1}F_{n-1,t+1}^{\$}\exp\{(B_{n-1}-1)\sigma_{\Delta\pi}v_{t+1}\}] \end{aligned}$$

If we use the law of iterated expectations twice and condition on $\xi_{t+1|t}$, that is the posterior probability at time $t+1$, and then on $\epsilon_{t+1}$, that is the error on the level of consumption growth we have

$$\begin{aligned} P_{n,t}^{\$} = &\exp\{A_{n-1} + (B_{n-1}-1)(\eta_0 + \psi_0\Delta\pi_t) \\ &\sum_{j\in\{h,l\}} \xi_{t+1|t}(j)E_t[M_{t+1}F_{n-1,t+1}^{\$}\exp\{(B_{n-1}-1)\sigma_{\Delta\pi}v_{t+1}\}|\sigma_{\zeta_{t+1}}\epsilon_{t+1}, \sigma_{\zeta_{t+1}} = \sigma_j, \xi_{t+1|t}] \end{aligned}$$

given that

$$(B_{n-1}-1)\sigma_{\Delta\pi}v_{t+1}|\sigma_j\epsilon_{t+1} \sim N(\rho(B_{n-1}-1)\sigma_{\Delta\pi}\epsilon_{t+1}, (B_{n-1}-1)^2\sigma_{\Delta\pi}^2(1-\rho^2))$$

we have

$$\begin{aligned} P_{n,t}^{\$} = &\exp\{A_{n-1} + (B_{n-1}-1)(\eta_0 + \psi_0\Delta\pi_t) + 0.5(B_{n-1}-1)^2\sigma_{\Delta\pi}^2(1-\rho^2) \\ &\sum_{j\in\{h,l\}} \xi_{t+1|t}(j)E_t[M_{t+1}F_{n-1,t+1}^{\$}\exp\{\rho(B_{n-1}-1)\sigma_{\Delta\pi}\epsilon_{t+1}\}|\sigma_{\zeta_{t+1}} = \sigma_j, \xi_{t+1|t}] \end{aligned}$$

Therefore, equation (A.11) is satisfied with

$$F_n^{\$}(s_t) = E_t[M_{t+1}\exp\{\rho(B_{n-1}-1)\sigma_{\Delta\pi}\epsilon_{t+1}\}F_{n-1,t+1}^{\$}]$$
$$A_n = A_{n-1} + (B_{n-1}-1)\eta_0 + 0.5(B_{n-1}-1)^2\sigma_{\Delta\pi}^2(1-\rho^2)$$
$$B_n = (B_{n-1}-1)\psi_0$$

## A.4 Nominal risk premium

Let's compute the nominal risk premium

$$E_t\Big(r^{\$}_{n,t+1} - r^{\$}_{1,t+1}\Big) \tag{A.12}$$

Using formula (1.18) we have that

$$\begin{aligned}
E_t\Big(r^{\$}_{n,t+1}\Big) &= E_t\Big(\ln F^{\$}_{n-1}(s_{t+1}) + A_{n-1} + B_{n-1}\Delta\pi_{t+1} - \ln F^{\$}_{n}(s_t) + A_n + B_n\Delta\pi_t\Big) = \\
&= cost + E_t\Big(\ln F^{\$}_{n-1}(s_{t+1})\Big) - \ln F^{\$}_{n}(s_t) + B_{n-1}(\underbrace{\eta_0 + \psi_0\Delta\pi_t}_{E_t(\Delta\pi_{t+1})}) - B_n\Delta\pi_t = \\
&= cost + E_t\Big(\ln F^{\$}_{n-1}(s_{t+1})\Big) - \ln F^{\$}_{n}(s_t) + \psi_0\Delta\pi_t
\end{aligned}$$

where the last equality comes from $B_n = (B_{n-1} - 1)\psi_0$.
For the second term, we know that $r^{\$}_{1,t+1} = 1/\ln(M^{\$}_{t+1})$ and

$$\begin{aligned}
E_t\Big(M^{\$}_{t+1}\Big) &= E_t\Big(e^{-\Delta\pi_{t+1}}M_{t+1}\Big) = \\
&= E_t[e^{-(\eta_0+\psi_0\Delta\pi_t+\sigma_{\Delta\pi}v_{t+1})}e^{\ln\delta-\gamma[g+(1-\phi)(\bar{s}-s_t)+(\lambda(s_t)+1)\sigma_{\zeta_{t+1}}\epsilon_{t+1}]}]
\end{aligned}$$

By using the same methodology that we applied for the formula of the nominal bonds, we have

$$\begin{aligned}
E_t\Big(M^{\$}_{t+1}\Big) &= \exp(\ln\delta - \gamma(g + (1-\phi)(\bar{s} - s_t)) - \eta_0 - \psi_0\Delta\pi_t + 0.5\sigma^2_{\Delta\pi}(1-\rho^2)) \\
&\quad \sum_{j\in\{h,l\}} \xi_{t+1|t}(j)\exp(0.5(-\gamma(\lambda(s_t)+1)\sigma_j - \rho\sigma_{\Delta\pi})^2)
\end{aligned}$$

so

$$\begin{aligned}
r^{\$}_{1,t+1} &= 1/\ln(M^{\$}_{t+1}) = \\
&= -\ln\delta + \gamma(g + (1-\phi)(\bar{s} - s_t)) + \eta_0 + \psi_0\Delta\pi_t - 0.5\sigma^2_{\Delta\pi}(1-\rho^2)) - \\
&- \ln\Big(\sum_{j\in\{h,l\}} \xi_{t+1|t}(j)\exp(0.5(-\gamma(\lambda(s_t)+1)\sigma_j - \rho\sigma_{\Delta\pi})^2)\Big)
\end{aligned}$$

Therefore the nominal risk premium is

$$\begin{aligned}
E_t\Big(r^{\$}_{n,t+1} - r^{\$}_{1,t+1}\Big) &= cost + E_t\Big(\ln F^{\$}_{n-1}(s_{t+1})\Big) - \ln F^{\$}_{n}(s_t) - \\
&- \gamma(1-\phi)(\bar{s} - s_t) + \ln\Big(\sum_{j\in\{h,l\}} \xi_{t+1|t}(j)\exp(0.5(-\gamma(\lambda(s_t)+1)\sigma_j - \rho\sigma_{\Delta\pi})^2)\Big)
\end{aligned} \tag{A.13}$$

# Appendix B

# Appendix to Chapter 2

## B.1 *Expected* and *actual* investment expenditure

In this Appendix we carry some quantitative exercises to address two issues. The first one concerns the problem of measurement error in sample surveys. As documented in Bound et al. (2001), self-reported data are often inaccurate and this may lead to inefficient and/or biased estimates. In case of qualitative survey data forecasts, the true beliefs of individuals may not coincide with their responses to the survey questionnaire and thus one cannot be sure of what the response is actually picking. The second issue regards the realization rate of expected investment expenditure. Needless to say, this is an issue of critical importance in order to draw any practical policy implication from our previous results.

For these purposes, we cannot do much with the information from SIGE as the answers to the question on firms' inflation expectations are qualitative and there is no information about the realized (firm-level) investment expenditure. Hence, we proceed by combining the qualitative information on investment expectations from SIGE with the quantitative information from the Survey of Industrial and Service Firms (SISF, henceforth). This latter survey is conducted yearly since 1984 by the Bank of Italy and covers a representative sample of Italian firms with at least 20 employees. Among the many questions, SISF asks firms to provide information on their investment expenditures with reference to three periods: the year just ended (preliminary results), the previous year (final results) and the following year (forecasts)[1]. For the purposes of our analysis, SISF presents two major limitations. First, it does not contain any information regarding firm-level inflation expectations. Second, because SISF is conducted at yearly frequency, merging SIGE and SISF by firm and year leads to a marked reduction in the sample size (the number of firms participating in both surveys is modest). Nonetheless we use the information from SISF to carry out a number of checks.

To begin with, we compare the data from both surveys during the period 1999-2014, that is, the whole time the two surveys have been run together. Merging the two dataset leaves us with a total of roughly 67,000 observations. As shown in table (B.1), among these, 58,633 firms

[1]The question on fixed gross investment expenditure also asks firms their expectations regarding capital goods prices. This is an information that we plan to use to disentangle the price effect from the quantity effect in nominal investment expenditure expectations in the Survey on Inflation and Growth Expectations.

| | Number of Firms |
|---|---|
| SIGE respondents only | 9,314 |
| - *of which gave indication on willingness to invest* | 2,734 |
| | |
| SISF respondents | 58,633 |
| - *of which SIGE respondents* | 2,591 |
| - *of which gave indication on willingness to invest* | 516 |
| | |
| Total | 67,947 |

Table B.1: Basic statistics for the merged database SIGE-SISF.

responded to SISF and 9,314 were asked to answer to SIGE. Among the firms interviewed for the former survey, only 4% was called a second time to fill in the latter one. There are two main reasons why the sample size of SISF is much larger that in SIGE. First, the surveys collect data from firms with at least 20 and 50 employees, respectively. Moreover, we need to account for the different frequency of the surveys; in order to do so, we choose to keep only the most recent observation for each firm who answered to SIGE in each year. This reduces the sample size, but it does not influence the result on the relationship between the information in the two questions.[2]

As stated before, in SISF firms provide past and prospective information on investment. The formulation of the question that Bank of Italy poses firms in the first months of the year $T$ reads as:

**Gross fixed investment in Italy.** Please express amounts in € thousand; enter 0 for no investment.

| | *year T-1* | *year T* | *year T+1* (projection) |
|---|---|---|---|
| *Total expenditure on tangible assets* | ☐ | ☐ | ☐ |
| *Total expenditure on software & databases* | ☐ | ☐ | ☐ |
| *Expenditure on R&D; design and test products* | ☐ | ☐ | ☐ |

Table B.2: Question on investment in SISF.

Using the total investment expenditure in year T+1 and T, we compute the expected change in investment for T+1 and we compare this quantitative information with the qualitative answer from SIGE. It turns out that 64% of firms reporting higher investment expectations in SIGE also state so in SISF. Moreover, using the SISF information alone we assess that 84% of firms who predicted to increase the total gross investment in year T, reported an increment in year T+1.

We think this preliminary evidence suggests that the information in SIGE reflects firms' true intentions to invest.

[2]Results using only data from the last quarter of the year are available on request.

## B.2 Figures

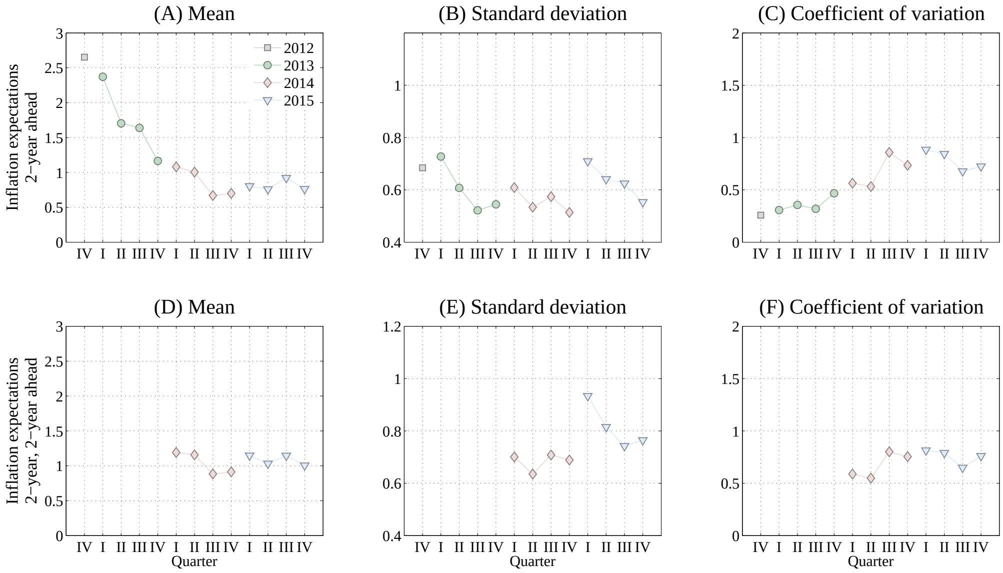


Figure B.1: Firms' expectations of consumer price inflations extracted from the Survey on Inflation and Growth Expectations.

Panels A to C report the (unweigthed) cross-section mean, standard deviation and coefficient of variation of inflation expectations 2-year ahead; panels D to F report the same statistics for the inflation expectations 2–year, 2-year ahead. Values are in percentages.

## B.3 Tables

| Question | Categories of response (numerical code in parentheses): | | | |
|---|---|---|---|---|
| (a) Your firm's total number of employees in the next 3 months will be: | lower (1) | unchanged (2) | higher (3) | |
| (b) Compared with 3 months ago, do you think conditions for investment are: | worse (1) | the same (2) | better (3) | |
| (c) Compared with 3 months ago, are credit conditions for your company: | worse (1) | unchanged (2) | better (3) | |
| (d) What do you think your liquidity situation will be in the next 3 months, given the expected change in the conditions of access to credit: | insufficient (1) | sufficient (2) | more than sufficient (3) | |
| (e) Compared with 3 months ago, do you consider Italy's general economic situation is: | worse (1) | the same (2) | better (3) | |
| (f) Number of employees: | 50-199 (1) | 200-999 (2) | 1000 and over (3) | |
| (g) Sector of economic activity: | industrial (1) | services (2) | construction (3) | |
| (h) Share of sales revenues coming from exports: | zero (1) | up to 1/3 (2) | between 1/3 and 2/3 (3) | over 2/3 (4) |
| (i) Geographical area: | North-West (1) | North-East (2) | Centre (3) | South & Islands (4) |

Table B.3: Selected questions and responses from the Survey on Inflation and Growth Expectations.

| | Dependent variable: business investment expectations | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Regressors | lower | lower | lower | lower | lower | lower | higher | higher | higher | higher | higher | higher |
| Exp. infl. 12-month ahead | -0.034*** | -0.032*** | -0.027*** | -0.028*** | -0.031*** | -0.029*** | 0.031*** | 0.031*** | 0.026*** | 0.027*** | 0.031*** | 0.027*** |
| Nr. empl. (next 3 months) | | | | | | | | | | | | |
| Lower (*omitted*) | | 0.000 | | | | | | 0.000 | | | | |
| Unchanged | | -0.162*** | | | | | | 0.119*** | | | | |
| Higher | | -0.305*** | | | | | | 0.309*** | | | | |
| Liq. cond. (next 3 month) | | | | | | | | | | | | |
| Worse (*omitted*) | | | 0.000 | | | | | | 0.000 | | | |
| The same | | | -0.129*** | | | | | | 0.099*** | | | |
| Better | | | -0.200*** | | | | | | 0.176*** | | | |
| Current eco. outlook (Italy) | | | | | | | | | | | | |
| Worse (*omitted*) | | | | 0.000 | | | | | | 0.000 | | |
| The same | | | | -0.127*** | | | | | | 0.099*** | | |
| Better | | | | -0.218*** | | | | | | 0.205*** | | |
| Current investment cond. | | | | | | | | | | | | |
| Worse (*omitted*) | | | | | 0.000 | | | | | | 0.000 | |
| The same | | | | | -0.176*** | | | | | | 0.131*** | |
| Better | | | | | -0.292*** | | | | | | 0.281*** | |
| Current credit access cond. | | | | | | | | | | | | |
| Worse (*omitted*) | | | | | | 0.000 | | | | | | 0.000 |
| The same | | | | | | -0.177*** | | | | | | 0.124*** |
| Better | | | | | | -0.291*** | | | | | | 0.260*** |
| Time dummy | | | | | | | | | | | | |
| Number of employees | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Sector of economic activity | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Revenues from exports | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Geographical area | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Time dummy | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Pseudo $R^2$ | 0.023 | 0.051 | 0.035 | 0.035 | 0.043 | 0.038 | 0.023 | 0.051 | 0.035 | 0.035 | 0.043 | 0.038 |
| N. of observations | 7710 | 7664 | 7631 | 7620 | 7657 | 7561 | 7710 | 7664 | 7631 | 7620 | 7657 | 7561 |

*, **, and *** denote statistical significance at the 10%, 5% and 1% critical level, respectively.

Table B.4: Determinants of firms' investment plans: marginal effects from ordered probit with 12-month ahead inflation expectations.

The Table reports the marginal effects for each response category of the dependent variable (lower, about the same, higher) and considering, among the regressors, firms' inflation expectations 12-month ahead. Marginal effects are calculated as explained in Section 2.3.

| | Dependent variable: business investment expectations | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Regressors | lower | lower | lower | lower | lower | lower | higher | higher | higher | higher | higher | higher |
| Exp. infl. 6-month ahead | -0.034*** | -0.029** | -0.031*** | -0.031*** | -0.031*** | -0.031*** | 0.030*** | 0.028** | 0.030*** | 0.030*** | 0.030*** | 0.029*** |
| Nr. empl. (next 3 months) | | | | | | | | | | | | |
| Lower (*omitted*) | | 0.000 | | | | | | 0.000 | | | | |
| Unchanged | | -0.162*** | | | | | | 0.118*** | | | | |
| Higher | | -0.306*** | | | | | | 0.308*** | | | | |
| Liq. cond. (next 3 month) | | | | | | | | | | | | |
| Worse (*omitted*) | | | 0.000 | | | | | | 0.000 | | | |
| The same | | | -0.129*** | | | | | | 0.099*** | | | |
| Better | | | -0.201*** | | | | | | 0.178*** | | | |
| Current eco. outlook (Italy) | | | | | | | | | | | | |
| Worse (*omitted*) | | | | 0.000 | | | | | | 0.000 | | |
| The same | | | | -0.128*** | | | | | | 0.099*** | | |
| Better | | | | -0.219*** | | | | | | 0.206*** | | |
| Current investment cond. | | | | | | | | | | | | |
| Worse (*omitted*) | | | | | 0.000 | | | | | | 0.000 | |
| The same | | | | | -0.176*** | | | | | | 0.130*** | |
| Better | | | | | -0.292*** | | | | | | 0.281*** | |
| Current credit access cond. | | | | | | | | | | | | |
| Worse (*omitted*) | | | | | | 0.000 | | | | | | 0.000 |
| The same | | | | | | -0.177*** | | | | | | 0.124*** |
| Better | | | | | | -0.292*** | | | | | | 0.261*** |
| Time dummy | | | | | | | | | | | | |
| Number of employees | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Sector of economic activity | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Revenues from exports | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Geographical area | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Time dummy | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Pseudo $R^2$ | 0.023 | 0.051 | 0.035 | 0.035 | 0.043 | 0.038 | 0.023 | 0.051 | 0.035 | 0.035 | 0.043 | 0.038 |
| N. of observations | 7710 | 7664 | 7631 | 7620 | 7657 | 7561 | 7710 | 7664 | 7631 | 7620 | 7657 | 7561 |

*, **, and *** denote statistical significance at the 10%, 5% and 1% critical level, respectively.

Table B.5: Determinants of firms' investment plans: marginal effects from ordered probit with 6-month ahead inflation expectations.

The Table reports the marginal effects for each response category of the dependent variable (lower, about the same, higher) and considering, among the regressors, firms' inflation expectations 6-month ahead. Marginal effects are calculated as explained in Section 2.3.

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