# Inflation expectations and monetary policy in Europe

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**Abstract**

We use monthly data across fifteen euro-area economies for the period 1985:1-2015:3 to obtain different monetary policy shocks pertaining to more versus less informed individuals. We then investigate how these affect inflation expectations of different types of consumers before and after the incidence of the recent Crisis. Shocks obtained based on the assumption that individuals are well informed can have different impact on inflation expectations as compared to shocks obtained based on the assumption that they are not as informed. Moreover, monetary policy can have different effects on inflation expectations for different types of consumers. Finally, monetary policy has different effects on inflation expectations after as compared to before the incidence of the recent Crisis.

**Keywords:** Inflation expectations, monetary policy, shocks, Crisis.

**JEL Classification: E31, E52, F41**

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# 1 Introduction

Expectations play a central role in the macroeconomy. Monetary policymakers consider both the direct impact of their policies on economic activity or inflation as well as the indirect effect via private-sector expectations responding to changes in monetary policy, while economic agents' current economic decisions are affected by their expectations of future economic developments. Because of the resulting self-fulfilling effects on realized inflation and economic activity, inflation expectations should thus be seriously taken into account especially in periods where uncertainty is relatively high.

The question of how monetary policy affects inflation expectations we address in this paper is an important one from a policy and theory perspective alike. On the policy side, the European Central Bank has repeatedly stated publicly over the past few years that its policies have been aiming at raising inflation expectations in line with its inflation objective, so as to boost current consumption and avoid a deflationary spiral. The importance of this question from the theory perspective is also unambiguous. Recent works by Cochrane (2015), Garcia-Schmidt (2015), Garcia-Scmhidt and Woodford (2015), Del Negro, Giannoni and Patterson (2013), and Campbell, Evans, Fisher and Justiniano (2012), suggest different theory-implied impact of monetary policy on inflation expectations depending on the theoretical model being considered. While a neo-Keynesian approach like in Garcia-Schmidt and Woodford (2015) would associate expansionary monetary policies with a rise in inflation and inflation expectations via a direct policy impact on economic activity through standard neo-Keynesian channels, a neo-Fisherian approach as in Cochrane (2015) would associate expansionary monetary policies (lower short-term interest rates) with decreases in inflation and inflation expectations.

In general, monetary policy can have two different types of effects on inflation expectations. First, if viewed by individuals as a credible action that will directly impact upon economic activity and inflation, then this would lead them to revise inflation expectations accordingly. An announcement to lower interest rates would thus have a positive effect on economic activity via standard neo-Keynesian channels putting upward pressure on prices and inflation expectations. Second, if individuals initially possess less information than the Central Bank then they could learn something new about economic fundamentals by observing the realization of the Central Bank's monetary

policy, and revise inflation expectations accordingly. In the latter case, they would adjust their expectations in a different way than what a neo-Keynesian model suggests.[1] Here, an unanticipated decrease in interest rates could be interpreted as negative news about the state of the economy by consumers that know that the policymaker has more information, so that the latter's actions merely reveal to these agents that the policymaker is worried about deflation.[2] In this case, the effect of an unanticipated decrease of the interest rate is to decrease inflation expectations.

Our empirical approach offers a direct test for the above theoretical propositions. We use monthly data across fifteen euro-area economies for the period 1985:1-2015:3 to obtain monetary policy shocks under different assumptions, and use these along with other variables to explain inflation expectations of different types of consumers before and after the incidence of the recent Crisis. Our empirical results indicate that monetary policy can have positive or negative effects on inflation expectations depending on the type of monetary shock, the period under study and the type of consumer.

Our goal is to investigate what factors affect inflation expectations. Since monetary policy actions often-stated goal is to influence inflation expectations, we find it useful to concentrate on monetary policy and its effect on these. Thus, we will estimate the dynamic response of inflation expectations to unanticipated monetary policy controlling for other variables that might possibly affect these. The different monetary policy shocks we obtain pertain to more or less informed individuals. A main focus of our study is to assess whether the impact of these two types of monetary shocks is different. Another goal of our analysis is to shed some light on how these affect inflation expectations of different types of consumers. Answering this question, will help us understand whether different types of individuals interpret related information and update their expectations in the same way. The availability of different categories of consumers in our dataset allows for an investigation of differences in inflation expectations formation across individuals with different costs and benefits of obtaining information and updating inflation expectations, and with different ability to use

[1] This resembles the discussions in Campbell, Evans, Fisher and Justiniano (2012), Del Negro, Giannoni and Patterson (2013) and Garcia-Schmidt (2015) regarding the ways forward guidance might influence economic agents. The first of these papers defines the so called "Delphic" case where monetary policy affects inflation expectations by enabling individuals to predict economic activity based on the policymaker's superior information set revealed after the latter undertakes monetary policy action, rather than by its anticipated direct impact on economic activity.

[2] In line with this, Campbell, Evans, Fisher and Justiniano (2012) find that market participants infer that unexpected policy adjustments by the Central Bank are responses to non-public information about the future state of the economy. Similarly, Gurkaynak, Sack and Swanson (2005) find that market participants believe that Central Bank announcements contain not previously known or anticipated information about future monetary policy actions.

information. We will also investigate how monetary policy impacts upon inflation expectations before and after the incidence of the recent Crisis. The impact of monetary policy could be different in normal periods as compared to less tranquil periods, a claim we will be assessing.

We define the unpredictable change in interest rates as a monetary policy shock. The unpredictability of monetary policy changes and their subsequent interpretation as exogenous shocks will depend on how much information we assume individuals to have. This is a shock to the extent that individuals have not observed the information set based on which they could have forecasted it prior to its arrival. It is a shock relevant to particular types of individuals to the extent that these also have the incentive and ability to observe it once it is realized. We will consider monetary policy shocks pertaining to individuals that have an information set similar to that of the Central Bank, and monetary policy shocks pertaining to individuals with less information. It should be pointed out, that the often used assumption that individuals are as informed as the Central Bank and can thus only be shocked by monetary policy shocks that also shock the policymaker (see Christiano, Eichenbaum and Evans 1999), is questionable. For example, the policymaker has more information about the state of the economy than private agents because the Central Bank has private information about its policy goals and access to confidential data. Thus, one might want to consider monetary policy shocks pertaining to individuals that are less informed than Central Bankers, especially when the goal is to explain inflation expectations of consumers rather than those of professional forecasters. Such changes in monetary policy would be forecastable by more informed individuals prior to arrival, and thus should not affect their expectations upon arrival.

Our empirical analysis is split in two stages. In the first stage, we identify monetary shocks based on two different specifications. In the first specification, we suppose that individuals have access to information which describes the economic environment, comparable to the information set of the Central Bank. These individuals find it worthwhile to incur the costs of obtaining information, especially if that information is more important to them in their economic decision making. In the second specification, we assume that individuals are less informed as they face some cost in obtaining information or simply cannot have access to the same information set as a Central Banker, so that they will be shocked by a much bigger set of events as compared to the set of events that shock the policymaker. This monetary policy change will then be a shock to less informed agents, but would not constitute a shock to more informed agents who would have been expecting this

prior to its arrival based on the forecast derived from their information set. Since the information that different private agents have is far from identical, we will investigate the impact of both types of monetary shocks on different categories of consumers. Having obtained these two different types of shocks discussed above, we will then investigate how these impact upon inflation expectations of different types of consumers depending on their income, education, employment status, and age. If costs and benefits of obtaining information and updating expectations vary across demographic subgroups, some types of consumers would be more responsive to monetary policy shocks.

Indeed, the impact is different across demographic subgroups. Importantly, shocks obtained based on the assumption that individuals are more informed have different impact on inflation expectations as compared to shocks obtained based on the assumption that individuals face costs in obtaining information. Furthermore, the impact of monetary policy on inflation expectations is different before as compared to after the incidence of a major Crisis such us the most recent one.

Our study is organized as follows. Section 2 describes the data and preliminary analysis. Section 3 describes the general structure of our econometric model. In its two subsections we describe each stage of analysis separately, where in the first stage we identify two types of monetary policy shocks using a time-series model, and in the second stage we work with a panel model to investigate the impact of these policy shocks on inflation expectations. Section 4 illustrates estimation results of the second stage, while section 5 briefly concludes.

# 2 Data and preliminary analysis

## 2.1 Description of data

### Inflation expectations

Data for inflation expectations are from the Joint Harmonised EU Programme of Business and Consumer Surveys database, which is published monthly by the European Commission (Economic and Financial Affairs) for 28 member countries. The inflation expectations for consumers we will use in our study, derive from the answers of this consumer survey. The sample size of the survey varies across countries and is generally positively related to their respective population size. The consumer survey is mainly qualitative although, as of 2003, two quantitative questions are asked concerning perceived and expected price changes. In our analysis, we concentrate on qualitative

data that come from around 40,000 consumers who are currently surveyed every month across the EU.

The database categorizes inflation expectations data according to respondents income, education, occupation and age, and we will be considering two subcategories for each of these categories. We will thus be using monthly data across fifteen euro-area economies for the period 1985:1-2015:3 for potentially 5445 observations for each of eight consumer subcategories. As these data for some countries are only available starting at a later date, in practice we will have less than 5445 observations for each consumer subgroup.[3] The consumer subgroups we focus on are: low and high income consumers, low and high educated consumers, unemployed and full time workers, and ages between 30 and 49, and between 50 and 64. Moreover, we examine the inflation expectations of total consumers. The latter category includes some other subcategories that we do not examine in detail (e.g. the 2nd and 3rd quartile of income, ages between 16 - 29, secondary education, etc). We are comparing expectations of consumers based on their education and income, given that the formation of inflation expectations might well depend on the ability of the respondents to gather and interpret information. We also consider occupation status and age of consumers since the economic situation and particular point in their life cycle might lead to differences in the formation of inflation expectations.

As we mentioned above, the data that the European Commission uses for inflation expectations are qualitative and they derive from the question "By comparison with the past 12 months, how do you expect that consumer prices will develop in the next 12 months? They will... " Consumers have six options to answer this question saying that: prices will increase more rapidly (PP), increase at the same rate (P), increase at a slower rate (E), stay about the same (M), fall (MM), and don't know (N). Since the data obtained from the consumer questionnaire is qualitative, they have to be quantified. Nielsen (2003) and Kyziak (2005) mention three main methods of quantifying qualitative data: the probability method (known as Carlson - Parkin method (1975)), the regression method, and the simple balance statistic defined as the difference between the proportions of respondents. We use the last method which is the simpler of the three.

Answers obtained from the surveys are aggregated in the form of "balances". Balances are the

[3] We have 4532 observations for total consumers, 4219 observations for low income and high income consumers, 4316 observations for low and high educated consumers and for full time workers, 3970 observations for unemployed consumers, and 4291 observations for consumers of ages 30-49 and ages 50-64.

difference between positive and negative answering options measured as percentage points of total answers. Balances are calculated on the basis of weighted averages that add up to 100, $PP + P + E + M + MM + N = 100$, and are obtained as $B = (PP + \frac{1}{2}P) - (\frac{1}{2}M + MM)$. Thus, values range from -100, when all respondents choose the negative option to +100, when all respondents choose the positive option. Finally, the Commission calculates EU and euro-area aggregates on the basis of the national results and seasonally adjusts the balance series that we use in our analysis.

Figure 1 plots the time series for expected inflation of total consumers over the period 1985:1-2015:3 across 15 euro area countries and the euro area as a whole. This is the 12-month forward-looking inflation expectations derived from the European Commission's Business and Consumer Surveys database. Although expected inflation over the next 12 months can be different in each country, we can see from Figure 1 that the recent Crisis arrival has similar impact on inflation expectations for the countries in our sample.

**CPIs and Inflation rates**

Consumer price indices and inflation rates were obtained from OECD Stat.[4] The OECD calculates three area totals for the following product groups: all items, food (excluding restaurants), and energy (Fuel, electricity & gasoline).[5] Monthly changes of these provide an indication about the acceleration or deceleration of inflation but may also reflect seasonal variations. It should be noted that the majority of OECD countries do not produce seasonally adjusted CPIs because seasonal effects are not generally significant enough to warrant it.

Data for short term interest rates is taken from OECD's Monthly Monetary and Financial Statistics.[6] Short term interest rates are usually either the 3-month interbank offer rate attached to loans given and taken amongst banks for any excess or shortage of liquidity over several months, or the rate associated with Treasury bills, Certificates of Deposit or comparable instruments, each of three month maturity. For all Euro Area countries, the 3-month "European Interbank Offered Rate" is used as of the date the country joined the euro. We note that short term interest rates are identical for all 15 euro area countries that we examine as of January 2011, and identical for 11 of

[4] Data available at http://stats.oecd.org/index.aspx?queryid=22519

[5] Energy refers to items "electricity, gas and other fuels" as defined under the classification of individual consumption according to purpose (COICOP 04.5) and "fuel and lubricants for personal transport equipment" (COICOP 07.2.2).

[6] The link is http://stats.oecd.org/Index.aspx?DatasetCode=MEI_FIN

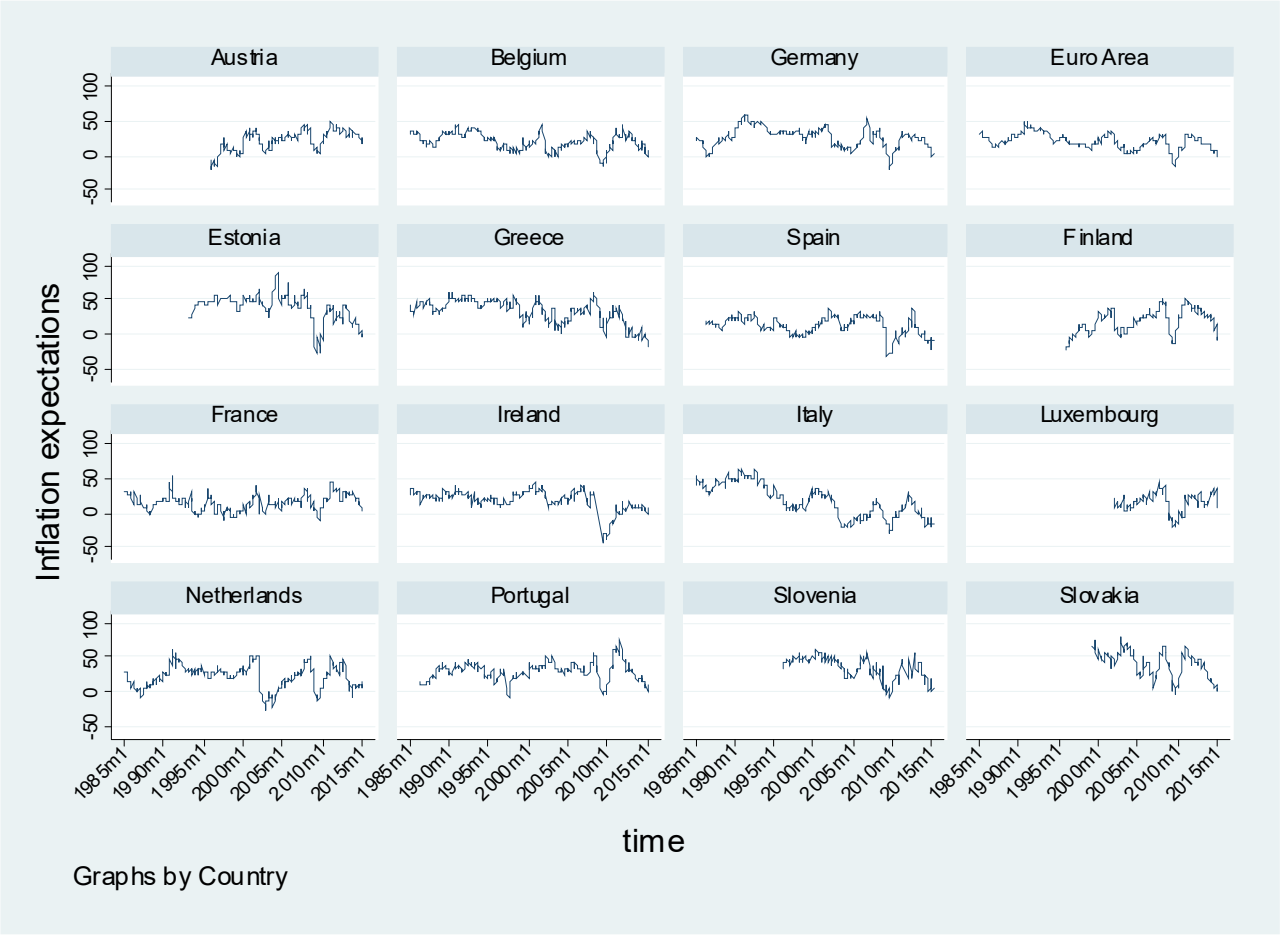


Figure 1: 12-month forward-looking inflation expectations for total consumers across 15 euro area economies and the euro area as a whole. Countries included are: Austria, Belgium, Germany, Estonia, Greece, Spain, Finland, France, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Slovenia and the Slovak Republic.

the 15 countries (i.e., excluding Estonia, Greece, the Slovak Republic and Slovenia) as of January 1999.[7]

Comparing the averages of short term interest rates before and after the incidence of the Crisis for the euro area, we find that the average has decreased from 6.23 to 0.99. These take values of less than one percent for the first time on July 2009 and continue decreasing taking very low values up until May 2010. From May 2010, interest rates are increasing from a low of 0.7 percent until March 2012. From March 2012, short term interest rates have been decreasing gradually from values slightly less than one percent to values very close to zero. By April 2015, short term interest rates are exactly equal to zero, and they take negative values since that date. In our analysis, the sample is from 1985:1 until 2015:3, thus, negative short term interest rates are not included in our analysis.

Other variables we use in our analysis are the Harmonised Unemployment rate for all persons, and Industrial Production. Both are available monthly in seasonally adjusted form from the OECD's Short-Term Economic Indicators.[8] Finally, data for commodity prices were obtained from the IMF's Primary Commodity Prices.[9] The Food Price Index we use includes Cereal, Vegetable Oils, Meat, Seafood, Sugar, Bananas and Oranges Price Indices. We also utilize the Europe Brent Spot Price FOB (Dollars per Barrel) from the THOMSON REUTERS database[10].

## 2.2 Preliminary analysis and testing

In this subsection we analyze the distribution and properties of two of the main variables we use in our estimations.

We begin by examining the distribution of inflation expectations. Figure 2 presents the Gaussian kernel density estimates of inflation expectations for the period before the Crisis (1985:1 - 2008:6) and for the period after the incidence of the Crisis (2008:10 - 2015:3) separately. The choice of the regimes was based on endogenous structural breaks tests which were also linked to crisis events in

[7] As of January 2001 short term interest rates become identical for 12 countries including Greece. As of January 2007 these were identical for 13 of the countries including Slovenia, and since January 2009 they were identical for 14 of the 15 countries including Estonia.

[8] Available respectively at http://stats.oecd.org/?queryid=21760 and and http://stats.oecd.org/index.aspx?DatasetCode=KEI#

[9] Available at http://www.imf.org/external/np/res/commod/index.aspx

[10] Available at http://www.eia.gov/dnav/pet/pet_pri_spt_s1_m.htm

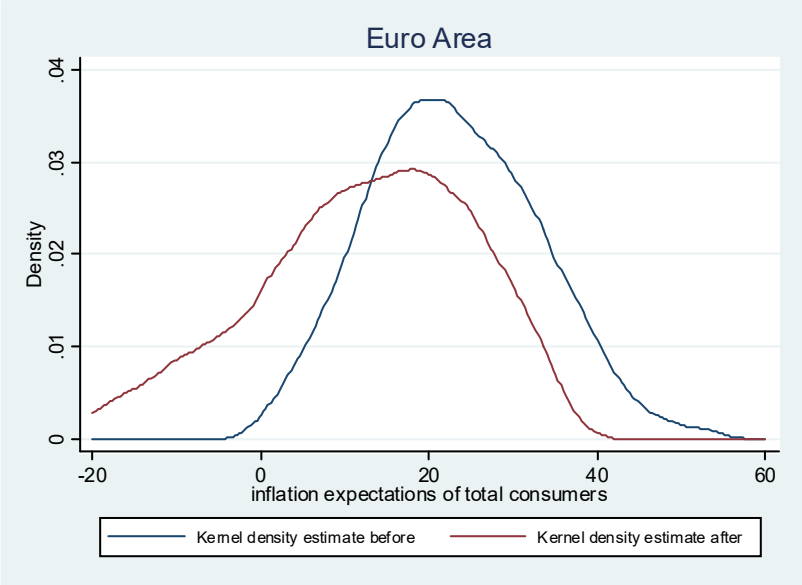


Figure 2: Distribution of inflation expectations of total consumers for the Euro Area as a whole, before and after the incidence of the recent crisis.

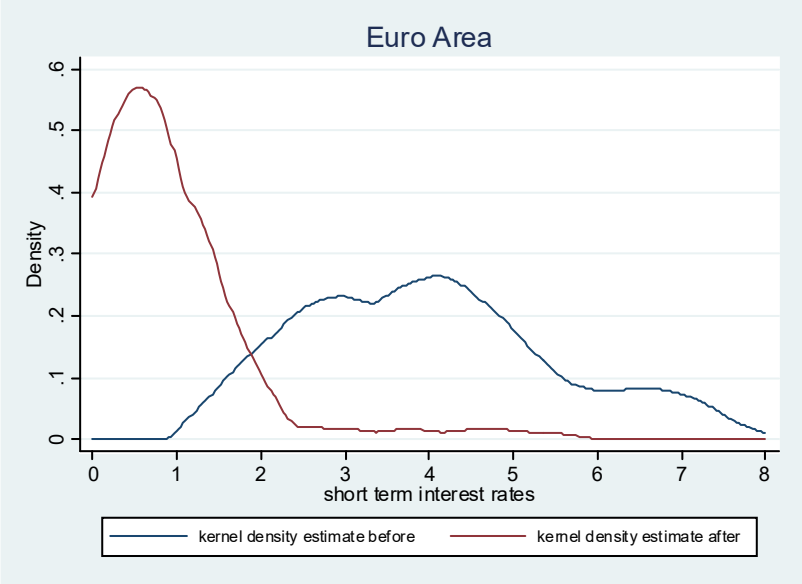


Figure 3: Distribution of short term interest rates for the Euro Area as a whole, before and after the incidence of the recent crisis.

Europe. Further details on this are discussed in the next section. Comparing the kernel densities for the period before and after the incidence of the recent Crisis, we see that there has indeed been a significant change since the recent Crisis arrival. We see that before the Crisis the mass of the distribution is concentrated on the right of the figure indicating that the distribution of inflation expectations is positively skewed while after the Crisis the distribution ranges from (-20) to (+40). This indicates that after the Crisis arrival, the number of consumers that believe that prices will decrease in the next 12 months, has increased considerably.

Figure 3 illustrates the distributions of short term interest rate for the period before the Crisis (1985:1 - 2008:6) and for the period after the Crisis (2008:10 - 2015:3) separately. Comparing these densities we see that after the incidence of the Crisis, short term interest rates for the Euro Area have decreased substantially, and the shape of the probability distribution has changed considerably.

To correctly specify our first and second stage estimation specifications, we conducted unit root tests for the variables that we include in our estimations. Performing the Im–Pesaran–Shin (2003) panel unit root test, we find that industrial production as well as the unemployment rate contain unit roots. We thus take first differences of the log of industrial production and the unemployment rate and use these transformed variables for estimating our models. Prices of commodities (oil and food) are also non stationary. In line with previous related research (e.g. Christiano, Eichenbaum and Evans, 1999), we smooth the log of these prices by removing the trend using a Hodrick–Prescott time-series filter. We take the smoothed change of these commodity prices as an explanatory variable in our first stage model estimation exercise. The first stage regression model employs a time series approach to obtain the monetary policy shock by regressing short-term interest rates on a number of variables, and to identify the monetary policy shocks as the unexplained residual. We also performed a unit root test for the monetary policy shocks generated in the first stage, and used in our second-stage estimation exercise to explain inflation expectations. Our findings strongly reject the null hypothesis of the existence of a unit root.

## 3 A statistical model

This section describes the statistical model we used in order to identify the monetary policy shocks and investigate their impact on inflation expectations. Our analysis is split in two stages.

In the first stage, we use a statistical model to identify monetary policy shocks. Here, we make similar assumptions to Christiano, Eichenbaum and Evans (1999). We assume that the instrument of monetary policy is the short term interest rate and that monetary policy is based on a set of macroeconomic variables that determine the policy stance. One of our main assumptions is that the policy shock is orthogonal to the information set of the Central Bank. Thus, the recursiveness assumption is implemented to identify the monetary policy shock. Assuming that the Central Bank controls the short term interest rate and sets it according to a reaction function which depends on a set of macroeconomic variables, then the monetary policy shock is a deviation from the usual reaction based on the Central Bank's information about macroeconomic conditions. In our first specification, we assume that the individuals' information set is similar to that of the Central Bank. The monetary policy shock identified in this case will be relevant for "more informed agents". In our second specification, we allow for the fact that individuals may have a smaller information set than the Central Bank due to costs associated with collecting and identifying information. In this case, the only variable that is included in the information set of the individuals will be past realizations of the short term interest rate. The monetary policy shock identified in this case will be relevant for "less informed agents". This will not be a shock for more informed individuals to the extent that they would have observed the information set based on which they could have forecasted this prior to its arrival. Such changes in monetary policy would be forecastable by more informed individuals prior to arrival, and thus should not affect their expectations upon arrival. In the first subsection below, we describe in detail how we identify these monetary policy shocks.

In the second stage, we investigate how these monetary policy shocks impact upon inflation expectations of different types of consumers, before and after the incidence of the recent Crisis, using monthly data across 15 European economies for the period 1985:1-2015:3. In the second subsection, we will thus be interested in the formation of inflation expectations across the Euro Area and will investigate the impact of these monetary policy shocks on inflation expectations of different types of consumers depending on their income, education, occupation and age.

In both the first and second stages, we estimate the model for the whole sample 1985:1 - 2015:3 and define this as the "model without regimes". Additionally, we distinguish between the period before and after the incidence of the Crisis in both stages, and label this as the "model with regimes". We define the period before the Crisis from the beginning of the sample, January 1985 until June

2008. The period after the incidence of the Crisis is from October 2008 until March 2015. We split the sample in this way for the following reasons. First, the Eurozone Crisis is a multi-year debt Crisis that has been taking place in the European Union at least since 2009. However, some European economies e.g. Ireland, had already faced difficulties from 2008, especially since the Lehman brothers collapse in September 2008. Performing a Supremum Wald test for a structural break with an unknown break date (Andrews, 1993) for inflation expectations, we find that the break date for the euro area was on August 2008. Moreover, estimating the reaction function of monetary policy, the break date for most countries is shown to be November 2008. Taking all the above into account, we consider that the pre-Crisis period ends in the first semester of 2008. Finally, we terminate our sample in March 2015 to avoid negative values for the short-term interest rate. Our analysis will thus concentrate on the period where short term interest rates take positive values across the euro area, to alleviate potential problems associated with the zero lower bound.

### 3.1 Identification of monetary shocks in the first stage

In the first stage, we estimate time series models for each country separately to identify the exogenous shock to monetary policy. We take the operating instrument of the Central Bank to be the short term interest rate. In addition, we need to make some assumption about the nature of the interaction of the policy shock with the variables in the feedback rule. Thus, we assume that the monetary shock is orthogonal to the information set and that time t variables in the Central Bank's information set do not respond to time t realizations of the monetary policy shock. The recursiveness assumption that we make along with linearity of the Central Bank's feedback rule, allow us to estimate monetary policy shocks from the fitted residuals of the ordinary least squares regression of the short term interest rate on the variables in the Central Bank's information set.

Thus, we identify a monetary policy shock with the disturbance term in the equation below

$$r_{t,i} = f(X_{t,i}) + \sigma_i u_{t,i} \tag{1}$$

where $r_{t,i}$ is the short term interest rate at time $t$ in country $i$, $f$ is a linear function that represents the monetary authority's feedback rule, and $X_{t,i}$ is the monetary authority's information set at time $t$ in country $i$. The random variable $\sigma_i u_{t,i}$ , is a monetary policy shock. Our assumption is that $u_{t,i}$

is orthogonal to the information set, $X_{t,i}$, meaning that at time t, $u_{t,i}$ does not affect the elements of the Central Bank's information set. The variable $u_{t,i}$ is normalized to have unit variance and $\sigma_i$ is the standard deviation of the monetary policy shock in country $i$. The information set $X_{t,i}$, will differ depending on whether we assume individuals to be as informed or less informed than the Central Bank. We analyze each case separately and present the restricted form of the above equation in the next two subsections.

### 3.1.1 More informed consumers

In the first specification, we consider that $X_{t,i}$ contains a number of macroeconomic variables observed by informed individuals and the Central Bank alike. We assume that these are industrial production, unemployment, CPI for all items excluding food and energy, and commodity prices. This resembles the specification in Christiano, Eichenbaum and Evans (1999).

First, we estimate equation (1) for the whole sample identifying the monetary shock relevant for more informed individuals ($uhat_{more,t,i}$). But assuming that the recent Crisis plays an important role in conducting monetary policy and in forming inflation expectations we cannot ignore the change of the economy structure since the recent Crisis arrival. Thus, we also estimate equation (1) for the period before and after the incidence of the recent Crisis separately, identifying the monetary shock relevant for more informed individuals for the period before ($uhat^{before}_{more,t,i}$) and for the period after ($uhat^{after}_{more,t,i}$) the incidence of the recent Crisis. Since the Crisis arrival, there has been a structural shift downwards for the short-term interest rate, which is one reason we estimate the equation below for two time periods separately, considering the general case where all parameters change in the two regimes. Monetary policy shocks are associated with unpredictable deviations from an interest rate policy reaction function that is illustrated in the equation below

$$r_{t,i} = \ a_{0,i} \ + a_{1,i}\, trend + \ \sum_{j=1}^{n} a_{2j,i} r_{t-j,i} \ + \ a_{3,i}\ X_{t,i} + \sum_{j=1}^{n} a_{4,j,i} X_{t-j,i} \ + u^{period}_{more,t,i} \qquad (1.1)$$

where *trend* is a deterministic time trend[11], $r_{t,i}$ is the short term interest rate at time $t$ in country $i$,

[11] We note that this is significant only for Belgium, Germany, Ireland, the Netherlands, Portugal and Slovenia for the period before the crisis, and Austria, Finland and the Slovak Republic for the period since the incidence of the crisis. We thus end up including a time trend only for these countries in the time series estimation before and after the incidence of the crisis respectively, and exclude the time trend when estimating equation (1.1) for all remaining cases.

and $X_{t,i}$ denotes the information set at time $t$ in country $i$ which includes both the contemporaneous and the lag of the following variables: the differenced log of Industrial Production ($\text{Dlnip}_{\text{t,i}}$), the differenced unemployment rate ($\text{Dunrate}_{\text{t,i}}$), the log of the Consumer Price Index for all items excluding food and energy ($\text{lncpi\_others}_{\text{t,i}}$), the smoothed change in the log of the price of crude oil ($\text{DlnPoil\_hp}_{\text{t,i}}$), and the smoothed change in the log of the price of food ($\text{DlnPfood\_hp}_{\text{t,i}}$). All data are monthly and seasonally adjusted. Finally, $u^{period}_{more,t,i}$ is the residual or unpredicted component of the short-term interest rates which we use to capture the monetary shock for the period before ($uhat^{before}_{more,t,i}$) and after ($uhat^{after}_{more,t,i}$) the arrival of the Crisis, while ($uhat_{more,t,i}$) is the monetary shock we get estimating equation (1.1) for the whole sample without taking into account the two different time periods. Estimation of the above equation differs from country to country since the lag lengths for each variable differ. For each country and each of the two models, we use an optimal lag length selection approach based on the Bayesian Information Criterion (BIC).

By including the current values of the information set, we are effectively assuming that the Central Bank can observe current values of industrial production, the unemployment rate, the CPI and commodity prices, when choosing its short term interest rate. This assumption is consistent, with Christiano, Eichenbaum and Evans (1999) and Bernanke and Mihov (1995) but it comes in contrast with the specification of Sims and Zha (1995) where only lagged values are included. The empirical results show that for all the countries studied, most of the contemporaneous variables are statistically significant and thereby this constitutes relevant information in order to estimate the unpredictable component/shock of monetary policy.

The time series estimation results of equation (1.1) for each country are illustrated in Table 1 and Table 2 for the model without regimes for two groups of countries. For the model with regimes, the time series estimation results of equation (1.1) are illustrated in Table 3 and Table 4 for the period before the Crisis for two groups of countries. In Table 5 and Table 6, we present estimation results for the period since the Crisis incidence for each set of countries. The impact of variables that are included in the information set $X_{t,i}$ on short term interest rates can differ across the fifteen countries. Moreover, we observe that the sign of estimates can differ for the contemporaneous versus the lagged coefficients. Finally, comparing the results between the two time periods, we see that contemporaneous values as well as the sum of lagged coefficients of the variables that are included in the information set are significant for a greater number of countries after the incidence

of the recent Crisis. This finding indicates that the instrument of monetary policy is affected more from the state of the macroeconomy since the incidence of the recent Crisis.

### 3.1.2 Less informed consumers

In the second specification we estimate the monetary policy shock from the equation of the short term interest rate on its lagged values and a linear deterministic trend, as shown below in equation (1.2)**.** This will then be a shock relevant for less informed individuals. We suppose that the only information this kind of consumers have, is past values of short term interest rates. Thus, equation (1) is reduced to

$$r_{t,i} = \ a_{0,i} \ + a_{1,i}\, trend \ + \sum_{j=1}^{n} a_{2j,i} r_{t-j,i} \ + u_{less,t,i}^{period} \tag{1.2}$$

Again, we estimate equation (1.2) for the whole sample and get the monetary shock ($uhat_{less,t,i}$) from the model without regimes. Moreover, we also estimate the above equation separately for the two time periods to get two different monetary shocks, one for the period before ($uhat_{less,t,i}^{before}$) and for one the period after ($uhat_{less,t,i}^{after}$) the incidence of the recent Crisis for each country $i$. Since short term interest rates are trend stationary, we include a trend in the estimation above for all fifteen countries that we examine. The optimal lag length of the short term interest rate is selected based on the BIC separately for each of the two time periods. Based on this, for the period before the Crisis the optimal lag length is 2 for all countries except Finland, Ireland and the Slovak Republic where the lag lengths may be 3 or 4. For the period after the incidence of the Crisis, the lag length of the short term interest rate is the same across all countries except the Slovak Republic. Moreover, when we estimate the equation above for the whole sample, the optimal lag length of short term interest rates differs from what we get when we are looking separately for two different time periods.

Time series estimation results of equation (1.2) for each country are shown in Table 7 for the whole sample. For the model with regimes, the time series estimation results of equation (1.2) are illustrated in Table 8, for the period before the Crisis. For the period after the Crisis incidence, estimation results are shown in Table 9. In all cases, we can see that lagged values of the short-term interest rate have a strongly significant positive impact on current values of the short-term interest

rate which is similar for different countries in the sample and for the different periods we consider.

In the next subsection, we study how individuals interpret the change in the policy rate, investigating the impact of monetary shocks on inflation expectations of different types of consumers before and after the arrival of the Crisis.

### 3.2 Estimation of inflation expectations in the second stage

What happens to inflation expectations after an exogenous shock to monetary policy? Our goal will be to answer this question in relation to different types of consumers and different time periods using a panel data model. Our analysis of inflation expectations here resembles Curtin (2010), where consumers revise their expectations for the following period based on the error in their expectations in the current period. In general, the literature finds that individuals appear to gradually adjust their expectations in order to eliminate any systematic expectational error. Moreover, Curtin (2010) and Ueda (2010) assume that there is simultaneous co-dependence between realized and expected inflation. This assumption is adopted in our analysis as well.

In this subsection we examine the inflation expectations of different types of consumers. In particular, we examine the impact of two different types of monetary policy shocks, $uhat_{more,i}$ and $uhat_{less,i}$, that we identified in the first stage pertaining to more versus less informed agents for each country $i$, on inflation expectations of total consumers and some basic demographic consumer subgroups. Costs of updating inflation expectations might differ across demographic subgroups and our analysis here allows us to examine this possibility. We will thus consider inflation expectations of consumers based on their income, education, occupation and age.

Curtin (2010) argues that the formation of inflation expectations depends on the ability of individuals to gather and interpret information. Moreover, the economic situation and personal experiences are different over the life cycle. For this reason, we include in our analysis inflation expectations of low and high income consumers, low and high educated consumers, unemployed and full time workers, and consumers of ages 30 to 49 and ages 50 to 64. Comparing the results between these demographic subgroups we can have a complete picture of different types of consumers and their ability to interpret the information that they get.

In general, expectations formation depends on the information set consumers have and on the model

of transforming this information into expectations. Here, we consider panel models and estimate inflation expectations on lagged values of inflation expectations, current and lagged values of actual inflation and on the lagged values of monetary policy shocks pertaining to more and less informed individuals, across 15 european economies. We estimate the following equation

$$\pi^e_{t,i} = b_i + b_t + \sum_{j=1}^{n} b_{1j,i}\pi^e_{t-j,i} + b_2\ \pi_t + \sum_{j=1}^{n} b_{3j}\pi_{t-j} + \sum_{j=1}^{n} b_{4j}\ uhat_{k,t-j} + \varepsilon_{t,i} \tag{2.1}$$

where $\pi^e_{t,i}$ captures inflation expectations at time t for country $i$, $b_i$ and $b_t$ are country and period dummies respectively, $\pi_t$ is the actual inflation rate at time t, $j$ is the lag length, *uhat* is the monetary policy shock which can be either $uhat_{\text{more}}$ or $uhat_{\text{less}}$ depending on the type of monetary shock, $k = [more, less]$, obtained in the first stage and included in the above equation, and $\varepsilon_t$ is the error term. The optimal lag length for each demographic subgroup was selected according to the BIC. Our results imply that only one lag of actual inflation should be included in equation (2.1) for both types of shocks and for all demographic subgroups. This indicates that current inflation expectations of all types of consumers are affected only from contemporaneous inflation and the inflation value they observed in the previous month. We do not get this clear result for other variables that we use in equation (2.1). The optimal lag length for monetary policy shocks or inflation expectations differs across the demographic subgroups that we examine.

In our second specification, we separate the sample for the period before and after the incidence of the recent Crisis. We do this via dummy variables, where *dpre* takes value 1 from 1985:1 until 2008:6 and zero otherwise, while *dpost* takes value 1 from 2008:10 until 2015:3 and zero otherwise. We are interested in how the estimation of the equation above changes with the recent Crisis arrival and to achieve this we multiply each variable and its lagged value with these two dummies (*dpre* and *dpost*). We estimate the model with regimes as follows

$$\begin{aligned}\pi^e_{t,i} \;=\; & b_i + b_t + b_1 dpost + \sum_{j=1}^{n} b_{2j,i}\pi^e_{t-j,i,pre} + b_3\pi_{t,pre} + \sum_{j=1}^{n} b_{4j}\pi_{t-j,pre} + \sum_{j=1}^{n} b_{5j}\ uhat_{k,t-j,pre} \\ & + \sum_{j=1}^{n} b_{6j,i}\pi^e_{t-j,i,post} + b_7\pi_{t,post} + \sum_{j=1}^{n} b_{8j}\pi_{t-j,post} + \sum_{j=1}^{n} b_{9j}\ uhat_{k,t-j,post} + \varepsilon_{t,i}\end{aligned} \tag{2.2}$$

where $\pi^e_{t,i}$ captures inflation expectations at time t for country $i$, $b_i$ and $b_t$ are country and period dummies respectively, and *dpost* is a dummy variable for the period after the incidence of the Crisis.

Subscripts *pre* and *post* indicate that the variables included in the estimation are multiplied with dummies *dpre* and *dpost* respectively. Again, the selection of the optimal lag length for the period before and after is based on the BIC.

In the following section we discuss the results of the second stage estimation for the model without regimes and for the model with regimes. In the first subsection, we discuss results based on the monetary shock obtained under the assumption that individuals are as informed as the Central Bank, while in the second subsection we discuss results based on the monetary shock obtained under the assumption that individuals are less informed.

# 4 Estimation Results for the second stage

## 4.1 The case of More informed individuals

In Table 10 we present estimation results based on equation (2.1) where we explain inflation expectations of total consumers and consumer subcategories with lagged values of inflation expectations, current and lagged values of actual inflation and lagged values of the monetary shock that was constructed in the first stage assuming that individuals are informed about the main variables that describe the macroeconomy. In Table 11, we show estimation results based on equation (2.2) where we separate the sample in two periods and examine again the impact of lagged values of inflation expectations, current and lagged values of actual inflation, and lagged values of the monetary shock for the period before and after the incidence of the recent Crisis, separately. In both cases, we consider panel regressions with time and country effects.

Estimation results of equation (2.1) in Table 10 show that the overall impact of the monetary policy shock identified from equation (1.1) in the first stage under the assumption that individuals are informed about macroeconomic variables, is negative and statistically significant at the 5% significance level for ages 30-49 and for low income or low educated consumers, and at the 10% significance level for high income consumers and full time workers, suggesting that for these subgroups an unpredictable increase in the interest rate lowers inflation expectations. The most negative sum of coefficients is for low income consumers. Following an unpredictable increase in interest rates, these individuals believe that prices will decrease in the next 12 months and lower their inflation expectations. These results are consistent with a standard neo-Keynesian response

to an exogenous policy shock.

It should be noted that the contemporaneous actual inflation rate has the highest positive impact on inflation expectations at time t. The significance of the contemporaneous actual inflation on inflation expectations of all types of consumers that we are looking at, indicates that consumers obtain information about current inflationary trends from sources other than the official announcements regarding previous period values of the series (see Curtin, 2010). For example, individuals gain information about current up to date prices in their daily transactions in supermarkets.

Next, in what amounts to our preferred or richer specification, we present in Table 11 results from estimating equation (2.2) that take into account possible changes in the estimated relationships before and after the incidence of the Crisis for shocks estimated from equation (1.1) pertaining to individuals that are informed about a variety of variables describing macroeconomic conditions.[12] For the period before the Crisis, the monetary shock is negatively significant at the 5% significance level for low income consumers and at the 10% significance level for ages 30-49. For the period since the arrival of the Crisis, the impact of the monetary shock is much more negative, and is statistically significant at the 5% level for high educated and high income consumers, full time workers, and ages 30-49. This is in line with individuals with different costs and benefits of obtaining information and updating inflation expectations, and with different ability to use information, reacting differently to monetary policy shocks. That is, consumer types that we would a priori expect to have higher ability to extract signals from a given realization (high educated, high income and full time working consumers as compared respectively to low educated, low income and the unemployed) appear to be reacting more to a given monetary policy shock after the arrival of the Crisis, a period during which signal extraction is presumably more difficult and the incentive to do so is greater. Similarly, individuals with a longer horizon and thus a higher incentive to react to a shock (ages 30-49) appear to be reacting more to a given monetary policy shock as compared to individuals with a shorter horizon and thus a lower incentive to react (ages 50-64). Moreover, that the monetary policy shock has statistically significant negative impact on inflation expectations for several subcategories, is in line with standard neo Keynesian channels.

As was the case for the whole sample, contemporaneous actual inflation is positively related with

[12] We note that in the period before the crisis, households appear to have longer memory and the exogenous shock affects their expectations at time t-1, t-2, and t-3, while in the period after the crisis incidence only the monetary shock of the previous month affects current inflation expectations.

inflation expectations for both periods. However, its impact is statistically significant for more consumer subgroups and with much higher coefficient estimates for the period after the Crisis incidence as compared to before the Crisis. This indicates that individuals rely more on their own information about inflation from their daily transactions after the incidence of Crisis as compared to before the Crisis. In addition, the inflation realization of the previous month has no statistically significant impact on inflation expectations. This suggests that consumers did not rely as much on official announcements about inflation. In fact, given the above results regarding the effect of current inflation and lagged inflation on inflation expectations, we can infer that consumers rely more on their own contemporaneous information about inflation based on their daily transactions rather than on official announcements and publicly available information from previous periods e.g. regarding previous values of the inflation series.

Next, we present results from the second stage regression using the monetary shock that was constructed in the first stage under the assumption that individuals are not as informed.

### 4.2 The case of Less informed individuals

In our second specification, we explain inflation expectations of different types of consumers using lagged values of a monetary policy shock obtained by estimating equation (1.2) under the assumption that individuals are less informed about the macroeconomy as compared to the Central Bank, along with lagged values of inflation expectations and contemporaneous and lagged values of actual inflation. First, we consider the whole sample period without imposing a break based on equation (2.1), and then we consider a model with regimes estimating equation (2.2). In Table 12, we illustrate estimation results based on equation (2.1) for the model without regimes. The accumulated effect of a positive monetary policy shock as given by the sum of its lagged estimated coefficients, is to raise inflation expectations of total consumers. A positive statistically significant impact is also estimated for high income, high educated and less educated consumers (with a higher coefficient for the high as compared to the less educated) and for ages 50-64.[13] In this case, individuals appear to be aware that the Central Bank has a superior information set and utilize the monetary policy shock to learn what the Central Bank believes about current and future macroeconomic conditions.

[13] If we look at the impact of the monetary policy shock on inflation expectations for each individual lag, then we observe that the impact of the monetary shock at time t-2 is negative as was in the first specification, but in this case insignificant and not negative enough to eliminate the overall positive effect due to the impact of the monetary shock at t-1.

Thus, when there is an unanticipated increase in interest rates, these individuals learn that the Central Bank is worried about inflation so they update inflation expectations upwards. This is then one instance where we do not estimate the negative effect of interest rate shocks one would expect based on standard neo-Keynesian channels.

Estimating the model with regimes from equation (2.2) using shocks obtained by estimating equation (1.2) in the first stage under the assumption that individuals are less informed, we get the results shown in Table 13. The overall impact of the monetary policy shock before the Crisis can be positive or negative depending on the subgroup being considered but is statistically insignificant for all consumer subcategories examined. For the period after the incidence of the recent Crisis, the impact of the monetary policy shock is much bigger than before the Crisis, negative, and strongly significant for all eight subgroups and for total consumers. This is consistent with a standard neo-Keynesian channel via which monetary policy affects consumption, investment, and other economic outcomes in the period since the Crisis arrived.

As compared to the results based on the monetary policy shock obtained under the assumption that individuals are more informed about the macroeconomy, we can outline a number of differences.[14] For the model without regimes, the overall impact of the monetary policy shock on inflation expectations is different as we can see comparing Tables 10 and 12. The relation of the unanticipated change in interest rates with inflation expectations is negative in line with a standard neo-Keynesian mechanism in the first case but positive in the second case. The latter is consistent with individuals that are aware they have less information than the Central Bank and thus use monetary policy actions to make inferences about the state of the macroeconomy. That is, individuals believe that monetary policy shocks contain useful and unavailable macroeconomic information. This finding is consistent with Romer and Romer (2000), Campbell, Evans, Fisher, and Justiniano (2012), and Nakamura and Steinsson (2013) which document small increases in forecasts of inflation and real economic activity following positive interest rates surprises. It is also consistent with Cochrane's (2015) neo-Fisherian approach.

[14] Here, it is worthwhile to mention that depending on the specification that we use, we choose different optimal lag lengths for each variable and for each consumer subgroup based on the BIC. For instance, in the first specification where we assume that individuals are more informed, in the period since the incidence of the Crisis the monetary shock affects inflation expectations only at time t-1. In the second specification where the monetary policy shock being utilized to explain inflation expectations is based on the assumption that individuals are less informed, inflation expectations are affected from the monetary policy shock at t-1, t-2 and t-3. So the optimal lag lengths that are included to explain inflation expectations, is one difference between these two specifications other than that we are using monetary shocks constructed in two different ways.

For the model with regimes, comparing the impact of the two monetary shocks before the Crisis we see that the unpredictable increase in interest rates has negative and typically significant impact on inflation expectations for the specification utilizing monetary shocks obtained under the assumption that individuals are informed as shown in Table 11, but statistically insignificant (negative or positive across consumer subgroups) impact for the specification utilizing monetary shocks obtained under the assumption that individuals are not as informed shown in Table 13. For the period since the arrival of the Crisis, the impact of the monetary shock is typically negative and larger than before the Crisis, for both specifications. Moreover, the impact is larger in absolute magnitude for the second specification. That is, for the specification utilizing the monetary shock obtained under the assumption that individuals are less informed, the coefficient is much more negative and strongly significant for all eight subgroups as well as for total consumers. Thus, according to our results, after the incidence of the Crisis the monetary shock obtained under the assumption that individuals are less informed has larger and more often significant impact on inflation expectations than the monetary shock pertaining to more informed individuals, exactly the opposite of what we find for the period before the Crisis. This suggests that since the incidence of the Crisis, the monetary shock obtained under the assumption that individuals are not as informed becomes more relevant, which is consistent with consumers finding it more difficult to be well informed about macroeconomic fundamentals in this period of presumably higher uncertainty.

# 5 Conclusion

How has the recent Crisis influenced consumers' expectation formation? Do different demographic consumer subgroups interpret monetary policy shocks in the same way? Does a monetary shock constructed under the assumption that individuals are less informed have the same impact as a monetary shock constructed under the assumption that individuals have an information set resembling that of Central Bankers?

Our results suggest that the impact of monetary policy shocks on inflation expectations differs depending on the period being considered, the demographic consumer subgroup, and the type of shock. Since the arrival of the Crisis in 2008, this impact is typically significantly negative and larger than before the Crisis. Taking into account the possibility that the estimated relationships differ before and after the Crisis and focusing on shocks pertaining to individuals that are well in-

formed about macroeconomic conditions, our results shed particular light on differences in inflation expectations formation across consumer types. In this case, consumer types that we would a priori expect to have higher ability to extract signals from a given realization (high educated, high income and full time working consumers as compared respectively to low educated, low income and the unemployed) appear to be reacting more to a given monetary policy shock in the period after the incidence of the Crisis, a period during which signal extraction is presumably more difficult and the incentive to extract information greater. Similarly, individuals with a longer horizon and thus a higher incentive to react to a shock (ages 30-49) appear to be reacting more to a given monetary policy shock as compared to individuals with a shorter horizon and thus a lower incentive to react (ages 50-64).

The impact of unanticipated changes in short-term interest rates on inflation expectations is typically negative reflecting standard neo-Keynesian macroeconomic channels where an increase in short-term interest rates reduces economic activity and thus inflation and inflation expectations decrease. There is less evidence for a second distinct theoretical channel where consumers learn from an unanticipated increase in interest rates that the Central Bank, based on its superior information set, is expecting an increase in economic activity and a rise in inflation, so that raising the policy rate increases inflation expectations. However, this impact can sometimes be positive depending on the type of shock and the demographic consumer subgroup being considered. For example, in the specification where the monetary shock is constructed under the assumption that agents are less informed, the accumulated impact of the shock on inflation expectations for the complete sample period is significantly positive for total consumers and a number of consumer subgroups, consistent with the above channel.

Finally, one of the most robust findings of our analysis of inflation expectations formation is that contemporaneous actual inflation is positively related with inflation expectations, especially so in the period after the incidence of the Crisis. In addition, the inflation realization of the previous month has a lower and typically insignificant impact on inflation expectations. These results taken together imply that in forming inflation expectations, consumers rely more on their own contemporaneous information about inflation based on their daily transactions rather than on official announcements about past values of inflation.

Table 1: Estimation results for equation (1.1) for the whole sample 1985:1-2015:3.

| VARIABLES | (AT) $r_t$ | (BE) $r_t$ | (DE) $r_t$ | (EE) $r_t$ | (EL) $r_t$ | (ES) $r_t$ | (FI) $r_t$ |
|---|---|---|---|---|---|---|---|
| time trend | | 0.008** | 0.001*** | | | | |
| | | (0.004) | (0.000) | | | | |
| Industrial Production | 0.808 | 1.020* | 1.422** | -1.451 | 0.236 | 0.773 | -0.021 |
| | (0.574) | (0.552) | (0.659) | (1.463) | (0.567) | (1.101) | (0.885) |
| Unemployment rate | -0.193*** | -0.178** | -0.121 | 0.022 | 0.018 | -0.014 | 0.069 |
| | (0.055) | (0.086) | (0.116) | (0.059) | (0.044) | (0.129) | (0.153) |
| CPI excl food&energy | 3.389* | 0.257 | -0.665 | 5.265 | 0.060 | 2.061 | 10.307** |
| | (1.962) | (5.635) | (2.367) | (7.701) | (0.688) | (1.296) | (5.220) |
| Price of crude oil | 0.056 | -0.004 | 0.004 | 0.047 | 0.404** | 0.098 | 0.059 |
| | (0.104) | (0.142) | (0.110) | (0.498) | (0.197) | (0.146) | (0.204) |
| Price of food | -0.266 | -0.371 | -0.025 | 0.072 | -0.861 | -0.008 | 1.833 |
| | (0.294) | (0.512) | (0.335) | (1.279) | (0.642) | (0.530) | (1.117) |
| Interest rate lags | 0.981*** | 0.951 | 0.977*** | 0.965*** | 0.978*** | 0.966*** | 0.973*** |
| | (0.011) | (0.016) | (0.012) | (0.029) | (0.014) | (0.015) | (0.026) |
| Industrial production lags | 0.819 | 0.216 | 1.383** | -4.101** | 0.227 | -0.989 | 2.099** |
| | (0.570) | (0.541) | (0.581) | (1.653) | (0.584) | (1.315) | (1.044) |
| Unemployment rate lag | 0.009 | 0.073 | -0.337*** | -0.143* | 0.009 | 0.048 | -0.137 |
| | (0.055) | (0.088) | (0.119) | (0.081) | (0.053) | (0.114) | (0.159) |
| CPI excl food&energy lag | -3.573* | -6.083 | -1.007 | -5.810 | -0.224 | -2.642** | -10.684** |
| | (1.995) | ( 5.124) | (2.378) | (7.722) | (0.691) | (1.230) | (5.412) |
| Price of crude oil lags | 0.100 | 0.100 | 0.187* | -0.035 | 0.709* | 0.323* | 0.079 |
| | (0.107) | (0.169) | (0.112) | (0.432) | (0.273) | (0.179) | (0.204) |
| Price of food lag | 0.794* | 0.524 | 0.319 | -1.152 | 0.578 | 0.473 | 0.126 |
| | (0.459) | (0.645) | (0.494) | (1.304) | (0.611) | (0.618) | (0.795) |
| Constant | 0.865 | 24.526** | 7.311*** | 2.551** | 0.768 | 2.704** | 1.749 |
| | (0.789) | (10.709) | (2.580) | (1.163) | (0.850) | (1.252) | (2.292) |
| Observations | 265 | 289 | 289 | 204 | 202 | 289 | 289 |
| adjusted R-squared | 0.995 | 0.991 | 0.997 | 0.980 | 0.996 | 0.996 | 0.988 |

Notes: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors in parentheses. We identify the monetary policy shock based on the assumption that individuals are more informed and have the same information set as the Central Bank. We are estimating equation (1.1), regressing short term interest rates on the information set of the Central Bank which includes current and lagged values of differenced log industrial production, differenced unemployment rate, the log of the CPI (all items excluding food and energy) and on smoothed changes of the log price of oil and the log price of food for the whole sample 1985:1-2015:3. In columns (1) - (7), we present results for the following countries: Austria, Belgium, Germany, Estonia, Greece, Spain and Finland.

Table 2: Estimation results for equation (1.1) for the whole sample 1985:1-2015:3.

| VARIABLES | (FR) $r_t$ | (IE) $r_t$ | (IT) $r_t$ | (LU) $r_t$ | (NL) $r_t$ | (PT) $r_t$ | (SI) $r_t$ | (SK) $r_t$ |
|---|---|---|---|---|---|---|---|---|
| Industrial Production | 1.616 | 0.617 | 0.679 | 0.058 | 0.635 | 1.192 | 1.192 | 0.219 |
| | (1.294) | (0.583) | (1.803) | (0.287) | (0.445) | (1.104) | (0.823) | (0.935) |
| Unemployment rate | -0.578*** | 0.957* | -0.016 | -0.043 | -0.107 | -0.139 | 0.067 | -0.088 |
| | (0.184) | (0.504) | (0.116) | (0.081) | (0.090) | (0.097) | (0.091) | (0.163) |
| CPI excl food&energy | 8.412** | 3.662 | -14.155 | 1.765* | 2.122 | 1.879 | 0.324 | -4.918 |
| | (3.692) | (17.635) | (16.931) | (0.928) | (1.483) | (3.605) | (1.440) | (7.802) |
| Price of crude oil | -0.199 | -0.046 | -0.007 | 0.005 | 0.004 | 0.324 | 0.350** | 0.172 |
| | (0.158) | (0.406) | (0.237) | (0.129) | (0.120) | (0.230) | (0.151) | (0.460) |
| Price of food | 0.072 | -3.870 | 1.074 | -0.124 | 0.030 | -0.650 | 0.149 | -1.480 |
| | (0.506) | (2.417) | (1.028) | (0.376) | (0.351) | (0.819) | (0.488) | (1.124) |
| Interest rate lags | 0.975*** | 0.822*** | 0.975*** | 0.985*** | 0.991*** | 0.970*** | 0.980*** | 0.800*** |
| | (0.023) | (0.125) | (0.036) | (0.012) | (0.009) | (0.018) | (0.018) | (0.064) |
| Industrial production lags | 0.329 | 1.433* | 1.751 | 0.290 | 0.799* | 1.547 | 3.512*** | 1.805 |
| | (1.498) | (0.753) | (1.832) | (0.332) | (0.447) | (1.027) | (0.832) | (1.113) |
| Unemployment rate lag | 0.137 | -0.249 | -0.106 | -0.069 | -0.159 | -0.013 | -0.196** | -0.118 |
| | (0.161) | (0.471) | (0.084) | (0.073) | (0.098) | (0.113) | (0.087) | (0.153) |
| CPI excl food&energy lag | -8.938** | -6.322 | 13.698 | -1.991** | -2.164 | -2.262 | -0.698 | 1.449 |
| | (3.885) | (18.387) | (17.069) | (0.967) | (1.474) | (3.556) | (1.552) | (7.827) |
| Price of crude oil lags | 0.178 | 0.735 | 0.536** | 0.074 | 0.408** | 0.491** | 0.280 | 0.015 |
| | (0.154) | (0.978) | (0.254) | (0.124) | (0.176) | (0.247) | (0.173) | (0.339) |
| Price of food lags | 0.231 | -0.694 | 0.675 | | 0.336 | -0.366 | -0.533 | 0.495 |
| | (0.706) | (4.283) | (1.127) | | (0.584) | (0.864) | (0.629) | (1.081) |
| Constant | 2.426 | 12.474** | 2.132 | 1.051 | 0.201 | 1.775 | 1.732 | 16.192*** |
| | (2.125) | (6.096) | (2.932) | (0.927) | (0.628) | (1.373) | (2.973) | (5.571) |
| Observations | 289 | 289 | 289 | 193 | 289 | 289 | 156 | 196 |
| adjusted R-squared | 0.988 | 0.814 | 0.990 | 0.994 | 0.996 | 0.992 | 0.995 | 0.984 |

Notes: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors in parentheses. We identify the monetary policy shock based on the assumption that individuals are more informed and have the same information set as the Central Bank. We are estimating equation (1.1), regressing short term interest rates on the information set of the Central Bank which includes current and lagged values of differenced log industrial production, differenced unemployment rate, the log of the CPI (all items excluding food and energy) and on smoothed changes of the log price of oil and the log price of food for the whole sample 1985:1-2015:3. In columns (1) - (8), we present results for the following countries: France ,Ireland, Italy, Luxembourg, Netherlands, Portugal, Slovenia and the Slovak Republic.

Table 3: Estimation results for equation (1.1) for the period before the Crisis.

| VARIABLES | (AT) $r_t$ | (BE) $r_t$ | (DE) $r_t$ | (EE) $r_t$ | (EL) $r_t$ | (ES) $r_t$ | (FI) $r_t$ |
|---|---|---|---|---|---|---|---|
| time trend | | 0.011** | 0.003*** | | | | |
| | | (0.005) | (0.001) | | | | |
| Industrial Production | 0.684 | 1.176 | 0.865 | -3.046 | 0.072 | 0.427 | -1.253 |
| | (0.590) | (0.766) | (0.924) | (2.644) | (0.883) | (1.341) | (1.025) |
| Unemployment rate | -0.255*** | -0.152* | -0.054 | 0.131 | 0.186* | 0.158 | 0.180 |
| | (0.068) | (0.086) | (0.143) | (0.104) | (0.104) | (0.195) | (0.153) |
| CPI excl food&energy | 3.214 | -2.266 | -1.177 | 3.553 | 1.659 | 1.643 | 12.305* |
| | (3.394) | (6.829) | (3.315) | (16.216) | (1.358) | (1.920) | (6.792) |
| Price of crude oil | -0.028 | -0.055 | -0.094 | 0.003 | 0.413 | 0.017 | 0.282 |
| | (0.121) | (0.164) | (0.125) | (0.623) | (0.274) | (0.176) | (0.283) |
| Price of food | -0.073 | 0.233 | 0.430 | 1.255 | -0.905 | 0.471 | 3.817* |
| | (0.364) | (0.834) | (0.445) | (2.343) | (1.219) | (0.783) | (1.954) |
| Interest rate lags | 0.978*** | .0948*** | 0.971*** | 0.866*** | 0.991*** | 0.951*** | 0.956*** |
| | (0.011) | (0.020) | (0.013) | (0.044) | (0.013) | (0.015) | (0.031) |
| Industrial production lags | 0.390 | -0.285 | 1.028 | -26.204*** | -0.248 | -1.894 | 1.276 |
| | (0.574) | (0.685) | (0.810) | (8.884) | (0.766) | (1.728) | (1.283) |
| Unemployment rate lag | 0.040 | 0.038 | -0.399*** | -0.006 | 0.206** | 0.139 | -0.012 |
| | (0.088) | (0.106) | (0.137) | (0.108) | (0.093) | (0.138) | (0.172) |
| CPI excl food&energy lags | -3.070 | -5.106 | -1.330 | -4.897 | -0.774 | -2.458 | -12.878* |
| | (3.428) | (5.821) | (3.279) | (16.547) | (1.355) | (1.907) | (6.995) |
| Price of crude oil lag | -0.030 | -0.046 | 0.085 | -0.317 | -0.100 | 0.132 | 0.068 |
| | (0.126) | (0.179) | (0.125) | (0.584) | (0.189) | (0.203) | (0.266) |
| Price of food lags | 0.354 | -0.260 | -0.174 | -1.390 | .145 | -0.202 | -0.226 |
| | (0.388) | (0.803) | (0.449) | (2.549) | (1.425) | (0.774) | (1.005) |
| Constant | -0.579 | 30.871** | 10.822*** | 6.419 | -3.898** | 3.820*** | 2.711 |
| | (0.887) | (15.115) | (3.172) | (5.289) | (1.494) | (1.362) | (2.799) |
| Observations | 184 | 208 | 208 | 121 | 121 | 208 | 208 |
| adjusted R-squared | 0.989 | 0.986 | 0.996 | 0.974 | 0.994 | 0.995 | 0.983 |

Notes: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors in parentheses. We identify the monetary policy shock based on the assumption that individuals are more informed and have the same information set as the Central Bank. We are estimating equation (1.1), regressing short term interest rates on the information set of the Central Bank which includes current and lagged values of differenced log industrial production, differenced unemployment rate, the log of the CPI (all items excluding food and energy) and on smoothed changes of the log price of oil and the log price of food for the period before the Crisis1985:1-2008:6. In columns (1) - (7), we present results for the following countries: Austria, Belgium, Germany, Estonia, Greece, Spain and Finland.

Table 4: Estimation results for equation (1.1) for the period before the Crisis.

| VARIABLES | (FR) $r_t$ | (IE) $r_t$ | (IT) $r_t$ | (LU) $r_t$ | (NL) $r_t$ | (PT) $r_t$ | (SI) $r_t$ | (SK) $r_t$ |
|---|---|---|---|---|---|---|---|---|
| time trend | | -0.057*** | | | 0.007*** | 0.011*** | 0.012*** | |
| | | (0.015) | | | (0.002) | (0.004) | (0.004) | |
| Industrial Production | 0.566 | 0.540 | -1.468 | -0.520 | 0.519 | 1.647 | -0.327 | 1.724 |
| | (1.930) | (1.332) | (3.082) | (0.421) | (0.529) | (1.400) | (1.333) | (1.878) |
| Unemployment rate | -0.621** | 1.543 | 0.021 | -0.116 | 0.028 | -0.062 | 0.305 | 0.258 |
| | (0.261) | (1.125) | (0.217) | (0.114) | (0.144) | (0.181) | (0.247) | (0.261) |
| CPI excl food&energy | 18.669** | -2.829 | -35.723 | 2.078 | 1.314 | -0.810 | -1.171 | -15.220 |
| | (8.625) | (23.109) | (31.851) | (1.430) | (1.998) | (6.493) | (3.966) | (13.505) |
| Price of crude oil | -0.324 | -0.661 | 0.120 | -0.105 | -0.176 | 0.317 | 0.723** | 0.261 |
| | (0.201) | (0.865) | (0.279) | (0.163) | (0.132) | (0.317) | (0.299) | (0.764) |
| Price of food | 0.574 | -3.935 | 3.090* | 0.290 | 0.235 | 0.293 | 2.972** | -1.626 |
| | (0.865) | (4.802) | (1.602) | (0.545) | (0.487) | (1.426) | (1.186) | (2.721) |
| Interest rate lags | 0.975*** | 0.638*** | 0.972*** | 0.985*** | 0.975*** | 0.926*** | 0.936*** | 0.785*** |
| | (0.026) | (0.113) | (0.038) | (0.013) | (0.013) | (0.032) | (0.039) | (0.063) |
| Industrial production lags | -1.355 | 1.433 | -0.105 | -0.316 | 1.067** | 2.052 | 5.712** | 4.554** |
| | (2.099) | (1.120) | (3.313) | (0.388) | (0.490) | (1.254) | (2.358) | (1.750) |
| Unemployment rate lag | 0.186 | -0.648 | -0.156 | -0.087 | -0.042 | 0.113 | -0.193 | 0.247 |
| | (0.246) | (0.957) | (0.142) | (0.094) | (0.145) | (0.196) | (0.177) | (0.216) |
| CPI excl food&energy lags | -19.016** | 19.027 | 35.008 | -1.953 | -4.849** | -3.842 | -4.821 | 12.358 |
| | (8.885) | (25.593) | (31.875) | (1.496) | (1.876) | (6.438) | (4.073) | (13.539) |
| Price of crude oil lag | -0.010 | 0.111 | 0.541* | 0.033 | -0.007 | 0.413 | 0.623** | 0.370 |
| | (0.195) | (0.705) | (0.318) | (0.189) | (0.130) | (0.302) | (0.265) | (0.564) |
| Price of food lags | -0.388 | 7.295 | 0.964 | 0.336 | -0.568 | -1.078 | -3.555*** | 0.903 |
| | (1.108) | (4.562) | (1.704) | (0.575) | (0.496) | (1.218) | (1.013) | (2.625) |
| Constant | 1.619 | -58.526*** | 3.338 | -0.495 | 14.434*** | 18.422*** | 24.227*** | 13.709*** |
| | (2.727) | (17.617) | (3.064) | (1.413) | (5.249) | (6.899) | (8.223) | (5.066) |
| Observations | 208 | 207 | 208 | 112 | 208 | 208 | 75 | 115 |
| adjusted R-squared | 0.980 | 0.746 | 0.986 | 0.982 | 0.995 | 0.990 | 0.986 | 0.970 |

Notes: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors in parentheses. We identify the monetary policy shock based on the assumption that individuals are more informed and have the same information set as the Central Bank. We are estimating equation (1.1), regressing short term interest rates on the information set of the Central Bank which includes current and lagged values of differenced log industrial production, differenced unemployment rate, the log of the CPI (all items excluding food and energy) and on smoothed changes of the log price of oil and the log price of food for the period before the Crisis1985:1-2008:6. In columns (1) - (8), we present results for the following countries: France ,Ireland, Italy, Luxembourg, Netherlands, Portugal, Slovenia and the Slovak Republic.

Table 5: We present estimation results for equation (1.1) for the period after the incidence of the Crisis.

| VARIABLES | (AT) $r_t$ | (BE) $r_t$ | (DE) $r_t$ | (EE) $r_t$ | (EL) $r_t$ | (ES) $r_t$ | (FI) $r_t$ |
|---|---|---|---|---|---|---|---|
| time trend | -0.015*** | | | | | | 0.010** |
| | (0.004) | | | | | | (0.004) |
| Industrial Production | 1.394 | -0.198 | 0.505 | -1.287 | -0.234 | -0.988 | -0.951 |
| | (0.891) | (0.403) | (0.657) | (0.894) | (0.469) | (0.935) | (0.794) |
| Unemployment rate | -0.132 | 0.056 | -0.307* | 0.022 | 0.024 | -0.271** | 0.065 |
| | (0.093) | (0.108) | (0.180) | (0.074) | (0.056) | (0.125) | (0.177) |
| CPI excl food&energy | 5.476** | 0.450 | -1.325 | 6.264 | 0.351 | 0.803 | 4.391 |
| | (2.453) | (4.642) | (1.637) | (7.508) | (0.702) | (1.335) | (4.652) |
| Price of crude oil | 0.375** | 0.178 | 0.255* | -0.656** | 0.305** | 0.245 | 0.181 |
| | (0.148) | (0.112) | (0.137) | (0.306) | (0.125) | (0.169) | (0.120) |
| Price of food | -0.670 | -1.038* | -1.026 | -0.145 | -1.026 | -1.014* | -1.077** |
| | (0.470) | (0.610) | (0.636) | (0.634) | (0.665) | (0.595) | (0.528) |
| Interest rate lags | 1.023*** | 0.925*** | 0.925*** | 0.909*** | 0.938*** | 0.933*** | 0.909*** |
| | (0.036) | (0.037) | (0.043) | (0.034) | (0.042) | (0.038) | (0.033) |
| Industrial production lags | 11.745*** | 0.171 | 0.015 | -1.554 | -0.425 | 0.947 | -1.743 |
| | (2.130) | (0.345) | (0.513) | (0.995) | (0.418) | (0.680) | (1.504) |
| Unemployment rate lags | -0.653*** | -0.106 | -0.097 | 0.225 | -0.009 | 0.267** | -0.679** |
| | (0.114) | (0.110) | (0.211) | (0.097) | (0.040) | (0.112) | (0.268) |
| CPI excl food&energy lag | 4.695** | -1.220 | 0.561 | -10.088 | 0.307 | -1.873 | -12.438** |
| | (2.227) | (4.707) | (1.909) | (8.260) | (0.535) | (1.207) | (5.431) |
| Price of crude oil lags | 0.865*** | 0.071 | 0.110 | -0.266 | 0.128 | -0.023 | 0.075 |
| | (0.242) | (0.119) | (0.111) | (0.311) | (0.143) | (0.153) | (0.118) |
| Price of food lags | 0.932* | 1.041* | 0.690 | 3.177** | 0.900 | 1.304** | 0.221 |
| | (0.497) | (0.568) | (0.577) | (1.448) | (0.624) | (0.598) | (0.409) |
| Constant | -42.527*** | 3.616 | 3.557 | 17.891** | -3.002 | 4.983 | 34.046*** |
| | (11.564) | (2.212) | (4.142) | (7.535) | (2.907) | (3.112) | (12.495) |
| Observations | 78 | 78 | 78 | 78 | 78 | 78 | 78 |
| adjusted R-squared | 0.990 | 0.990 | 0.988 | 0.994 | 0.987 | 0.989 | 0.992 |

Notes: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors in parentheses. We identify the monetary policy shock based on the assumption that individuals are more informed and have the same information set as the Central Bank. We are estimating equation (1.1), regressing short term interest rates on the information set of the Central Bank which includes current and lagged values of differenced log industrial production, differenced unemployment rate, the log of the CPI (all items excluding food and energy) and on smoothed changes of the log price of oil and the log price of food for the period after the incidence of the Crisis 2008:10-2015:3. In columns (1) - (7), we present results for the following countries: Austria, Belgium, Germany, Estonia, Greece, Spain and Finland.

Table 6: We present estimation results for equation (1.1) for the period after the incidence of the Crisis.

| VARIABLES | (FR) $r_t$ | (IE) $r_t$ | (IT) $r_t$ | (LU) $r_t$ | (NL) $r_t$ | (PT) $r_t$ | (SI) $r_t$ | (SK) $r_t$ |
|---|---|---|---|---|---|---|---|---|
| time trend | | | | | | | | -0.004*** |
| | | | | | | | | (0.001) |
| Industrial Production | 0.022 | -0.128 | -1.984** | -0.187 | 0.336 | -0.143 | 1.085* | -0.116 |
| | (1.032) | (0.223) | (0.828) | (0.271) | (0.473) | (0.415) | (0.617) | (0.211) |
| Unemployment rate | 0.086 | -0.057 | -0.030 | 0.222 | -0.000 | -0.025 | 0.044 | -0.097 |
| | (0.094) | (0.050) | (0.053) | (0.141) | (0.105) | (0.054) | (0.060) | (0.074) |
| CPI excl food&energy | 0.866 | 4.076** | 7.959** | 0.408 | -0.637 | 1.042 | -0.988 | 2.444 |
| | (1.959) | (2.024) | (3.398) | (1.617) | (1.735) | (1.215) | (1.794) | (1.627) |
| Price of crude oil | 0.232* | 0.180 | 0.260** | 0.177 | 0.245* | 0.287** | 0.124 | 0.089 |
| | (0.128) | (0.127) | (0.118) | (0.115) | (0.129) | (0.140) | (0.103) | (0.106) |
| Price of food | -1.063* | -1.036 | -0.849** | -0.822 | -1.178* | -1.122* | -1.030* | -0.285 |
| | (0.632) | (0.655) | (0.364) | (0.509) | (0.644) | (0.643) | (0.588) | (0.306) |
| Interest rate lags | 0.918*** | 0.928*** | 0.920*** | 0.917*** | 0.912*** | 0.924*** | 0.915*** | 0.952*** |
| | (0.035) | (0.036) | (0.029) | (0.035) | (0.045) | (0.038) | (0.041) | (0.023) |
| Industrial production lags | 1.001 | -0.194 | 1.878 | 0.094 | -0.465 | 0.423 | 0.335 | 0.726 |
| | (1.194) | (0.120) | (2.054) | (0.278) | (0.521) | (0.513) | (0.441) | (0.618) |
| Unemployment rate lags | 0.090 | 0.105* | -0.046 | -0.145 | -0.095 | 0.055 | -0.090 | 0.013 |
| | (0.132) | (0.058) | (0.109) | (0.121) | (0.093) | (0.043) | (0.066) | (0.062) |
| CPI excl food&energy lags | -2.454 | -5.256*** | -8.767*** | -1.120 | -0.243 | -1.715 | -1.541 | 0.009 |
| | (1.626) | (1.931) | ( 3.263) | (1.549) | (1.532) | (1.214) | (1.562) | (1.545) |
| Price of crude oil lags | 0.048 | 0.031 | 0.144 | 0.247 | 0.078 | 0.007 | 0.022 | 0.348* |
| | (0.156) | (0.146) | (0.119) | (0.203) | (0.151) | (0.157) | (0.151) | (0.182) |
| Price of food lag | 0.929 | 0.673 | 0.961** | 0.919 | 0.808 | 1.001 | 0.758 | 0.280 |
| | (0.594) | (0.619) | (0.426) | (0.572) | (0.576) | (0.652) | (0.505) | (0.423) |
| Constant | 7.378* | 5.501 | 3.785 | 3.343 | 4.137* | 3.156 | 11.726** | -10.044** |
| | (4.414) | (4.271) | (2.933) | (2.114) | (2.344) | (2.470) | (5.606) | (4.777) |
| Observations | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 78 |
| adjusted R-squared | 0.988 | 0.989 | 0.993 | 0.989 | 0.988 | 0.988 | 0.989 | 0.992 |

Notes: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors in parentheses. We identify the monetary policy shock based on the assumption that individuals are more informed and have the same information set as the Central Bank. We are estimating equation (1.1), regressing short term interest rates on the information set of the Central Bank which includes current and lagged values of differenced log industrial production, differenced unemployment rate, the log of the CPI (all items excluding food and energy) and on smoothed changes of the log price of oil and the log price of food for the period after the incidence of the Crisis 2008:10-2015:3. In columns (1) - (8), we present results for the following countries: France ,Ireland, Italy, Luxembourg, the Netherlands, Portugal, Slovenia and the Slovak Republic.

Table 7: Estimation results for equation (1.2) for the whole sample 1985:1-2015:3.

| | **(AT)** | **(BE)** | **(DE)** | **(EE)** | **(EL)** | **(ES)** | **(FI)** | |
|---|---|---|---|---|---|---|---|---|
| **VARIABLES** | $\mathbf{r}_t$ | $\mathbf{r}_t$ | $\mathbf{r}_t$ | $\mathbf{r}_t$ | $\mathbf{r}_t$ | $\mathbf{r}_t$ | $\mathbf{r}_t$ | |
| time trend | -0.000 | -0.001** | -0.000 | -0.002* | -0.016*** | -0.001** | -0.001 | |
| | (0.000) | (0.000) | (0.000) | (0.001) | (0.003) | (0.001) | (0.001) | |
| Interest rate lags | 0.987*** | 0.971*** | 0.989*** | 0.964*** | 0.726*** | 0.971*** | 0.978*** | |
| | (0.009) | (0.011) | (0.007) | (0.029) | (0.042) | (0.013) | (0.019) | |
| Constant | 0.101 | 0.231** | 0.074 | 0.505 | 5.108*** | 0.399** | 0.239 | |
| | (0.085) | (0.096) | (0.064) | (0.314) | (0.914) | (0.167) | (0.171) | |
| Observations | 308 | 361 | 361 | 225 | 250 | 361 | 336 | |
| adjusted R-squared | 0.996 | 0.991 | 0.995 | 0.976 | 0.963 | 0.994 | 0.991 | |
| | **(FR)** | **(IE)** | **(IT)** | **(LU)** | **(NL)** | **(PT)** | **(SI)** | **(SK)** |
| time trend | -0.001* | -0.007* | -0.001 | -0.001 | -0.000 | -0.001 | -0.002* | -0.005*** |
| | (0.000) | (0.004) | (0.001) | (0.000) | (0.000) | (0.001) | (0.001) | (0.002) |
| Interest rate lags | 0.970*** | 0.809*** | 0.963*** | 0.979*** | 0.986*** | 0.979*** | 0.958*** | 0.917*** |
| | (0.018) | (0.117) | (0.027) | (0.017) | (0.009) | (0.012) | (0.023) | (0.035) |
| Constant | 0.273* | 2.196* | 0.462 | 0.182 | 0.112 | 0.245 | 0.637* | 1.733*** |
| | (0.161) | (1.207) | (0.334) | (0.145) | (0.077) | (0.164) | (0.341) | (0.613) |
| Observations | 361 | 357 | 361 | 193 | 349 | 350 | 155 | 220 |
| adjusted R-squared | 0.991 | 0.875 | 0.992 | 0.993 | 0.995 | 0.993 | 0.995 | 0.983 |

Notes: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors in parentheses. We identify the monetary policy shock based on the assumption that individuals are less informed. We are estimating equation (1.2), regressing the short term interest rate on its lagged values and a trend, for the whole sample 1985:1-2015:3. We present results for the following countries: Austria, Belgium, Germany, Estonia, Greece, Spain, Finland, France, Ireland, Italy, Luxembourg, Netherlands, Portugal, Slovenia and Slovak Republic.

Table 8: Estimation results for equation (1.2) for the period before the incidence of the Crisis.

| **VARIABLES** | **(AT)** $\mathbf{r}_t$ | **(BE)** $\mathbf{r}_t$ | **(DE)** $\mathbf{r}_t$ | **(EE)** $\mathbf{r}_t$ | **(EL)** $\mathbf{r}_t$ | **(ES)** $\mathbf{r}_t$ | **(FI)** $\mathbf{r}_t$ | |
|---|---|---|---|---|---|---|---|---|
| time trend | 0.000 | -0.000 | -0.000 | -0.004* | -0.039*** | -0.001* | -0.001 | |
| | (0.000) | (0.000) | (0.000) | (0.002) | (0.013) | (0.001) | (0.001) | |
| Interest rate lags | 0.998*** | 0.978*** | 0.993*** | 0.917*** | 0.665*** | 0.970*** | 0.981*** | |
| | (0.008) | (0.011) | (0.008) | (0.045) | (0.115) | (0.015) | (0.020) | |
| Constant | -0.040 | 0.146 | 0.031 | 1.313** | 10.427*** | 0.431** | 0.203 | |
| | (0.085) | (0.101) | (0.065) | (0.621) | (3.349) | (0.212) | (0.192) | |
| Observations | 227 | 280 | 280 | 148 | 170 | 280 | 255 | |
| adjusted R-squared | 0.995 | 0.986 | 0.992 | 0.959 | 0.748 | 0.992 | 0.988 | |
| | **(FR)** | **(IE)** | **(IT)** | **(LU)** | **(NL)** | **(PT)** | **(SI)** | **(SK)** |
| time trend | -0.000 | -0.010*** | -0.001 | 0.000 | -0.000 | -0.001 | 0.002 | -0.008*** |
| | (0.001) | (0.004) | (0.001) | (0.001) | (0.000) | (0.001) | (0.002) | (0.003) |
| Interest rate lags | 0.976*** | 1.075*** | 0.965*** | 0.992*** | 0.991*** | 0.982*** | 0.993*** | 0.904*** |
| | (0.020) | (0.255) | (0.031) | (0.013) | (0.009) | (0.014) | (0.029) | (0.037) |
| Constant | 0.196 | 3.258*** | 0.435 | -0.046 | 0.054 | 0.201 | -0.429 | 2.458*** |
| | (0.187) | (1.217) | (0.406) | (0.147) | (0.078) | (0.221) | (0.537) | (0.771) |
| Observations | 280 | 278 | 280 | 112 | 268 | 269 | 75 | 139 |
| adjusted R-squared | 0.986 | 0.817 | 0.989 | 0.983 | 0.992 | 0.990 | 0.982 | 0.970 |

Notes: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors in parentheses. We identify the monetary policy shock based on the assumption that individuals are less informed. We are estimating equation (1.2), regressing the short term interest rate on its lagged values and a trend, for the period before the Crisis 1985:1-2008:6. We present results for the following countries: Austria, Belgium, Germany, Estonia, Greece, Spain, Finland, France, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Slovenia and the Slovak Republic.

Table 9: Estimation results for equation (1.2) for the period after the incidence of the Crisis.

| | **(AT)** | **(BE)** | **(DE)** | **(EE)** | **(EL)** | **(ES)** | **(FI)** | |
|---|---|---|---|---|---|---|---|---|
| **VARIABLES** | $\mathbf{r}_t$ | $\mathbf{r}_t$ | $\mathbf{r}_t$ | $\mathbf{r}_t$ | $\mathbf{r}_t$ | $\mathbf{r}_t$ | $\mathbf{r}_t$ | |
| time trend | -0.002** | -0.002** | -0.002** | -0.001 | -0.002** | -0.002** | -0.002** | |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | |
| Interest rate lags | 0.895*** | 0.895*** | 0.895*** | 0.972*** | 0.895*** | 0.895*** | 0.895*** | |
| | (0.063) | (0.063) | (0.063) | (0.025) | (0.063) | (0.063) | (0.063) | |
| Constant | 0.642** | 0.642** | 0.642** | 0.367 | 0.642** | 0.642** | 0.642** | |
| | (0.314) | (0.314) | (0.314) | (0.366) | (0.314) | (0.314) | (0.314) | |
| Observations | 78 | 78 | 78 | 78 | 78 | 78 | 78 | |
| adjusted R-squared | 0.987 | 0.987 | 0.987 | 0.992 | 0.987 | 0.987 | 0.987 | |
| | **(FR)** | **(IE)** | **(IT)** | **(LU)** | **(NL)** | **(PT)** | **(SI)** | **(SK)** |
| time trend | -0.002** | -0.002** | -0.002** | -0.002** | -0.002** | -0.002** | -0.002** | -0.002*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Interest rate lags | 0.895*** | 0.895*** | 0.895*** | 0.895*** | 0.895*** | 0.895*** | 0.895*** | 1.182*** |
| | (0.063) | (0.063) | (0.063) | (0.063) | (0.063) | (0.063) | (0.063) | (0.085) |
| Constant | 0.642** | 0.642** | 0.642** | 0.642** | 0.642** | 0.642** | 0.642** | 0.552*** |
| | (0.314) | (0.314) | (0.314) | (0.314) | (0.314) | (0.314) | (0.314) | (0.202) |
| Observations | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 78 |
| adjusted R-squared | 0.987 | 0.987 | 0.987 | 0.987 | 0.987 | 0.987 | 0.987 | 0.991 |

Notes: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors in parentheses. We identify the monetary policy shock based on the assumption that individuals are less informed. We are estimating equation (1.2), regressing the short term interest rate on its lagged values and a trend, for the period after the incidence of the Crisis 2008:10-2015:3. We present results for the following countries: Austria, Belgium, Germany, Estonia, Greece, Spain, Finland,France, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Slovenia and the Slovak Republic .

Table 10: Estimation of equation (2.1) with shock pertaining to more informed individuals.

| VARIABLES | Total consumers | Low income | High income | Low educated | High educated | Unemployed | Work full time | ages 30 - 49 | ages 50-64 |
|---|---|---|---|---|---|---|---|---|---|
| | $\pi_t^e$ | $\pi_t^e$ | $\pi_t^e$ | $\pi_t^e$ | $\pi_t^e$ | $\pi_t^e$ | $\pi_t^e$ | $\pi_t^e$ | $\pi_t^e$ |
| mon.shock lags | 0.255 | -0.732** | -0.503* | -0.572** | -0.434 | -0.290 | -0.440* | -0.570** | -0.455 |
| | (0.236) | (0.289) | (0.261) | (0.263) | (0.339) | (0.221) | (0.264) | (0.256) | (0.327) |
| inf.exp.lags | 0.904*** | 0.867*** | 0.881*** | 0.889*** | 0.890*** | 0.827*** | 0.896*** | 0.897*** | 0.888*** |
| | (0.008) | (0.010) | (0.011) | (0.009) | (0.009) | (0.015) | (0.009) | (0.009) | (0.009) |
| current infl. | 1.142*** | 1.073*** | 1.249*** | 1.193*** | 1.211*** | 1.419*** | 1.209*** | 1.227*** | 1.252*** |
| | (0.197) | (0.259) | (0.327) | (0.230) | (0.241) | (0.374) | (0.224) | (0.230) | (0.242) |
| lagged infl. | 0.277 | 0.699** | 0.390 | 0.455* | 0.504** | 0.624 | 0.475** | 0.357 | 0.468* |
| | (0.198) | (0.271) | (0.308) | (0.241) | (0.236) | (0.387) | (0.226) | (0.221) | (0.246) |
| Constant | -0.122 | 6.245*** | 4.256*** | 5.176*** | -0.893 | 8.036*** | -0.695 | 0.007 | -0.522 |
| | (0.917) | (1.026) | (1.060) | (0.912) | (1.058) | (1.569) | (0.947) | (1.020) | (1.062) |
| Observations | 3,615 | 3,561 | 3,555 | 3,596 | 3,601 | 3,314 | 3,601 | 3,601 | 3,601 |
| adjusted R-squared | 0.914 | 0.851 | 0.864 | 0.875 | 0.884 | 0.743 | 0.894 | 0.899 | 0.886 |

Notes: *** p<0.01, ** p<0.05, * p<0.1 Murphy-Topel standard errors in parentheses. We consider inflation expectations of total consumers and demographic subgroups of consumers which are: low and high income, low and high educated, unemployed and full time workers, ages between 30 - 49 and 50 - 64 on lagged values of the monetary shock (constructed under the assumption that individuals are more informed), on lagged values of inflation expectations and on contemporaneous and lagged values of actual inflation for the period 1985:1-2015:3. We include yearly dummies and country dummies.

Table 11: Estimation of equation (2.2) with shock pertaining to more informed individuals.

| VARIABLES | Total consumers $\pi_t^e$ | Low income $\pi_t^e$ | High income $\pi_t^e$ | Low educated $\pi_t^e$ | High educated $\pi_t^e$ | Unemployed $\pi_t^e$ | Work full time $\pi_t^e$ | ages 30 - 49 $\pi_t^e$ | ages 50-64 $\pi_t^e$ |
|---|---|---|---|---|---|---|---|---|---|
| mon.shock lags pre-Crisis | 0.359 | -0.572** | -0.434 | -0.406 | -0.380 | -0.534 | -0.369 | -0.463* | 0.240 |
| | (0.239) | (0.266) | (0.270) | (0.258) | (0.331) | (0.330) | (0.263) | (0.240) | (0.313) |
| mon.shock lag after | -4.576 | -5.394 | -7.982** | -3.026 | -7.322** | -0.137 | -8.169** | -8.040** | -2.955 |
| | (3.094) | (3.449) | (4.014) | (3.499) | (3.690) | (4.817) | (3.363) | (3.284) | (3.523) |
| infl.exp.lags pre-Crisis | 0.869*** | 0.832*** | 0.845*** | 0.852*** | 0.862*** | 0.812*** | 0.862*** | 0.862*** | 0.852*** |
| | (0.014) | (0.017) | (0.015) | (0.015) | (0.014) | (0.020) | (0.014) | (0.014) | (0.015) |
| infl.exp.lags after | 0.878*** | 0.838*** | 0.851*** | 0.847*** | 0.868*** | 0.789*** | 0.871*** | 0.871*** | 0.854*** |
| | (0.013) | (0.017) | (0.018) | (0.016) | (0.014) | (0.024) | (0.014) | (0.014) | (0.015) |
| current infl. pre-Crisis | 0.454* | 0.691* | 0.470* | 0.656** | 0.306 | 0.661 | 0.442 | 0.572** | 0.476 |
| | (0.247) | (0.359) | (0.284) | (0.294) | (0.311) | (0.426) | (0.273) | (0.271) | (0.291) |
| current infl.after | 1.193*** | 0.897** | 1.304* | 0.998** | 1.351*** | 1.636** | 1.205*** | 1.112*** | 1.387*** |
| | (0.325) | (0.371) | (0.690) | (0.386) | (0.382) | (0.681) | (0.383) | (0.399) | (0.430) |
| lagged infl. pre-Crisis | 0.141 | 0.448 | 0.285 | 0.089 | 0.308 | 0.368 | 0.276 | 0.170 | 0.135 |
| | (0.259) | (0.363) | (0.315) | (0.297) | (0.306) | (0.453) | (0.283) | (0.273) | (0.303) |
| lagged infl. after | 0.047 | 0.608 | 0.032 | 0.601 | 0.181 | 0.711 | 0.173 | 0.168 | 0.481 |
| | (0.338) | (0.423) | (0.619) | (0.414) | (0.388) | (0.699) | (0.378) | (0.388) | (0.421) |
| dummy for period after | -6.180*** | -16.235*** | -21.165*** | -14.841*** | -20.167*** | -15.633*** | -18.945*** | -18.133*** | -0.595 |
| | (1.102) | (2.595) | (3.430) | (2.646) | (2.909) | (3.588) | (2.703) | (2.504) | (1.054) |
| Constant | 6.976*** | 17.171*** | 21.632*** | 8.037*** | 20.201*** | 18.550*** | 7.092*** | 7.511*** | 8.224*** |
| | (1.152) | (2.996) | (3.786) | (1.196) | (3.203) | (3.995) | (1.234) | (1.174) | (1.265) |
| Observations | 3,542 | 3,498 | 3,498 | 3,544 | 3,539 | 3,246 | 3,544 | 3,544 | 3,519 |
| adjusted R-squared | 0.902 | 0.838 | 0.856 | 0.863 | 0.876 | 0.736 | 0.884 | 0.888 | 0.875 |

Notes: *** p<0.01, ** p<0.05, * p<0.1 Murphy-Topel standard errors in parentheses. We consider inflation expectations of total consumers and demographic subgroups of consumers which are: low and high income, low and high educated, unemployed and full time workers, ages between 30 - 49 and 50 - 64 on lagged values of the monetary shock (constructed under the assumption that individuals are more informed), on lagged values of inflation expectations and on contemporaneous and lagged values of actual inflation for the period 1985:1-2015:3. We include yearly dummies and country dummies.

Table 12: Estimation of equation (2.1) with shock pertaining to less informed individuals.

| VARIABLES | Total consumers $\pi_t^e$ | Low income $\pi_t^e$ | High income $\pi_t^e$ | Low educated $\pi_t^e$ | High educated $\pi_t^e$ | Unemployed $\pi_t^e$ | Work full time $\pi_t^e$ | ages 30 - 49 $\pi_t^e$ | ages 50-64 $\pi_t^e$ |
|---|---|---|---|---|---|---|---|---|---|
| mon.shock lags | 0.248** | -0.327 | 0.309* | 0.290* | 0.385* | -0.038 | -0.123 | 0.214 | 0.379* |
| | (0.126) | (0.272) | (0.164) | (0.171) | (0.219) | (0.206) | (0.228) | (0.149) | (0.199) |
| inflation exp.lags | 0.913*** | 0.883*** | 0.889*** | 0.910*** | 0.902*** | 0.862*** | 0.904*** | 0.908*** | 0.904*** |
| | (0.007) | (0.012) | (0.011) | (0.009) | (0.008) | (0.012) | (0.009) | (0.008) | (0.008) |
| current inflation | 1.154*** | 1.061*** | 1.184*** | 1.124*** | 1.195*** | 1.263*** | 1.187*** | 1.134*** | 1.262*** |
| | (0.180) | (0.246) | (0.301) | (0.216) | (0.225) | (0.339) | (0.215) | (0.215) | (0.224) |
| lagged inflation | 0.301* | 0.629** | 0.432 | 0.390* | 0.480** | 0.690** | 0.417* | 0.369* | 0.440* |
| | (0.179) | (0.244) | (0.280) | (0.217) | (0.221) | (0.350) | (0.214) | (0.205) | (0.225) |
| Constant | 3.108*** | -0.610 | -0.408 | 1.893** | 2.188* | 4.176*** | -1.097 | 1.367 | 1.595* |
| | (0.798) | (1.119) | ( 1.462) | (0.786) | (1.190) | (1.297) | (0.953) | (1.234) | (0.928) |
| Observations | 4,192 | 3,980 | 3,985 | 4,082 | 4,082 | 3,728 | 4,090 | 4,070 | 4,070 |
| adjusted R-squared | 0.914 | 0.860 | 0.867 | 0.887 | 0.883 | 0.772 | 0.890 | 0.901 | 0.894 |

Notes: *** p<0.01, ** p<0.05, * p<0.1 Murphy-Topel standard errors in parentheses. We consider inflation expectations of total consumers and demographic subgroups of consumers which are: low and high income, low and high educated, unemployed and full time workers, ages between 30 - 49 and 50 - 64 on lagged values of the monetary shock (constructed under the assumption that individuals are less informed), on lagged values of inflation expectations and on contemporaneous and lagged values of actual inflation for the period 1985:1-2015:3. We include yearly dummies and country dummies.

Table 13: Estimation of equation (2.2) with shock pertaining to less informed individuals.

| VARIABLES | Total consumers $\pi_t^e$ | Low income $\pi_t^e$ | High income $\pi_t^e$ | Low educated $\pi_t^e$ | High educated $\pi_t^e$ | Unemployed $\pi_t^e$ | Work full time $\pi_t^e$ | ages 30 - 49 $\pi_t^e$ | ages 50-64 $\pi_t^e$ |
|---|---|---|---|---|---|---|---|---|---|
| mon.shock lags pre-Crisis | 0.143 | -0.333 | 0.190 | -0.220 | -0.323 | -0.114 | -0.283 | 0.126 | -0.259 |
| | (0.129) | (0.294) | (0.170) | (0.245) | (0.332) | (0.178) | (0.222) | (0.147) | (0.275) |
| mon.shock lags after | -20.673*** | -20.446*** | -25.307*** | -18.096*** | -21.549*** | -14.559* | -23.284*** | -22.672*** | -22.458*** |
| | (5.249) | (5.761) | (7.707) | (5.817) | (6.076) | (7.700) | (5.519) | (5.376) | (5.841) |
| infl.exp. lags pre -Crisis | 0.888*** | 0.855*** | 0.870*** | 0.896*** | 0.883*** | 0.862*** | 0.883*** | 0.888*** | 0.883*** |
| | (0.012) | (0.017) | (0.015) | (0.013) | (0.012) | (0.015) | (0.013) | (0.012) | (0.013) |
| infl.exp. lags after | 0.890*** | 0.844*** | 0.856*** | 0.864*** | 0.877*** | 0.800*** | 0.878*** | 0.880*** | 0.871*** |
| | (0.013) | (0.017) | (0.018) | (0.016) | (0.014) | (0.024) | (0.014) | (0.014) | (0.015) |
| current infl. pre-Crisis | 0.647*** | 0.706** | 0.524* | 0.646** | 0.442 | 0.539 | 0.549** | 0.554** | 0.648** |
| | (0.223) | (0.333) | (0.279) | (0.276) | (0.292) | (0.366) | (0.265) | (0.256) | (0.273) |
| current infl. after | 0.995*** | 0.710* | 1.040 | 0.871** | 1.128*** | 1.435** | 1.006*** | 0.924** | 1.161*** |
| | (0.321) | (0.375) | (0.690) | (0.383) | (0.380) | (0.683) | (0.381) | (0.398) | (0.424) |
| lagged infl. pre-Crisis | 0.234 | 0.437 | 0.384 | 0.092 | 0.320 | 0.549 | 0.278 | 0.279 | 0.163 |
| | (0.224) | (0.311) | (0.281) | (0.256) | (0.280) | (0.396) | (0.267) | (0.249) | (0.272) |
| lagged infl.after | 0.134 | 0.661 | 0.145 | 0.609 | 0.253 | 0.645 | 0.280 | 0.284 | 0.522 |
| | (0.337) | (0.421) | (0.630) | (0.410) | (0.386) | (0.705) | (0.378) | (0.389) | (0.418) |
| Dummy for period after | -4.505*** | -3.118** | -2.272 | -6.047*** | -5.428*** | -3.444 | -4.378*** | 4.389*** | 4.462*** |
| | (1.056) | (1.232) | (1.767) | (1.281) | (1.279) | (2.227) | (1.667) | (1.534) | (1.123) |
| Constant | 4.953*** | 3.750*** | 2.512* | 5.643*** | 5.201*** | 5.647*** | 4.325*** | 3.035** | 3.452*** |
| | (1.048) | (1.054) | (1.355) | (1.155) | (1.285) | (1.899) | (1.615) | (1.545) | (1.104) |
| Observations | 4,113 | 3,907 | 3,907 | 4,004 | 4,004 | 3,643 | 4,017 | 3,979 | 3,979 |
| adjusted R-squared | 0.904 | 0.850 | 0.860 | 0.878 | 0.876 | 0.765 | 0.881 | 0.892 | 0.884 |

Notes: *** p<0.01, ** p<0.05, * p<0.1 Murphy-Topel standard errors in parentheses. We consider inflation expectations of total consumers and demographic subgroups of consumers which are: low and high income, low and high educated, unemployed and full time workers, ages between 30 - 49 and 50 - 64 on lagged values of the monetary shock (constructed under the assumption that individuals are less informed), on lagged values of inflation expectations and on contemporaneous and lagged values of actual inflation for the period 1985:1-2015:3. We include yearly dummies and country dummies.

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