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A mia madre, la mia roccia

Abstract

In Chapter 1, written jointly with Maddalena Galardo, we propose a new indicator of central bank's verbal guidance, which measures the communication about future based on the frequency of future verbs in monetary policy statements. We consider the press conferences of the European Central Bank as testing case. First, we analyze the main determinants of our index and estimate the unexpected component. Second, we investigate the effects of the identified innovation of verbal guidance on daily changes of forward money markets rates between September 2007 and December 2015. Our results show that financial markets' expectations on future short-term interest rates react to a shock of communication about future: the effect is negative and larger for longer horizons, after controlling for the standard policy rate shock and the announcement of unconventional monetary policies. This suggests that the verbal guidance has been an effective policy instrument to signal further accommodative monetary policy stance.

In Chapter 2, written jointly with Caterina Mendicino, we investigate the relevance of the wealth channel, i.e. whether and the extent to which wealth changes affect households' consumption. To address these questions, we use newly available harmonized euro area wealth data and the methodology in Carroll, Otsuka and Slacalek (2011). We find that the marginal propensity to consume out of total wealth averaged across the largest euro area economies is around 3 cents per euro, with a marginal propensity to consume out of financial wealth significantly larger than that of housing wealth. Country-groups estimates document no significant differences between the largest economies and the rest of the sample. In contrast, remarkable differences emerge between periphery and core countries. Total and financial wealth effects are about 2 and 4 times larger in periphery economies.

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All errors are and remain my own.

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Chapter 1

The Effects of Central Bank's Verbal Guidance: Evidence from the ECB

with Maddalena Galardo (Banca d'Italia & LUISS Guido Carli)

1.1 Introduction

After the onset of the Global Financial Crisis, the role of central bank communication has evolved remarkably. The close proximity of the policy rate to the effective lower bound and the impairments to the conventional interest rate channel of the monetary policy transmission mechanism have risen the need of shaping financial markets' expectations on future short-term interest rates through a forward-looking communication strategy.[1] In other terms, the signalling channel has gained momentum: as stated by Woodford (2005) "for not only do expectations about policy matter, but, at least under current conditions, very little else matters."[2]

In this paper we propose a new indicator of central bank's verbal guidance, which quantifies the forward-looking statements according to the frequency of future verbs used in the monetary policy press releases. To the best of our knowledge, we are the first to adopt this approach for

[1] Please refer to Bernanke and Reinhart (2004) and Blinder (2010) for a discussion of the unconventional monetary policies at the zero lower bound.

[2] In fact, world's major central banks have recently introduced or reinforced their guidance on policy inclination, in order to convince firmly the financial markets that the future monetary policy stance will remain accommodative.

identifying central bank communication about future.[3] We exploit the fact pointed out by Chen (2013) that the English language "requires future events to be grammatically marked when making predictions": according to the typological linguistic literature, English is classified as a *strong future-time reference* language which "requires speakers to encode a distinction between present and future events".[4] As a consequence, the identification of central bank communication about future is straightforward: we collect the future markers, namely the future auxiliary and semi-auxiliary verbs *will*, *shall*, *going to*.[5] Moreover, this approach can be implemented in an automated fashion, which makes our index consistent and easy to replicate.[6]
Is this indicator effective for measuring the evolution towards a forward-looking communication? Is the impact of changes in verbal guidance on money markets rates relevant? To convincingly answer these questions two major challenges need to be addressed. First, to have a precise measure of verbal guidance, the forward-looking communication related to monetary policy stance needs to be disentangled from that related to other issues such as the projections of output growth and inflation. Second, since in a forward-looking environment financial markets react only to surprises, to assess the market response to communication about future, we need to identify the unexpected component of news.
In this paper we use the European Central Bank (ECB) as testing case. To have a measure of verbal guidance which abstracts from communication not related to future monetary policy stance, we restrict the analysis to the first section of the Introductory statement, we call *policy summary*, that is used to summarize the policy decision and communicate the policy inclination. The evidence shows that there has been a positive trend of the words used in the policy summary along with an increase of the future verbs, especially in the aftermath of the financial turmoil, with peaks at the end of 2011 and over 2014-2015. This period coincides with the decrease of the policy rates towards the effective lower bound (as shown in Figure 1.1) and the announcement of several types of unconventional monetary policies, suggesting that the communication strategy has evolved accordingly.

[3] Karapandza (2016) propose a similar approach to study the relationship between the firms' information about the future conveyed in the annual report and the stock returns.

[4] On the contrary, the *weak future-time reference* languages (e.g. German) do not necessarily require to mark future events through future markers (Chen (2013)).

[5] Please refer to Szmrecsanyi (2003).

[6] We also exploit the fact that all relevant information released by central banks are often available in the *lingua franca* of international financial markets, English.

To obtain the unexpected component we follow a two-step approach. First, we compute the index from 2002 to 2015. We then identify the process of our ECB verbal guidance index given the information set available on the press conference day, in order to estimate the news that could explain financial markets' movements around that event.

In the second part of the paper, we investigate the effects of a shock to verbal guidance on the daily changes of money market rates. Our estimation procedure is based on a standard event-study regression analysis for a period that spans from September 2007 to December 2015. In particular, we look at the implied forward three-month Euribor rates at different horizons (Figure 1.2) which reflect the financial markets' expectations on future short-term interest rates. Our results show that the interest rates are negatively affected by an unexpected increase in verbal guidance on the press conference day, after controlling for the monetary policy shock. Although our verbal guidance index does not detect the tone of the forward-looking statements, we acknowledge that the announcements on future policy intentions have been used mostly to communicate a longer-lasting accommodative stance from the beginning of the financial turmoil to nowadays. We interpret these results as evidence that verbal guidance has been an effective policy instrument to signal further accommodative monetary policy stance. These results are robust, *inter alia*, to the inclusion of dummy variables for the forward guidance announced on July 2013 and for the other unconventional monetary policies, suggesting that financial markets react not only to the announcement *per se* but also to the way the message is conveyed.

We contribute to the literature on ECB communication in several ways. First, our paper proposes a novel approach to measure the semantic content of central bank official releases. Former indicators of the ECB communication have been constructed to measure the direction of the policy stance: Ehrmann and Fratzscher (2007) classify the extracted sentences from inter-meeting speeches held by central bankers based on their interpretation of dovish or hawkish tone; a similar approach has been adopted by Rosa and Verga (2007) to identify the direction of the policy summary. We thus contribute to the semantic literature on the ECB communication by proposing a new index which does not consider words but only verbal tenses. We exploit the fact that the use of verbal tenses belongs to a precise and stable system

of rules (the grammars) which are not dynamic entities as words are.[7] Moreover, the grammars are not subjective rules and therefore no authors' interpretation is needed to identify the future tenses.

Second, other papers rely on the use of dummy variables to measure the type of information conveyed during the ECB press conference: for example, Ferrero and Secchi (2009) construct several dummies for each type of quantitative and qualitative announcement on the future monetary policy stance;[8] Ehrmann and Fratzscher (2009) uses Reuters snaps on the economic outlook, inflation, money growth, and interest rates to construct several dummy variables accordingly. However, relying on dummy variables, though widely used, limits the validity of this empirical strategy, because it assumes that the entire announcement was a complete surprise. As pointed out by Christensen and Rudebusch (2012), this is likely to underestimate the interest rate response as, especially for the later announcements, market participants may have anticipated some actions. This drawback puts a premium on the need to have a measure of news shock, as we show in this paper.

Finally, our approach differs from the standard factor analysis applied by Brand, Buncic and Turunen (2010) to the ECB for extracting monetary policy indicators relating to different time horizons.[9] The authors analyze changes in forward money market rates occurring during a time window from 1:35 pm to 3:50 pm CET, and extract two orthogonal factors: changes at the short end of the forward curve are identified as jump news, whereas changes at longer maturities are identified as path news, i.e. related to the future policy path communicated during the press conference.[10] Nevertheless, the factor analysis approach cannot reveal anything about why financial markets forecast a different forward path for interest rates after the statement release, or which aspect of the statement constitutes the news that changes their beliefs.[11] On the contrary, in this paper we show the evolution of language to communicate possible future

[7] Language is a dynamic entity and words can change meaning according to circumstances. In addition, new words can be introduced.

[8] Namely, numerical interest rate path (quantitative announcement), verbal hints on the future evolution of policy rates (qualitative announcement) with clear timing (clear qualitative announcement) or ambiguous timing (opaque qualitative announcement), and no announcement.

[9] This approach was firstly proposed by Gurkaynak, Sack and Swanson (2005) for identifying the future path of the policy factor associated with FOMC statements.

[10] Moreover, the authors show that this indirect econometric method to construct measures of news is consistent with the information obtained from a direct measurement, based on intra day changes in money markets rate occurring during two separate time windows, i.e. 1:35-2:05 pm for the jump news and 2:20-3:50 pm for the path news.

[11] The limits of this kind of analysis are amply discussed in Woodford (2012).

moves and its effects on financial markets' expectations.

The remainder of the paper is organized as follows. Section 1.2 introduces our verbal guidance index and its application to the ECB. In this section we also analyze the main determinants of our index and identify the unexpected component. Section 1.3 presents the empirical strategy and the results. Section 1.4 concludes. The Appendix **??** provides details on the data used in this paper.

1.2 A New Index of Verbal Guidance

In this section we introduce a simple indicator of central bank communication about future based on the frequency of future verbs. We exploit a peculiarity of the English grammar, which allows us to identify the forward-looking statement in a very straightforward way. In general, the human spoken language can be described as a system of symbols and rules (the grammars) by which the symbols are manipulated, and every complete sentence is built around a verb that indicates the time when the action occurs (present, past and future). Particularly, English requires the use of future markers to mark the timing of future events in nearly all circumstances (Chen (2013)). The future markers are the auxiliary and semi-auxiliary future verbs *will*, *shall*, *going to* (Szmrecsanyi (2003)). As defined on the Oxford Dictionary, these verbs refer to actions stated as promises or commitments. In a robustness exercise, we extend the category of future markers to include verbs which convey a future meaning even if less certain: *to expect*, as it refers to something as likely to happen; *may* and *might*, as they express a possibility.[12]

In practice, we compute the frequencies of future markers in an automated fashion, through a *search words*-based computer-coded content analysis. This allows us to overcome one of the main caveat related to the standard literature based on subjective indicators, i.e. our index is not affected by personal judgments. Moreover, it can be easily replicated.

We then use the word counts to construct an objective indicator, we call the *verbal guidance index*, which is obtained as follows

$$VG_t = \frac{\sum_{i=1}^{M_t} FutureMarker_{i,t}}{N_t}$$

[12] As defined on the Oxford Dictionary at https://en.oxforddictionaries.com/verb. Although *may* and *might* represents the present and past tense respectively, this distinction is rarely observed and they are generally acceptable as substitutes.

where t refers to the press statement, i denotes the future marker, M_t and N_t stand for the total number of future tenses and words in a given statement, respectively. The denominator reports the total number of words, N_t , to avoid the possibility that the phenomenon captured by the index may reflect the intensity of speaking by the central bank. One of the main advantage of our indicator is that it does not use glossaries, but verbal tenses. In other terms, it is not contest-dependent, as the use of verbal tenses belongs to a precise and stable system of rules which are not dynamic entities as words are.

1.2.1 Evidence from the European Central Bank

We explore the validity of our approach by considering the European Central Bank as testing case. The means by which information on future monetary policy is transmitted to financial markets can include press releases, press conferences, bulletins, speeches and interviews. To the purpose of our analysis, we consider only the press conferences which follow the monetary policy meeting of the Governing Council, as they are held regularly in terms of frequency and are systematic in terms of structure.

Since January 2002 to December 2014 the press conference was held the first Thursday of every month, while starting as of January 2015 the frequency of the monetary policy meetings has been reduced from monthly to every six weeks.[13] The timing of the communication strategy is the following: the press release reporting the decision on the key interest rates is issued at 1:45 p.m. CET/CEST; it is followed shortly by the press conference starting at 2:30 p.m., which is divided in two main sessions, i.e. the Introductory statement and the Question and Answer Session.[14] The former reports all the necessary information concerning the ECB monetary policy stance in a simple and systematic way, while the latter is often used to clarify ECB's message.

The structure of the Introductory statement has remained quite the same since the very beginning: (i) the first part summarizes the ECB's monetary policy decision; (ii) the second part discusses both real and monetary developments in the Euro area; (iii) the last part

[13] Although the first press conference took place on January 1999, our sample starts from January 2002 because only since November 2001 ECB's President monthly press conference has a structure which can be precisely identified.

[14] The Introductory statement read by the Governor is published (almost) simultaneously online at http://www.ecb.europa.eu/press/html/index.en.html.

concludes with some considerations on fiscal policy and structural reforms.

As we are interested in the communication about the future policy stance, we restrict the analysis to the first section of the Introductory statement, we call *policy summary*: this choice is motivated by the fact that the verbal guidance is communicated to the public after the explanation of the policy decision, generally in the forms of a policy inclination based on the risks to the primary objective of price stability.

This selection criterion allows us to extract the text of interest properly, and minimize the risks that our index might capture the future markers that refer to information other than the monetary policy verbal guidance, such as the developments and the projections of output growth and inflation that are generally discussed in the subsequent economic pillar.

Our sample covers 159 press conferences, starting from January 2002 to December 2015. Figure 1.3 shows the evolution of the ECB policy summary: the top graph plots the length measured by the number of words, while the bottom graph its share with respect to the Introductory statement. In both cases, the figure also reports the moving average over the previous 12 press conferences. Overall, the length of the policy summary has increased from 58 words on January 2002 to 436 words on December 2015, reaching a maximum of 670 words on June 2014. This tendency does not reflect a mere increase of length of the Introductory statement: in fact, also the share has considerably increased from around 7% to around 37%, with a peak of around 47,5% on January 2015. The positive medium-term trends suggest that the ECB has provided over time more information about the monetary policy decision and its possible future path, especially after the beginning of the financial turmoil.

Before exploring the forward-looking content of the policy summary, we restrict the sample of words to be analyzed by considering only words which have a sparsity lower than 80 per cent (i.e. that appear once in at least 30 policy summaries), and by excluding numbers, stopwords (such as articles, prepositions, conjunctions) and ECB-related terms.[15] Figure 1.4 summarizes our findings: the top panel shows the number of future markers, namely *will*, *shall* and *going to*. We also report *expect*, *may* and *might*, which convey a future message even if less certain. It is evident that the ECB generally uses *will* to communicate about future, while in none of the policy summary we could find the other future markers *shall* and *going to*. We observe a concentration of *expect* during November 2009-December 2010, a period characterized by

[15] Please refer to Table A.1 in the Appendix.

the economic recession. Interestingly, *may* has been used twice in August 2012 to announce the OMT program and in general unconventional measures: "The Governing Council, [...], may undertake outright open market operation of a size adequate to reach its objective. Furthermore, the Governing Council may consider undertaking further non-standard monetary policy measures according to what is required to repair monetary policy transmission". So far, the OMT has been announced but never implemented, as its activation depends on the country request: the verb *may* refers indeed to a possibility, and not to something certain to happen. Finally, *might* has been used only few times at the very beginning of our sample.

The bottom part of Figure 1.4 plots the number of words of the policy summary versus the number of *will*. The evolution of *will* reflects the trend observed for the number of words, suggesting that there has been a shift towards explicit forward-looking statements over time. This evidence is reinforced by the content analysis provided by Figure 1.5, which reports a visual overview of the most frequent words in four main sub-periods, i.e. 2002-2006, 2007-2009, 2010-2012, 2013-2015. While the frequency of technical terms (e.g. monetary, price stability or inflation) is mostly constant over the four sub-periods, the frequency of *will* has increased.

In our view, these facts are consistent with the increasing need of managing financial markets' expectations on the future path of short-term interest rates, especially in the recent years characterized by policy rates close to the effective lower bound. In this respect, we plot in Figure 1.6 the ECB's Main Refinancing Operations Rate versus the number of *will* in the policy summary, by focusing on the period September 2007 - December 2015. We register the major peaks in the use of *will*: (i) on May 2009, coinciding with the beginning of a two-year period of unchanged policy rate at very low level; (ii) on June 2011, followed by an increase of the MRO rate on July 2011;[16] (iii) during August-December 2011, when the policy rate has been reduced to the "before-April 2011" level; (iv) on May 2013, preceding the announcement of forward guidance on July 2013; and (v) starting as of June 2014, when the Governor announced intensified preparatory work for purchases of asset-backed securities, to January 2015, when it was announced the extended asset purchase programme, in correspondence of the MRO approximating the zero level bound. This evidence suggests that the verbal guidance

[16]On the contrary, when Trichet has increased firstly the MRO on April 2011 after a prolonged period of no changes, the number of *will* has been stable.

has been used mostly to signal further the accommodative monetary policy stance, with the exception of June 2011.

Yet we acknowledge that our analysis might be affected by the presence of future markers related to the ECB's target and the outlook of inflation expectations. To tackle on the possibility that our index might contain some noise, which could produce a bias towards zero in the estimates, we identify manually the future markers related to the intentions of signalling some future action and to monitor closely a situation.[17] Figure 1.7 plots the number of *will* computed through automated and manual computation: the paths are very close, suggesting that our methodology is effective in capturing the ECB's verbal guidance.[18]

As examples, we report the text extracted from four Introductory statements which show clearly how the ECB has increasingly relied on explicit communication about future.

At the very beginning, the policy summary consisted of a very limited number of strings, and an implicit policy inclination was released through key words related to the risks to price stability: e.g. on January 2002 "We also confirmed that the current level of key ECB interest rates remains appropriate for the maintenance of price stability over the medium term".

Starting as of September 2005, statements on the inflation expectations have been introduced, e.g. on April 2006: "It remains essential to ensure that medium to long-term inflation expectations in the euro area are kept solidly anchored at levels consistent with price stability. Such anchoring of inflation expectations is a prerequisite for monetary policy [...] With interest rates across the whole maturity spectrum still at very low levels in both nominal and real terms, [...], our monetary policy remains accommodative".

During the crisis, we observe both an increase of wording and *will*, e.g. on June 2014: "[...] the measures will contribute to a return of inflation rates to levels closer to 2% [...] Looking ahead, the Governing Council is strongly determined to safeguard this anchoring. Concerning our forward guidance, the key ECB interest rates will remain at present levels for an extended period of time in view of the current outlook for inflation [...]Moreover, if required, we will act swiftly with further monetary policy easing". On September 2015: "[...] Accordingly, the Governing Council will closely monitor all relevant incoming information. [...] In the

[17]We tried to reduce the probability of a wrong classification by doing our coding independently from one another. When we came up with a different coding for the same press conference, we have double-checked it together and agreed on a common value.

[18]In fact, the statements on the ECB's monetary policy objective and the inflation expectations are generally constructed using the present verbal tense.

meantime, we will fully implement our monthly asset purchases of €60 billion."

The future verbal tenses are related to ensure that (i) the measures taken will be effective; (ii) the policy interest rates will continue to be low, (iii) the ECB is ready to react by easing further the monetary policy stance. In other terms, to signal and convince financial markets that monetary policy stance will remain accommodative in the future.

In fact, as stated by the ECB President Mario Draghi: "Our response was to *place more emphasis on enhanced communication* - both regarding our commitment to our price stability objective, and regarding our assessment of and response to the rapidly changing economic and financial situation", Draghi (2014).

1.2.2 The ECB's Verbal Guidance Index

Given the evidence presented above, we compute two versions of our indicator of central bank verbal guidance for the ECB policy summary. The former includes only *will*, while the latter also *expect, may, might*:

$$VG_t = \frac{\sum_{i=1}^{M_t} FutureMarker_{i,t}}{N_t} \tag{1.1}$$

$$VG_t^e = \frac{\sum_{i=1}^{M_t} w * FutureMarker_{i,t}}{N_t} \tag{1.2}$$

where t refers to the press conference day; FutureMarker={will} in equation (1.1) and FutureMarker={will, expect, may, might} in equation (1.2).; w={0.5,1} denotes the weights, where 0.5 refers to *expect, may, might* and 1 to *will*; M_t and N_t represent the total number of future markers and words in each policy summary, respectively.[19] Our weighting scheme is motivated by the fact that *expect, may, might*, although convey a future message, refer to something as likely to happen or to a possibility, and therefore their message is less certain. Given that their frequency is very low in our sample, this choice should not have a crucial impact on the computation of the index.[20]

[19] We disregard *will* when it is preceded by the article *the*, as in this case it denotes a noun and not a verb. Moreover, we control for possible case-sensitive issue, by removing *May* from our counting.

[20] As someone could rightly point out, the use of these verbs could introduce more uncertainty about future and therefore have a negative effect on the volatility of financial markets. As we do not investigate this issue here, we leave this question open to further research.

Figure 1.8 reports the two versions of the index: the main difference occurs during the period November 2009 - December 2010, which was characterized by a larger use of *expect* with respect to *will*. As expected, we observe large values of the index during the peak of the sovereign debt crisis in November 2011 (coinciding with the decrease of the Main Refinancing Operation rate, few months after the previous increases in April and July). Moreover, the highest values occur in the last part of our sample, during which several unconventional monetary policies have been announced, included the *Quantitative Easing* on January 2015.[21]

1.2.3 The identification of the ECB verbal guidance shock

As emphasized by Kuttner (2001), in a forward-looking environment financial markets should react only to the surprise element of the monetary policy announcements. Therefore, in order to assess the market response to communication about future, we need to identify the unexpected component. To this purpose, we explore the process underlying the ECB verbal guidance index;[22] our hypothesis is that the financial markets participants form their prediction based on the following augmented autoregressive process:

$$E[VG_t|I_{t^*}] = \alpha + \sum_{i=1}^{n} \beta_i VG_{t-i} + Z_t^\top \gamma \tag{1.3}$$

where t stands for the press conference day, the frequency of VG_t reflects the timing of the ECB meetings and n refers to the past values; E denotes the expectation conditional on the information set I_{t^*} at the time just prior to the Governing Council press conference which takes place at 2:30 p.m.; Z_t is a vector of control variables, which includes (i) the key policy rate announced on the same day at 1:45 p.m.; (ii) the Consensus Economics forecasts twelve months ahead for the Euro Area GDP growth rate and the CPI inflation rate.[23] The inclusion

[21] Some examples of ECB policy summary and the corresponding verbal guidance index are reported in Appendix A.1.

[22] As defined in equation (1.1). Results are consistent when we consider the verbal guidance index as defined in equation (1.2).

[23] The Consensus Economics forecasts are released for the current year and the following calendar year. Since the horizon is not constant, we approximate the forecast for the twelve months ahead as average of the forecasts for the current and next years, weighted by their shares in the forecast period. By adopting the same methodology as in Mehrotra and Yetman (2015), we compute the fixed horizon forecast according to this formula (for inflation as example):

$$\pi_t^f = \frac{k}{12}\pi_{t+k|t}^f + \frac{12-k}{12}\pi_{t+12+k|t}^f \tag{1.4}$$

where $k \in \{1,2,\ldots,12\}$ denotes the k-month ahead forecast horizon based on information available at time t.

of the forward-looking macro variables is consistent with several contributions in literature which show that central banks respond to forecasts of future economic variables (Orphanides (2010)).[24]

We estimate equation (1.3) with ordinary least squares and robust correction of standard errors, for the period January 2002 - December 2015. Table 1.1 reports the results under two specifications: (i) we only consider the autoregressive components up to two lags.[25] (ii) we add the control variables.[26] The two lags are statistically significant and large, while the coefficients on the policy rate and the forecast for inflation are negative, as expected, but small and statistically significant at 90%. The estimated persistence of the verbal guidance index is consistent with the findings of Amaya and Filbien (2015) which show that the content of the ECB press conference is similar over time.[27]

In order to obtain a measure of real-time news, we re-estimate equation (1.3) as:

$$VG_t = \alpha + \beta_1 VG_{t-1} + \beta_2 VG_{t-2} + \gamma_1 i_t + \gamma_2 \Delta\pi_t^f + \varepsilon \tag{1.5}$$

where ε_t is the error term. We follow a recursive approach to compute the one-period ahead forecast, where the starting sample is composed by the first 30 observations and at each iteration the window increases by one unit. The unexpected component of the ECB verbal guidance index, we call verbal guidance shock (henceforth, VGS), is given by the difference between the actual and the predicted values (Figure 1.9).

1.3 Empirical Analysis

In this section we investigate whether and the extent to which an unexpected change in the communication about future may affect financial markets' beliefs. Our estimation procedure

[24] In a robustness exercise (not reported), we consider as control variables the official releases of the CPI inflation rate and the industrial production, both defined as difference between the actual and expected values as polled by Bloomberg. The coefficients on these variables tuned out to be not statistically significant.

[25] According to both Akaike and Schwarz Bayes information criteria. Higher lags turn out to be statistically insignificant.

[26] Alternatively, we also use the Eonia rate on the day preceding the press conference. As motivated in the literature on this field, the Eonia rate approximates the accommodative monetary policy stance after the crisis: as shown in Figure 1.1, the Eonia stands systematically below the ECB Main Refinancing Rate starting as of 2009.

[27] The authors follow the methodology proposed by Tetlock (2011) and measure the similarity of two successive ECB statements based on the proportion of textual information overlapping in both statements.

is based on a standard event-study regression analysis around the ECB's monetary policy Governing Council meeting.[28]

1.3.1 Data

To evaluate the impact of the verbal guidance on the signalling channel, we look at the daily changes of the Euribor rate after the press conference takes place. The Euribor (Euro Interbank Offered Rate) is a daily reference rate, determined and published at about 11:00 CET/CEST each working day, as the filtered average interbank interest rate at which European banks are prepared to lend to one another.[29] Our choice is motivated by the fact that the Euribor represents the benchmark rate of the large euro money market and reflects the expectations of financial markets on future short-term interest rates. Specifically, we use the spot rates for the three-month ($3M$), six-month ($6M$), nine-month ($9M$) and twelve-month ($12M$) maturities that were obtained from Thomson Reuters-Datastream. As the spot rate (e.g. $12M$) implicitly incorporates the expectations on *all* short-term interest rates over a specific horizon (e.g. 12 months), for our analysis we compute the implied k-month-ahead three-month forward rate, $f_t^{(k)}$, by the simple definition:

$$1 + f_t^{(k)} = \frac{\left(1 + r_t^{(k+3)}\right)^{\frac{k+3}{12}}}{\left(1 + r_t^{(k)}\right)^{\frac{k}{12}}} \tag{1.6}$$

where $k = \{3, 6, 9\}$, as a measure of expectations on the three-month rate in k months ahead (Figure 1.2).

Conditionally on the assumption that financial markets are efficient and respond only to news that could affect their belief about the future, we assume that: (i) on meeting days the relevant news concerns the policy rates (the Main Refinancing Operation and standing facilities rates) and the ECB press conference; (ii) the expectation hypothesis holds; (iii) and the term premium is constant during a one-day window.[30]

[28] As discussed in Gurkaynak and Wright (2013), the event-study approach is now a well recognized methodology for the identification of causal relationships in the macro-finance literature.

[29] For more information, please refer to the official website http://www.emmi-benchmarks.eu/euribor-org/euribor-rates.html.

[30] Nonetheless, we acknowledge that someone could question the validity of this assumption after the onset of the crisis. It is a testable hypothesis and we leave the answer to it to future research.

The first assumption implies that we need to control for the news related to the monetary policy rates. We use as proxy the difference between the Main Refinancing Operation rate and its market expectations, measured through the mean response of a Bloomberg survey among market participants.[31]

Given that the ECB has started to announce several non-standard measures in the aftermath of the financial turmoil, we also control for the announcements made during the press conference day.[32] In particular, we distinguish between two broad categories of non-standard measures. The former includes the policies aimed at improving the liquidity conditions of the interbank markets, which were severely impaired by the financial crisis. Precisely, we include a dummy which takes value 1 when one of the following measures are announced: (i) the unlimited provisions of liquidity through fixed rate tenders with full allotment for the main refinancing operations (FRFA); (ii) extension of maturity for the long-term refinancing operations (LTRO); (iii) extension of the list of eligible collateral assets for refinancing operations; (iv) liquidity provision in foreign currencies though swap lines with other central banks (FOR);[33] (v) the outright purchases of covered bonds (CBPP1 and CBPP2). The second category covers the asset purchases carried out in order to address the *redenomination risk* during the sovereign debt crisis and to activate other channels of the monetary policy transmission mechanism, such as the *portfolio rebalancing channel* and the *bank lending channel*.[34] In practice, we include a dummy which takes value 1 on the days the ECB announces: (i) purchases of government bonds carried out under the Outright Monetary Transactions (OMT); (ii) the extended asset purchases programme (APP);[35] (iii) the targeted longer-term refinancing

[31] As robustness check (non reported), we measure the monetary policy shock as daily difference of the Eonia overnight rate, and the results are confirmed.

[32] Please refer to Table A.2 in the Appendix for a list of all unconventional monetary policies covered in this paper. Our list is very similar to Falagiarda and Reitz (2015) up to 2012 and Altavilla, Carboni and Motto (2015) for the last years. As we consider only the announcements made during the regular monetary policy press conference, some relevant non-standard measures (e.g. the Securities Markets Programme) are not included.

[33] Even if the main goal of the swap lines is to provide foreign currency liquidity to domestic banks, this instrument should mitigate the negative spillovers effects by protecting the euro area interbank market from external tensions, as discussed in the article "Experience with foreign currency liquidity-providing central bank swaps", Monthly Bulletin, August 2014.

[34] For further discussion on the transmission channels see, among others, Falagiarda and Reitz (2015) for all the unconventional monetary policies implemented up to 2012, and Altavilla, Carboni and Motto (2015), Cova and Ferrero (2015) and Andrade et al. (2016) for the asset purchase programme.

[35] This programme also covers the asset-baked securities purchase programme (ABSPP) and the covered bonds purchase programme (CBPP3). For more information, please see the ECB official webpage at `https://www.ecb.europa.eu/mopo/implement/omt/html/index.en.html`.

operations (TLTRO).[36]

We also include a dummy which takes value 1 when the forward guidance has been first announced on July 2013. Finally, we include a set of control variables that could affect the dynamics of the Euribor rate other than the ECB policy news: (i) the surprise related to the ECB forecasts for the GDP growth and inflation, defined as the difference between the ECB and the Survey of Professional Forecast (SPF) projections;[37] (ii) changes in the Euro Stoxx volatility as a measure of aggregate risk;[38] (iii) three dummies corresponding to three main phases of the crisis that started in August 2007, namely the financial turmoil from 9 August 2007 to the collapse of Lehman Brothers, the Great Recession phase from 15 September 2008 until 7 May 2010, and the Eurozone sovereign debt crisis from May 2010 until November 2012;[39] (iv) a dummy which takes value 1 if Mario Draghi is the ECB's President in charge.[40]

1.3.2 Methodology

We estimate the following equation using ordinary least squares with robust correction of standard errors:

$$\Delta f_{t'}^{(k)} = \alpha^{(k)} + \beta_1^{(k)} VGS_t + \beta_2^{(k)} MPS_t + \beta_3^{(k)} FG + \beta_4^{(k)} REF_t + \beta_5^{(k)} UMP_t + Z_t^{\top} \gamma^{(k)} + \varepsilon_t^{(k)} \quad (1.7)$$

where the time index t' refers to the day after the press conference.[41] The dependent

[36] We include the TLTRO among these measures as they have been introduced mainly to affect the economy through the *bank lending channel*.

[37] Starting as of June 2004, the ECB has released the macroeconomic projections on the press conference day, while the SPF projections are released around one week before. Both projections are released on a quarterly frequency; we then assume that the surprise is zero when there are no releases. Finally, as both projections refer to current and next year, we compute the fixed horizon forecast using a slightly version of equation (1.4).

[38] The Euro Stoxx volatility, as VIX in the US, is an index that provides a market-based measure of the volatility perceived by investors in the European stock market. The index is widely used as a proxy of aggregate risk perceptions in the euro area (Arghyrou and Kontonikas (2012), Glick and Leduc (2012) and Falagiarda and Reitz (2015), among others).

[39] A similar identification of the crisis periods has been suggested by Drudi, Durré and Mongelli (2012).

[40] In a (non-reported) robustness exercise we also include the surprise of U.S. initial jobless claims, defined as the difference between the actual release and market expectations measured through the mean response of a Bloomberg survey among market participants. The release is issued every Thursday at 2:30 pm CET/CEST, contemporaneously with the ECB press conference. As the effect is almost null, we exclude it for parsimony.

[41] Given that the Euribor is fixed at 11:00 am CET/CEST, we compute the difference from the day of the Governing Council meeting (t) to the day after (t').

variable, $\Delta f_{t'}^{(k)} = f_{t'}^{(k)} - f_t^{(k)}$, represents the first difference of the 3-month implied forward rate, where $k = \{3,6,9\}$; VGS is the verbal guidance shock, as defined in Section 1.2.3; MPS stands for the monetary policy shock; FG refers to the forward guidance dummy; REF is a dummy variable taking value one if $FRFA$, $LTRO$, $COLL$, FOR, or $CBPP$ are announced and zero otherwise; UMP is a dummy variable taking value one if OMT, APP, or $TLTRO$ are announced and zero otherwise; Z is the vector of control variables; and ε_t denotes the error term.

We focus on the meetings between September 2007 and December 2015. This period was mostly characterized by an accommodative monetary policy stance, as amply discussed in the evidence in Section 1.2.1, and therefore we expect that a positive shock to our index (an unexpected increased use of future markers) might have a negative instantaneous effect on financial markets' expectations.

1.3.3 Main results

We estimate equation (1.7) under three specifications. First, we estimate a baseline version of the model, where the announcements of all non-standard measures (i.e. FG, REF and UMP) are not included. Table 1.2 reports the results. As expected, the effect of a monetary policy shock on expectations on future short-term interest rates is positive; moreover it is statistically significant for all the horizons analyzed. In line with our hypothesis, the coefficients for the verbal guidance shock are all negative and significantly different from zero too. In other terms, our findings suggest that: (i) the ECB communication about future influences expectations about future money market interest rates; (ii) an unexpected increase of future markers induces a reduction in the expected money markets rates. In addition, the effect is larger (in absolute value) for horizons between 6 and 9 months. This result can be explained by the fact that the verbal guidance aims at convincing firmly the financial markets participants that the monetary policy stance will remain accommodative in the medium term.

In order to quantify the magnitude of the effect of the VGS, we normalize by considering the impact of one standard deviation shock: the effect of the VGS has been around 1 basis point across the horizons. This effect can be relevant, given that the average (of the absolute value) of the change of forward money market rate on the press conference day is around 2 basis points

in our sample. In specific days the effect is much larger: e.g. on June 2014, when several non-standard measures have been announced, the VGS has been around 0.086, corresponding to an impact between 2 and 3 basis points. Interestingly, the coefficient on the dummy which takes value 1 if the President in charge is Mario Draghi is negative and statistically significant for all three horizons. This result is consistent with the literature highlighting the importance of the central bank governors, according to which the reputation of the central bank president is relevant for shaping markets' expectations.[42]

In the second specification, we estimate the full model as defined in equation (1.7). Table 1.3 reports the results. As expected, the forward guidance (FG) announced on July 2013 had a relieving impact in reducing money market rates of almost 4 basis points for all horizons, while the money markets have been not affected by the announcements of unconventional monetary policies, as shown by other researches.[43] This can be due to several reasons. For example, Brunetti, di Filippo and Harries (2011) show that during crisis long term refinancing operations are not effective in reducing prices and interbank market uncertainty due to the crowding-out effect that dominates the intervention news effect. Moreover, programs such as the OMT were oriented to alleviate the increasing tensions in the sovereign debt market, while the TLTRO to stimulate the bank credit to the economy. Even after controlling for the announcements of unconventional monetary policies, the coefficients of the verbal guidance shock are all negative and statistically significant. Actually, they are now bigger in magnitude: the effect is larger (in absolute value) than the baseline model, suggesting that omitting variables result in downwards biased estimation of the VGS. Finally, we estimate equation (1.7) by dropping the dummy variables for the non-standard measures, REF and UMP, which result to be not statistically relevant for explaining money market rates movements around the press conference day. In other terms, we estimate an extended version of the baseline model, by controlling for the announcement of forward guidance. Table 1.4 reports the results, which are fully consistent with the baseline model.

To conclude, our findings suggest that communication in the form of verbal guidance has been an effective policy instrument. The main advantage of including our variable is that it is continuous in time, as opposite to the dummy for the FG, and it is thereof able to capture the

[42] See Sørensen (2014), Neuenkirch, Tillmann et al. (2013)

[43] See Cecioni, Ferrero and Secchi (2011), for a review of the effects of unconventional monetary policies in the US and euro area interbank market until mid-2011.

effect of the evolution of language. As amply discussed in Section 1.2.1, our index captures the future markers used to communicate information about the future monetary policy stance, such as forward guidance and the announcements of asset purchases. While the announcements on non-standard measures are not effective *per se*, our results suggest that financial markets' expectations react to the way the message is conveyed.

1.3.4 Robustness checks

In this section, we perform a series of robustness exercises and discuss the results for the extended model.[44] Our econometric analysis has been carried out in two steps. First, we determine the market prediction of the verbal guidance index immediately before the start of the press conference in order to estimate the news shock; second, we investigate the extent to which the identified innovation in communication about future can explain forward rate movements around event-days. In other words, we use a generated regressor in the second step. This fact may give rise to underestimated standard errors and hence to spurious significant regressor coefficients.[45] In order to account for the generated-regressor problem when computing coefficient estimates' standard errors, we check the robustness of our conclusions by using a bootstrap approach to statistical inference (see, e.g., Efron and Tibshirani (1993)). More specifically, we apply a sampling-with-replacement raw residuals bootstrap scheme with 1,000 repetitions. In Table 1.5 we report the estimation results: the coefficients of the verbal guidance shock are qualitatively very similar to those obtained in the previous section where White-robust standard errors are used. This fact confirms that communication about future is indeed effective in moving money markets rates.

To further assess the robustness of our results, we estimate equation (1.7) using the surprise in the Verbal Guidance Index computed following equation (1.2). The Verbal Guidance Index we use here is computed adding as future markers *expect*, *may* and *might* to *will*. For this index we apply a weighting scheme that associates the weight 1 to *will* and 0.5 to the others. On the one hand, the new index captures a broader range of shades about the use of future tenses in communication. On the other, the inclusion of different future markers and the use of an arbitrary weighting scheme inevitably increase the noise in the index. The results reported

[44] The results remain valid for the other specifications too.

[45] See Pagan (1984) for more details on the generated regressors issue.

in Table 1.6 show that the coefficients of VGS^e are, as well as those of VGS, all negative, increasing in absolute value with horizons and statistically significant.

Using an automated index to measure communication has pros and cons. On the one hand, our index is quite appealing since it is easy to construct, can be replicate, does not depend on time-varying glossary, and it is not undermined by possible misclassification due to personal judgments. On the other, the way we compute the index may lead to the inclusion of noise in our estimation exercises. As described in section 1.2.1, the use of future tense markers (i.e. *will*) in the policy summary is generally related to the intention of signalling future monetary policy actions, but it could also refer to the intention to monitor closely a situation or to the expected return of inflation on target. While the first two instances can both be classified as signals of future actions, the last instance is more dubious: it should signal that, given the current policy stance, no further action is needed. To tackle this issue we manually disentangle the future markers related to the intentions of signalling some future action to those related to other aspects of the monetary policy stance (Figure 1.7 compare the number of will obtained manually to the automated one). Once obtained the number of future markers which only refer to signalling future action, we proceed as usual in two steps: we construct the index as the ratio between the future tenses and the number of words of the policy summary, and then we identify the communication shock. Table 1.7 reports the estimation for the extended model using as verbal guidance shock the one computed manually. Results are confirmed.

Moreover, we have run an event-study analyses measuring changes in expectations in a one-day window around the press conference meeting. As it has been stressed out in the literature, a limitation of the event-study approach is that it relies on the assumption that financial markets are informationally efficient, i.e. it assumes that the majority of the impact of ECB communication occurs immediately. Hence, the choice of the event window length is crucial, since it involves a trade-off between keeping the interval narrow to avoid the noise produced by extraneous information, and choosing a wider window to identify potential delayed and/or anticipated reactions of market participants. In order to capture possible anticipated reactions to news by market participants, we extend our event window to two days, defined as difference between the day after and the day before the press conference. The results are reported in Table 1.8. The coefficients of our variable of interest, the VGS, are larger in absolute value for all the horizons analyzed, the significance level and the measure of the goodness of fit

increase. The results indicate that ECB news have been subject to anticipation effects, as there has been an increase quantitatively (in absolute value) and qualitatively in comparison to a one-day window. On the other hand, the results obtained using a two-day window are less accurate in comparison to those obtained using a one-day window, as extending the event window inevitably increases the noise in the estimates of the announcement effect. So far we have considered changes in the Euribor forward rates to determine if and how the surprise in communication about future affects money market rates. Forward rates, due to the way they are computed, show sometimes erratic behaviour at high frequencies and, more important for our perspective, include term premia. In short time windows, as those used in this analysis, the term premia should not change. However, for important ECB communication, related for instance to the start of the APP programme, someone could question the validity of assuming a constant term premium. This could cause the increasing effect along horizons that we find for the coefficient of the verbal guidance shock. To asses this issue, we reestimate the model using as alternative dependent variable the Eonia Swap Rates: these rates are transaction-based and not quote-based as in the case of the Euribor, hence they should reflect more clearly market expectations. Table 1.9 reports the results obtained for a two-day window for maturities from 3 months to 2 years. The coefficients of our variable of interest are, as in previous estimates, negative and increasing in absolute value with maturities until 6 months. The verbal guidance shock results to be no longer statistically significant for maturities beyond 8 months.

Table 1.10 summarizes our results for the extended model for the horizon $k = 9$ in three cases, namely one-day window, one-day window with alternative index, and two-day window. Specifically, we report the effects of the verbal guidance and the monetary policy shocks, which are normalized by their standard deviations. Overall, the effect of a shock to verbal guidance is on average 1 basis point, and much larger than the monetary policy shock.

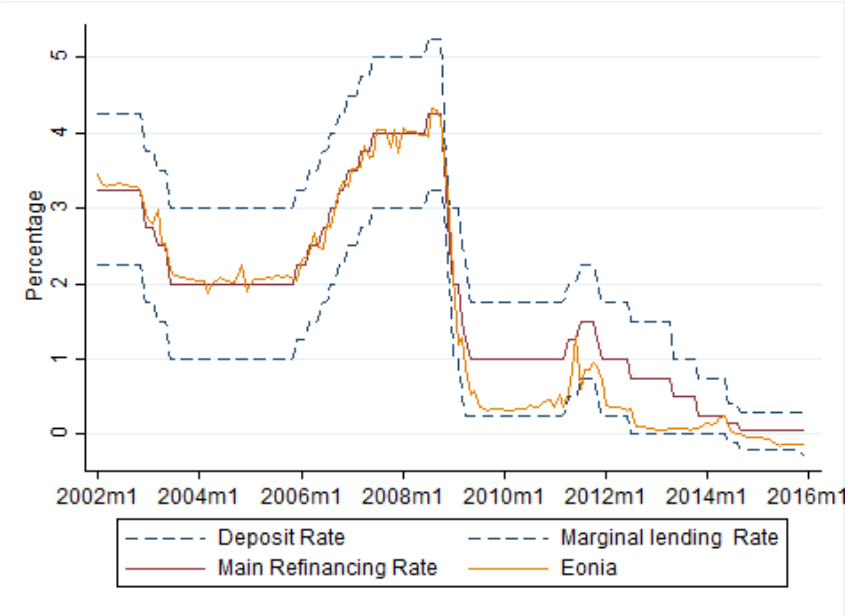
1.4 Concluding remarks

This paper has addressed a relevant question concerning central bank governance, i.e. whether and the extent which the verbal guidance has been effective in shaping the financial markets' expectations on future short-term interest rates. The answer to this question crucially depends on the way central bank communication is measured. Despite the burgeoning literature on this

topic, our paper has proposed a novel approach based on the frequency of future markers in monetary policy statements. We have considered the European Central Bank communication strategy as a testing case. The main findings are as follows: (i) our *verbal guidance index* is able to capture the evolution towards explicit forward-looking statements, especially in the aftermath of the Global Financial Crisis and well before the forward guidance on key policy interest rates announced firstly on July 2013; (ii) the results from the econometric analysis have showed that using a future tense that is perceived by the public as a commitment in pursuing a particular monetary policy stance is indeed effective in shaping future short-term interest rates expectations. In particular, the stronger is the surprise in speaking about future, the stronger is the effect on interest rates, especially for longer horizons.

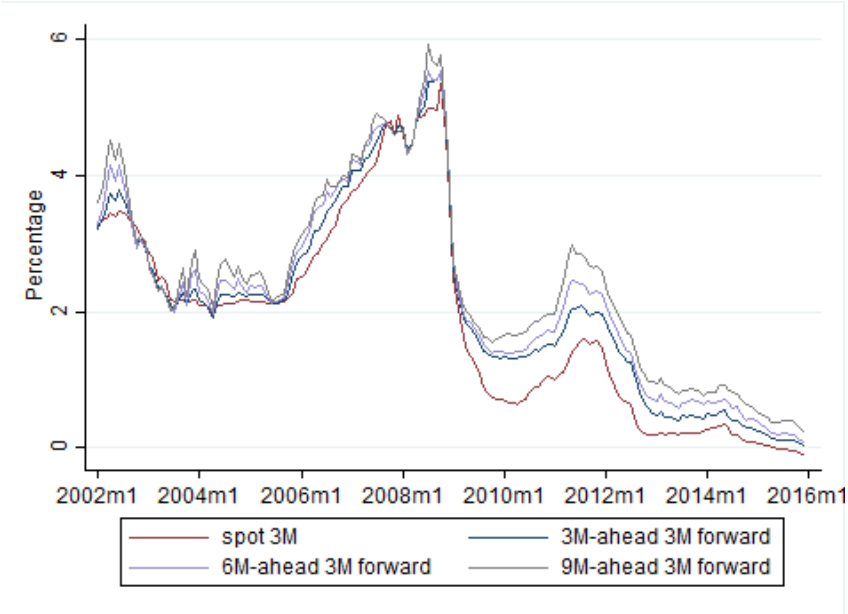
To conclude, we have performed our analysis during a period characterized mostly by a dovish attitude, and thereof the results are valid in a context of accommodative monetary policy stance. Although it is not possible to state if these implications hold in a hawkish context too, our results shed light on the importance of the verbal tenses used to signal future actions.

Figure 1.1: Evolution of the ECB Policy Rates



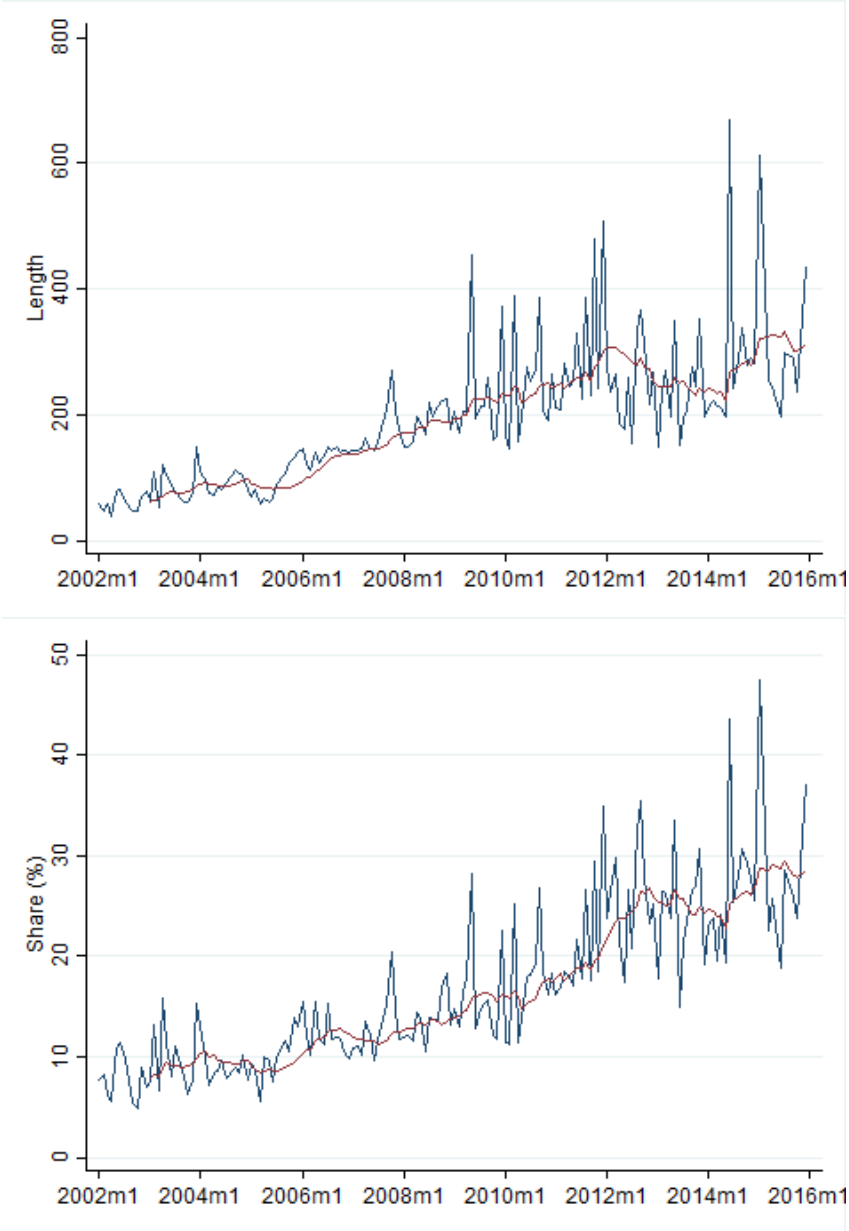
Notes: The graph plots the ECB official policy rates and the Eonia overnight rate. Source: Bloomberg.

Figure 1.2: Evolution of the Implied Forward Euribor Rate



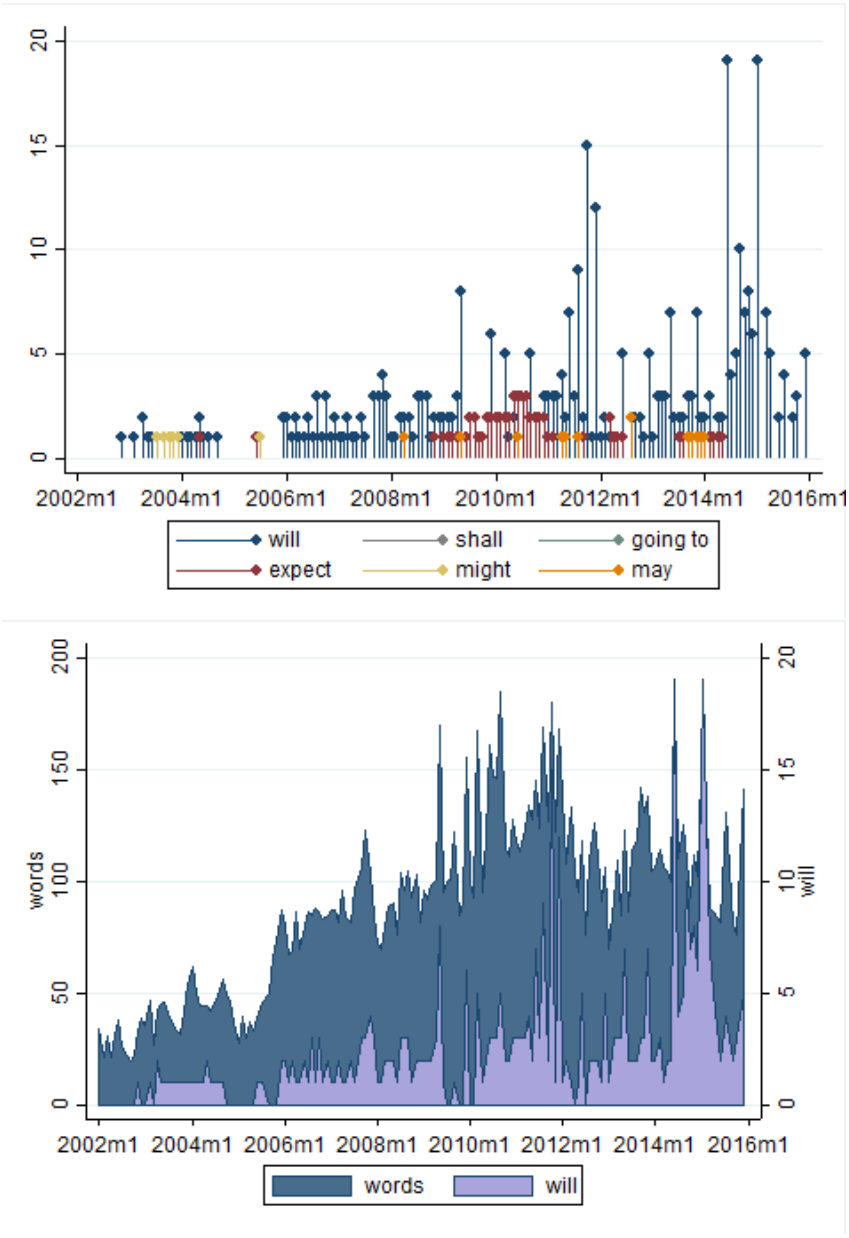
Notes: The graph plots the implied k-month-ahead three month forward rate and the three month spot rate on the ECB press conference days. Source: Thomson Reuters-Datastream.

Figure 1.3: Evolution of the ECB policy summary



Notes: The top graph reports the number of words of the ECB *policy summary* (blue line) and a moving average covering the previous 12 press conferences (red line). The bottom graph shows the share of the *policy summary* with respect to the Introductory statement (blue line) and a moving average covering the previous 12 press conferences (red line).

Figure 1.4: Evolution of the future markers



Notes: The top graph shows the number of future markers of the ECB *policy summary*, including *expect*, *may* and *might*. The bottom graph reports the number of words and *will*. The number of words does not include numbers and stopwords. Only words with a sparsity lower than 80% are considered.

Figure 1.5: The Word Clouds: an overview of the policy summary

2002-2006

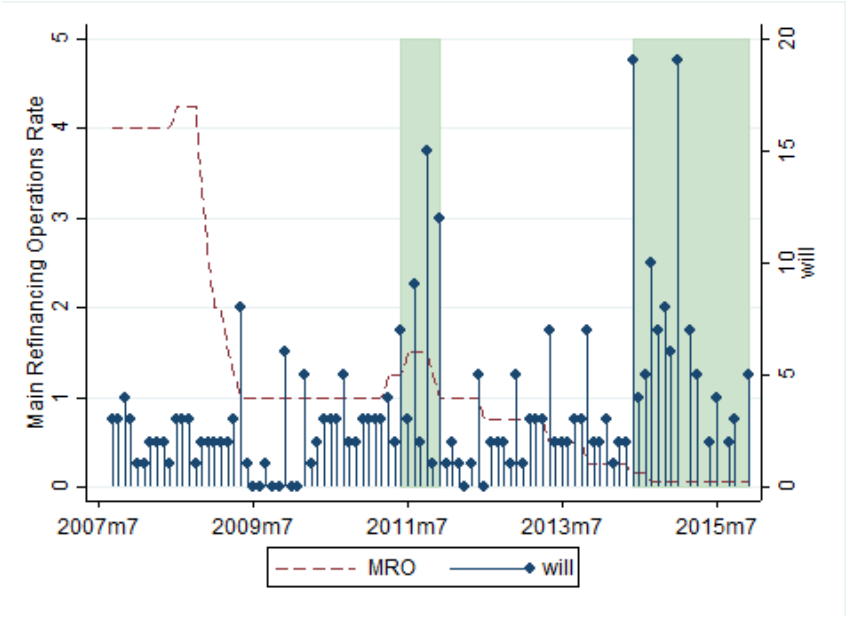
2007-2009

2010-2012

2013-2015

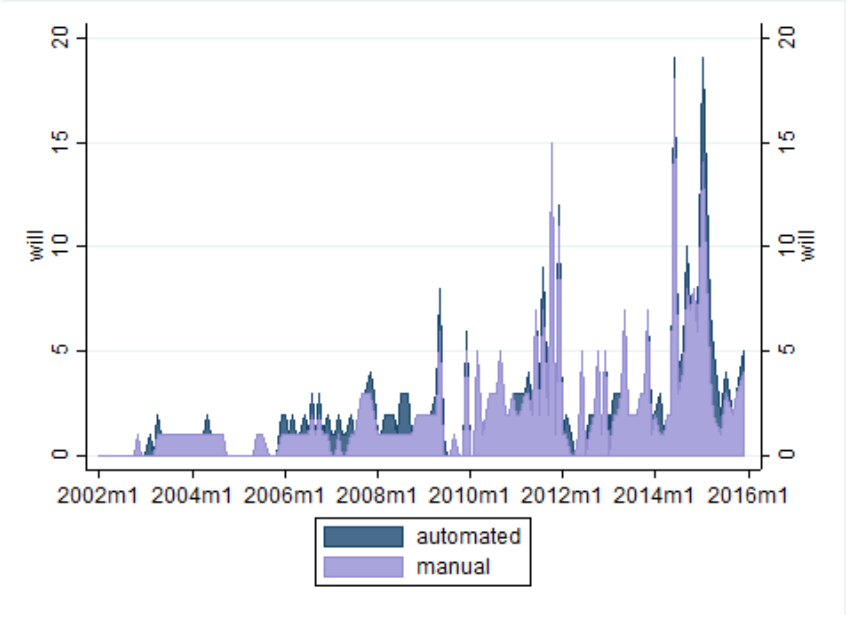
Notes: The 100 most frequent words. The size of each word maps the frequency. The future markers are highlighted in blue for explanatory purpose.

Figure 1.6: The ECB's MRO rate *versus* the future marker *will*



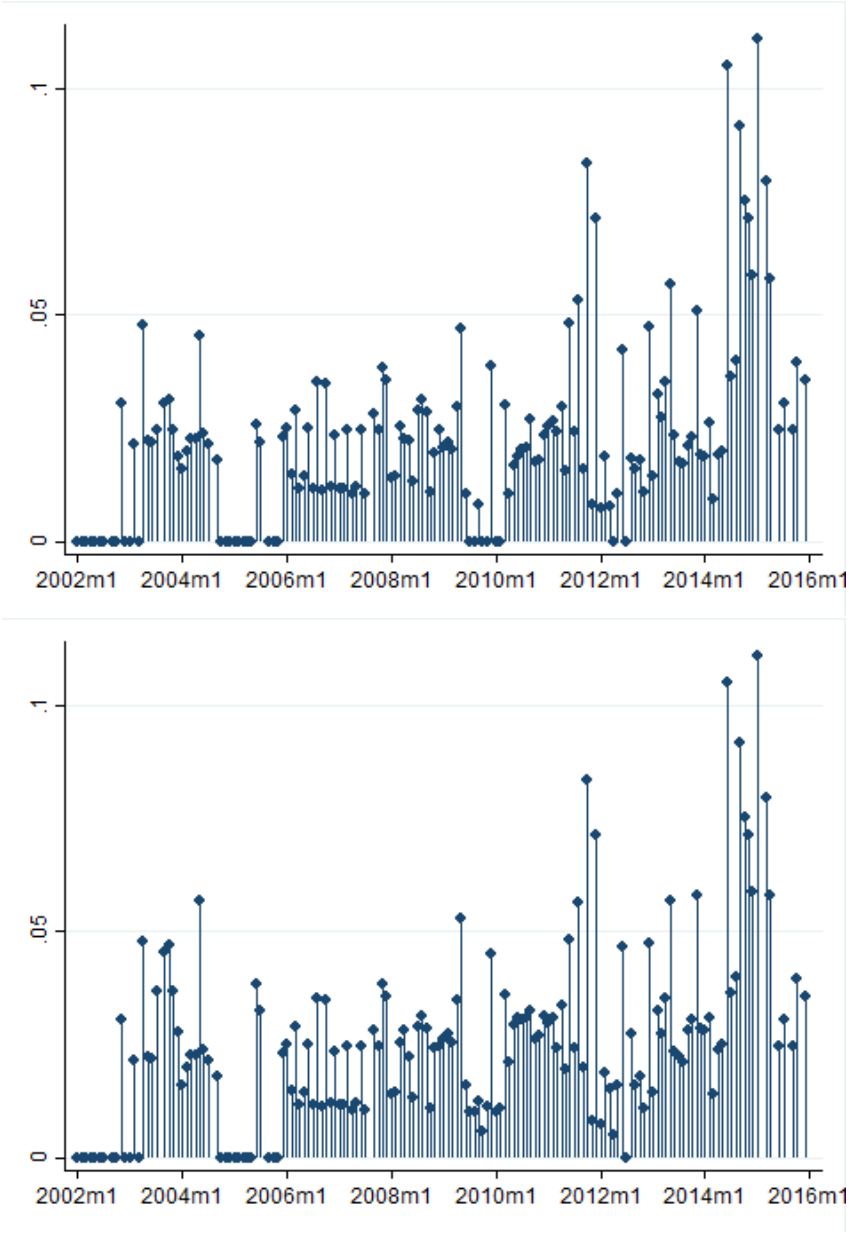
Notes: The graph plots the ECB Main Refinancing Operations Rate and the number of *will* used in the *policy summary*.

Figure 1.7: *Will*: Automated vs Manual Computation



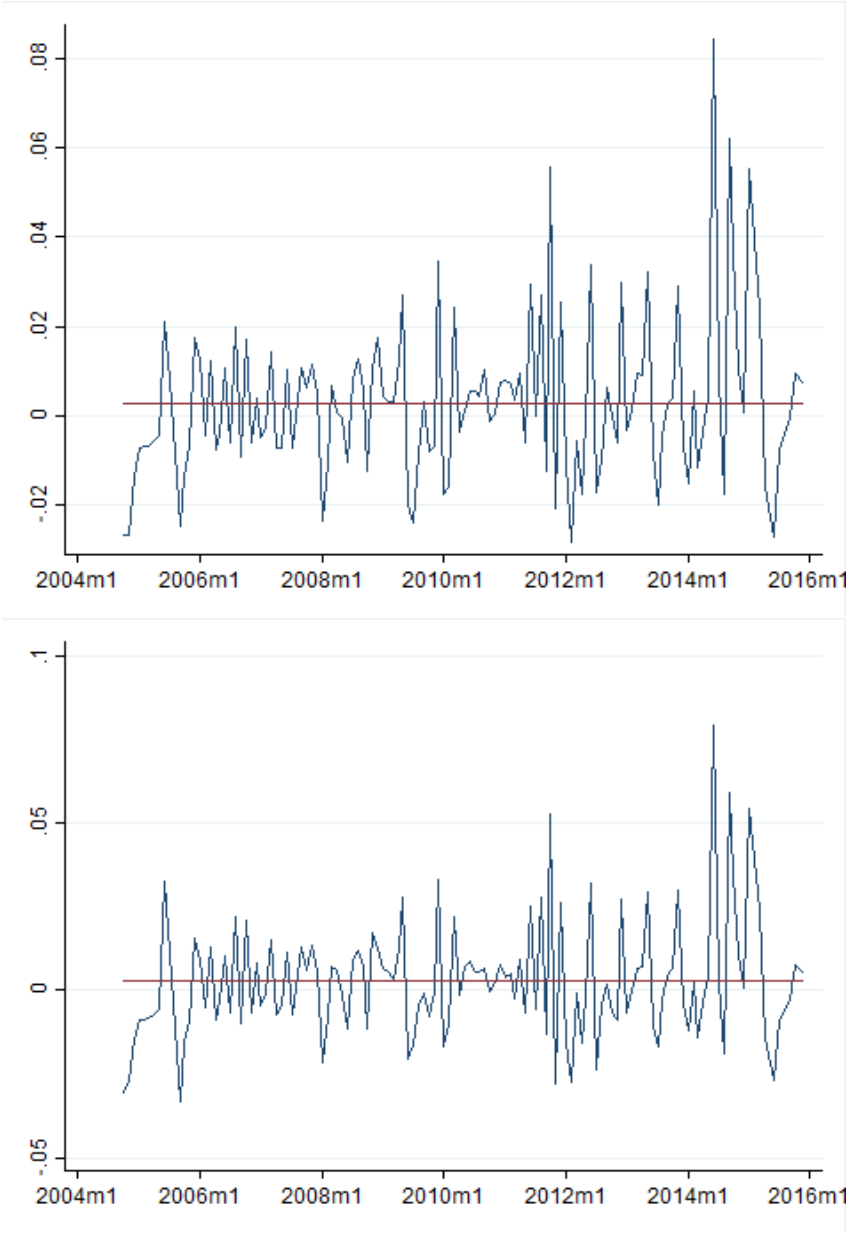
Notes: The graph plots the number of *will* computed through automated approach versus manual computation.

Figure 1.8: The ECB Verbal Guidance Index



Notes: The top graph reports the ECB Verbal Guidance Index as defined in eq. (1.1). The bottom graph shows the ECB Verbal Guidance Index as defined in eq. (1.2).

Figure 1.9: The ECB Verbal Guidance Shock



Notes: The top graph reports the VGS (blue line) and its average (red line) when the index is computed as in eq. (1.1). The bottom graph shows the VGS (blue line) and its average (red line) when the index is computed as in eq. (1.2).

Table 1.1: The ECB Verbal Guidance Index

	index	index	index
L.index	0.2422***	0.2041**	0.2029**
	(0.0829)	(0.0863)	(0.0878)
L2.index	0.4187***	0.3888***	0.3864***
	(0.0911)	(0.0860)	(0.0869)
Main Refinancing Rate		-0.0020*	-0.0021*
		(0.0012)	(0.0012)
D.consensusCPIfh		-0.0259*	-0.0247
		(0.0136)	(0.0183)
D.consensusGDPfh			-0.0014
			(0.0102)
Constant	0.0080***	0.0130***	0.0132***
	(0.0022)	(0.0038)	(0.0041)
Observations	157	157	157
R-squared	0.322	0.356	0.356
Adjusted R-squared	0.314	0.339	0.335

Notes: January 2002-December 2015. The econometric method is OLS with Robust standard errors in parentheses. ***, **, * indicate significance at the 99%, 95% and 90% level, respectively.

Table 1.2: One-day event-study on k-month-ahead 3-month forward Euribor rate: Baseline model

	k=3	k=6	k=9
Verbal Guidance Shock	-0.2631**	-0.3740**	-0.4192**
	(0.1226)	(0.1623)	(0.1942)
Monetary Policy Shock	0.1371***	0.1337***	0.1419***
	(0.0324)	(0.0390)	(0.0512)
Draghi	-0.0285**	-0.0320**	-0.0363**
	(0.0109)	(0.0146)	(0.0163)
EuroVIX change	-0.0036**	-0.0040*	-0.0054***
	(0.0018)	(0.0021)	(0.0020)
Financial Turmoil	-0.0277	-0.0216	-0.0353
	(0.0196)	(0.0276)	(0.0318)
Great Recession	-0.0398***	-0.0454***	-0.0454**
	(0.0123)	(0.0168)	(0.0194)
EMU Sovereign Debt Crisis	-0.0330***	-0.0387***	-0.0398***
	(0.0106)	(0.0136)	(0.0146)
CPI forecast surprise	0.1065**	0.1524**	0.1644**
	(0.0451)	(0.0692)	(0.0809)
GDP forecast surprise	-0.0233*	-0.0286	-0.0459*
	(0.0139)	(0.0214)	(0.0239)
Constant	0.0329**	0.0387**	0.0418**
	(0.0126)	(0.0176)	(0.0195)
Observations	96	96	96
R-squared	0.313	0.294	0.244
Adjusted R-squared	0.241	0.220	0.165

Notes: September 2007-December 2015. The econometric method is OLS with Robust standard errors in parentheses. ***, **, * indicate significance at the 99%, 95% and 90% level, respectively.

Table 1.3: One-day event-study on k-month-ahead 3-month forward Euribor rate: Full model

	k=3	k=6	k=9
Verbal Guidance Shock	-0.2838*	-0.4780**	-0.4944**
	(0.1686)	(0.1942)	(0.2384)
Monetary Policy Shock	0.1291***	0.1279***	0.1312**
	(0.0367)	(0.0437)	(0.0588)
Draghi	-0.0300**	-0.0352**	-0.0395**
	(0.0122)	(0.0165)	(0.0185)
EuroVIX change	-0.0035*	-0.0039*	-0.0052**
	(0.0018)	(0.0021)	(0.0021)
Financial Turmoil	-0.0288	-0.0246	-0.0373
	(0.0205)	(0.0296)	(0.0344)
Great Recession	-0.0418***	-0.0485***	-0.0481**
	(0.0131)	(0.0180)	(0.0208)
EMU Sovereign Debt Crisis	-0.0334***	-0.0406***	-0.0406***
	(0.0111)	(0.0142)	(0.0154)
CPI forecast surprise	0.1123**	0.1562**	0.1706**
	(0.0476)	(0.0720)	(0.0843)
GDP forecast surprise	-0.0308**	-0.0320	-0.0533**
	(0.0155)	(0.0213)	(0.0244)
Forward Guidance	-0.0366***	-0.0435***	-0.0368***
	(0.0065)	(0.0093)	(0.0104)
REF	-0.0061	-0.0003	-0.0044
	(0.0088)	(0.0109)	(0.0126)
UMP	0.0066	0.0108	0.0127
	(0.0093)	(0.0122)	(0.0128)
Constant	0.0356***	0.0415**	0.0448**
	(0.0130)	(0.0184)	(0.0203)
Observations	96	96	96
R-squared	0.330	0.304	0.253
Adjusted R-squared	0.233	0.203	0.145

Notes: September 2007-December 2015. The econometric method is OLS with Robust standard errors in parentheses. ***, **, * indicate significance at the 99%, 95% and 90% level, respectively.

Table 1.4: One-day event-study on *k*-month-ahead 3-month forward Euribor rate: Extended model

	k=3	k=6	k=9
Verbal Guidance Shock	-0.2944**	-0.4115**	-0.4513**
	(0.1248)	(0.1676)	(0.2021)
Monetary Policy Shock	0.1384***	0.1352***	0.1431***
	(0.0327)	(0.0393)	(0.0519)
Draghi	-0.0289**	-0.0325**	-0.0367**
	(0.0110)	(0.0148)	(0.0165)
EuroVIX change	-0.0036**	-0.0041**	-0.0054***
	(0.0017)	(0.0020)	(0.0020)
Financial Turmoil	-0.0295	-0.0238	-0.0372
	(0.0196)	(0.0276)	(0.0318)
Great Recession	-0.0415***	-0.0474***	-0.0471**
	(0.0125)	(0.0170)	(0.0197)
EMU Sovereign Debt Crisis	-0.0346***	-0.0406***	-0.0415***
	(0.0108)	(0.0139)	(0.0150)
CPI forecast surprise	0.1076**	0.1537**	0.1655**
	(0.0453)	(0.0696)	(0.0814)
GDP forecast surprise	-0.0237*	-0.0291	-0.0462*
	(0.0139)	(0.0214)	(0.0239)
Forward Guidance	-0.0372***	-0.0446***	-0.0381***
	(0.0065)	(0.0094)	(0.0105)
Constant	0.0347***	0.0408**	0.0436**
	(0.0127)	(0.0179)	(0.0199)
Observations	96	96	96
R-squared	0.323	0.301	0.248
Adjusted R-squared	0.243	0.219	0.160

Notes: September 2007-December 2015. The econometric method is OLS with Robust standard errors in parentheses. ***, **, * indicate significance at the 99%, 95% and 90% level, respectively.

Table 1.5: One-day event-study on *k*-month-ahead 3-month forward Euribor rate: Extended Model, Bootstrap Estimation

	k=3	k=6	k=9
Verbal Guidance Shock	-0.2944**	-0.4115**	-0.4513**
	(0.1428)	(0.2021)	(0.2182)
Monetary Policy Shock	0.1384***	0.1352**	0.1431*
	(0.0495)	(0.0659)	(0.0825)
Draghi	-0.0289**	-0.0325**	-0.0367**
	(0.0114)	(0.0152)	(0.0162)
EuroVIX change	-0.0036*	-0.0041*	-0.0054***
	(0.0019)	(0.0024)	(0.0021)
Financial Turmoil	-0.0295	-0.0238	-0.0372
	(0.0190)	(0.0279)	(0.0305)
Great Recession	-0.0415***	-0.0474***	-0.0471**
	(0.0131)	(0.0173)	(0.0202)
EMU Sovereign Debt Crisis	-0.0346***	-0.0406***	-0.0415***
	(0.0120)	(0.0149)	(0.0160)
CPI forecast surprise	0.1076**	0.1537**	0.1655*
	(0.0512)	(0.0763)	(0.0862)
GDP forecast surprise	-0.0237	-0.0291	-0.0462
	(0.0185)	(0.0333)	(0.0337)
Forward Guidance	-0.0372***	-0.0446***	-0.0381***
	(0.0068)	(0.0099)	(0.0108)
Constant	0.0347**	0.0408**	0.0436**
	(0.0135)	(0.0177)	(0.0198)
Observations	96	96	96
R-squared	0.323	0.301	0.248
Adjusted R-squared	0.243	0.219	0.160

Notes: September 2007-December 2015. The econometric method is OLS with Bootstrapped standard errors in parentheses. ***, **, * indicate significance at the 99%, 95% and 90% level, respectively.

Table 1.6: One-day event-study on *k*-month-ahead 3-month forward Euribor rate: Extended model with alternative verbal guidance index

	k=3	k=6	k=9
Verbal Guidance Shock	-0.3323**	-0.4773**	-0.5349**
	(0.1450)	(0.2028)	(0.2414)
Monetary Policy Shock	0.1399***	0.1374***	0.1456***
	(0.0340)	(0.0381)	(0.0515)
Draghi	-0.0295***	-0.0336**	-0.0380**
	(0.0112)	(0.0150)	(0.0167)
EuroVIX change	-0.0035**	-0.0040**	-0.0053***
	(0.0017)	(0.0020)	(0.0019)
Financial Turmoil	-0.0299	-0.0245	-0.0381
	(0.0195)	(0.0274)	(0.0316)
Great Recession	-0.0417***	-0.0480***	-0.0479**
	(0.0126)	(0.0173)	(0.0200)
EMU Sovereign Debt Crisis	-0.0353***	-0.0417***	-0.0428***
	(0.0111)	(0.0144)	(0.0156)
CPI forecast surprise	0.1079**	0.1541**	0.1659**
	(0.0448)	(0.0689)	(0.0806)
GDP forecast surprise	-0.0232*	-0.0285	-0.0456*
	(0.0139)	(0.0213)	(0.0238)
Forward Guidance	-0.0368***	-0.0444***	-0.0382***
	(0.0065)	(0.0096)	(0.0107)
Constant	0.0354***	0.0421**	0.0452**
	(0.0130)	(0.0184)	(0.0205)
Observations	96	96	96
R-squared	0.327	0.307	0.255
Adjusted R-squared	0.248	0.225	0.167

Notes: September 2007-December 2015. The econometric method is OLS with Robust standard errors in parentheses. ***, **, * indicate significance at the 99%, 95% and 90% level, respectively.

Table 1.7: One-day event-study on *k*-month-ahead 3-month forward Euribor rate: Extended model with "manual" verbal guidance index

	k=3	k=6	k=9
Verbal Guidance Shock (manual)	-0.3115**	-0.4395**	-0.5221**
	(0.1389)	(0.1891)	(0.2285)
Monetary Policy Shock	0.1424***	0.1409***	0.1498***
	(0.0336)	(0.0387)	(0.0496)
Draghi	-0.0300***	-0.0342**	-0.0392**
	(0.0113)	(0.0153)	(0.0171)
EuroVIX change	-0.0036**	-0.0041*	-0.0054***
	(0.0018)	(0.0021)	(0.0020)
Financial Turmoil	-0.0304	-0.0251	-0.0394
	(0.0195)	(0.0275)	(0.0317)
Great Recession	-0.0420***	-0.0482***	-0.0487**
	(0.0127)	(0.0174)	(0.0201)
EMU Sovereign Debt Crisis	-0.0358***	-0.0423***	-0.0439***
	(0.0112)	(0.0146)	(0.0159)
CPI forecast surprise	0.1101**	0.1572**	0.1695**
	(0.0454)	(0.0701)	(0.0819)
GDP forecast surprise	-0.0218	-0.0265	-0.0433*
	(0.0142)	(0.0218)	(0.0243)
Forward Guidance	-0.0380***	-0.0458***	-0.0406***
	(0.0068)	(0.0099)	(0.0112)
Constant	0.0380***	0.0456**	0.0501**
	(0.0134)	(0.0192)	(0.0215)
Observations	96	96	96
R-squared	0.322	0.301	0.251
Adjusted R-squared	0.242	0.218	0.163

Notes: September 2007-December 2015. The econometric method is OLS with Robust standard errors in parentheses. ***, **, * indicate significance at the 99%, 95% and 90% level, respectively.

Table 1.8: Two-day event-study on *k*-month-ahead 3-month forward Euribor rate: Extended Model

	k=3	k=6	k=9
Verbal Guidance Shock	-0.4132***	-0.5194***	-0.5908***
	(0.1367)	(0.1936)	(0.2143)
Monetary Policy Shock	0.1912***	0.1888***	0.1621***
	(0.0536)	(0.0561)	(0.0506)
Draghi	-0.0392***	-0.0453***	-0.0513***
	(0.0120)	(0.0161)	(0.0176)
EuroVIX change	-0.0052*	-0.0057*	-0.0071**
	(0.0027)	(0.0029)	(0.0029)
Financial Turmoil	-0.0429**	-0.0405	-0.0484
	(0.0205)	(0.0296)	(0.0328)
Great Recession	-0.0612***	-0.0681***	-0.0658***
	(0.0142)	(0.0188)	(0.0201)
EMU Sovereign Debt Crisis	-0.0433***	-0.0525***	-0.0527***
	(0.0116)	(0.0153)	(0.0162)
CPI forecast surprise	0.1295***	0.1803**	0.1871**
	(0.0484)	(0.0762)	(0.0829)
GDP forecast surprise	-0.0269	-0.0298	-0.0468*
	(0.0181)	(0.0281)	(0.0262)
Forward Guidance	-0.0424***	-0.0498***	-0.0443***
	(0.0074)	(0.0106)	(0.0112)
Constant	0.0455***	0.0544***	0.0594***
	(0.0137)	(0.0193)	(0.0206)
Observations	96	96	96
R-squared	0.408	0.349	0.307
Adjusted R-squared	0.339	0.272	0.226

Notes: September 2007-December 2015. The econometric method is OLS with Robust standard errors in parentheses. ***, **, * indicate significance at the 99%, 95% and 90% level, respectively.

Table 1.9: Two-day event-study on Overnight Indexed Swap rates: Extended Model

	3 months	4 months	5 months	6 months	7 months	8 months	9 months	1 year	18 months	2 years
Verbal Guidance Shock	-0.2349	-0.3493**	-0.3613**	-0.4049**	-0.3474*	-0.3979*	-0.3169	-0.3270	-0.1254	0.0148
	(0.1538)	(0.1543)	(0.1656)	(0.1755)	(0.1859)	(0.2066)	(0.2072)	(0.2401)	(0.3034)	(0.3595)
Monetary Policy Shock	0.2916***	0.3082***	0.2819***	0.2376**	0.2548***	0.2259**	0.2040**	0.2442**	0.2603*	0.3149**
	(0.0918)	(0.0989)	(0.1003)	(0.0909)	(0.0913)	(0.0989)	(0.0976)	(0.1198)	(0.1313)	(0.1397)
Draghi	-0.0348**	-0.0321**	-0.0349**	-0.0333*	-0.0308	-0.0312	-0.0331*	-0.0393*	-0.0263	-0.0309
	(0.0147)	(0.0161)	(0.0172)	(0.0184)	(0.0188)	(0.0197)	(0.0197)	(0.0218)	(0.0266)	(0.0293)
EuroVIX change	-0.0054***	-0.0064**	-0.0076**	-0.0090***	-0.0094***	-0.0097***	-0.0092***	-0.0094***	-0.0123***	-0.0127***
	(0.0018)	(0.0025)	(0.0029)	(0.0030)	(0.0030)	(0.0031)	(0.0025)	(0.0029)	(0.0040)	(0.0042)
Financial Turmoil	-0.0464**	-0.0411*	-0.0448*	-0.0430*	-0.0460*	-0.0486*	-0.0528*	-0.0670**	-0.0635	-0.0761*
	(0.0187)	(0.0208)	(0.0233)	(0.0251)	(0.0264)	(0.0280)	(0.0297)	(0.0337)	(0.0400)	(0.0420)
Great Recession	-0.0616***	-0.0571***	-0.0549**	-0.0505**	-0.0526**	-0.0483*	-0.0529**	-0.0567*	-0.0331	-0.0328
	(0.0174)	(0.0195)	(0.0218)	(0.0232)	(0.0243)	(0.0262)	(0.0253)	(0.0290)	(0.0353)	(0.0375)
EMU Sovereign Debt Crisis	-0.0331***	-0.0334**	-0.0345**	-0.0308**	-0.0370***	-0.0351**	-0.0335**	-0.0383**	-0.0324*	-0.0343*
	(0.0120)	(0.0127)	(0.0133)	(0.0138)	(0.0139)	(0.0148)	(0.0150)	(0.0168)	(0.0191)	(0.0198)
CPI forecast surprise	0.0772**	0.0792**	0.0834*	0.0785	0.0990*	0.1073*	0.1112*	0.1280*	0.1471*	0.1445*
	(0.0322)	(0.0386)	(0.0449)	(0.0497)	(0.0536)	(0.0575)	(0.0627)	(0.0706)	(0.0842)	(0.0856)
GDP forecast surprise	-0.0350	-0.0284	-0.0364	-0.0483*	-0.0628**	-0.0660**	-0.0755**	-0.0874**	-0.0948**	-0.0920**
	(0.0279)	(0.0241)	(0.0251)	(0.0248)	(0.0286)	(0.0315)	(0.0363)	(0.0395)	(0.0453)	(0.0441)
Forward Guidance	-0.0256***	-0.0323***	-0.0388***	-0.0421***	-0.0424***	-0.0488***	-0.0495***	-0.0536***	-0.0596***	-0.0578***
	(0.0061)	(0.0070)	(0.0079)	(0.0085)	(0.0090)	(0.0098)	(0.0097)	(0.0109)	(0.0134)	(0.0142)
Constant	0.0411**	0.0398**	0.0415**	0.0376*	0.0368*	0.0376*	0.0382*	0.0459*	0.0286	0.0326
	(0.0160)	(0.0177)	(0.0190)	(0.0203)	(0.0210)	(0.0220)	(0.0221)	(0.0244)	(0.0299)	(0.0322)
Observations	96	96	96	96	96	96	96	96	96	96
R-squared	0.422	0.405	0.352	0.318	0.333	0.292	0.270	0.251	0.237	0.236
Adjusted R-squared	0.354	0.335	0.276	0.238	0.255	0.209	0.184	0.163	0.147	0.146

Notes: September 2007-December 2015. The econometric method is OLS with Robust standard errors in parentheses. ***, **, * indicate significance at the 99%, 95% and 90% level, respectively.

Table 1.10: Order of magnitude of verbal guidance shock and monetary policy shock for $k = 9$ (in basis points)

	(1)	(2)	(3)
$\beta_1 * \sigma_{VGS}$	-0.87	-1.03	-1.14
$\beta_2 * \sigma_{MPS}$	0.69	0.70	0.78

Notes: The table shows the magnitude of the effects for the extended model estimated as: (1) one-day window, (2) one-day window for the verbal guidance index as define in eq. 1.2, (3) two-day window.

Chapter 2

Wealth Effects in the Euro Area

with Caterina Mendicino (European Central Bank)

2.1 Introduction

Movements in asset prices affect the real economy through a variety of channels. One of the most studied is the wealth channel, i.e. the effects on consumption of changes in households' assets value, such as stocks, bonds and real estate. Anecdotal evidence shows that larger household wealth is correlated with higher consumption spending. However, the literature presents mixed evidence on the magnitude of the marginal propensity to consume out of wealth across countries, with estimates ranging from 4 to 5 cents per dollar for Anglo-Saxon countries to often small or not significant in other advanced economies, such as euro area countries.[1] One of the reasons for the lack of systematic cross-country comparison is the inadequacy of standardized wealth data across economies. Moreover, these findings generally refer to the pre-financial crisis period. The substantial declines in (housing) wealth and consumption during the Great Recession have raised again interest in questioning the relevance of wealth effects. Namely, (i) whether and the extent to which changes in wealth alter the spending behavior nowadays?; (ii) which are the assets that have a major impact on consumption?; and (iii) do wealth effects change over time?. We address these questions by analyzing the dynamics of households' net worth in euro area economies during the period which spans from

[1] See, among others, Catte et al. (2004), Ludwig and Slok (2004), Case, Quigley and Shiller (2005), Cardarelli, Igan and Rebucci (2008) and Slacalek (2009).

1999 to 2016. To this purpose, we take advantage of newly available Household Sector Report data, which provides standardized wealth data across several euro area countries.

To investigate the relevance of the wealth channel, we follow the econometric methodology proposed by Carroll, Otsuka and Slacalek (2011), which aims at analyzing the wealth effects in terms of its two key aspects, i.e. the "speed" through which consumption responds to shocks and the "strength" of wealth impact. This approach is based on recent theoretical works that have showed the persistence of consumption growth (see for instance Carroll and Slacalek (2006)), in contrast to the standard random walk model by Hall (1978). The main implication is that the initial response of consumption to shocks is smaller than the one implied by the permanent income hypothesis, but it is increasing over time. In other terms, a change of wealth has a slow but long-lasting impact on consumption, implying that the "eventual" effect (after some years) is larger than the "immediate" one (next quarter).[2]

In practice, we measure the wealth effects by applying a three-step approach. First, we estimate the sluggishness of aggregate consumption growth across countries by using IV regression analysis, which allows us to overcome the limits of OLS estimates (i.e. bias towards zero) that arise when working with quarterly consumption data. Second, we estimate the immediate wealth effects on consumption, where wealth is defined as a geometric sum of its past values and the weights are given by the degree of consumption growth persistence estimated in the first step. Finally, we use the estimated consumption growth sluggishness and the immediate marginal propensity to consume out of wealth to construct a measure of eventual effect.

We contribute to the empirical literature in several ways. First, the recently standardized Household Sector Report data allows us to obtain more reliable estimates of the wealth effects on consumption in euro area countries, both at country- and group-level. Second, by analyzing a time period which spans from 1999Q1 to 2016Q3, this paper provides up-to-date estimates. In addition, we explore whether the consumption dynamics has changed in response to the

[2]We follow the same definitions as in Carroll, Otsuka and Slacalek (2011) to refer to the short- and medium-run marginal propensity to consume out of wealth.

sovereign debt crisis that hit the euro are periphery economies as of May 2010. Furthermore, we consider different definitions of wealth. Namely, we explore whether consumption responds differently to changes in aggregate and disaggregate wealth. In particular, we distinguish between housing and financial wealth. Moreover, the newly available data also allow us to disaggregate financial wealth into three major sub-components: currency and deposits, debt securities, and equities. To the best of our knowledge, we are the first to examine the relative importance of several types of financial and non-financial assets - which in turn reflect changes in the corresponding prices - affecting households' spending decisions across euro area countries.[3] Overall, our analysis provides useful insights to policy-makers interested in questioning the potential macroeconomic implications of a change in financial and non-financial asset prices on households' consumption.

We start by examining in detail the wealth effects in the five largest euro area economies (Big 5), i.e. Germany, France, Italy, Spain and the Netherlands. We then compare the results with the rest of the euro area countries for which we were able to collect consistent and comparable wealth data from the Household Sector Report, i.e. Austria, Belgium, Finland and Portugal. Last, we explore the heterogeneity in the results for various groups of countries, i.e. big five vs rest of the sample, core vs periphery.

The main findings are as follows. First, the persistence of consumption growth is around 0.7 on average across the five largest euro area countries. This is in line with recent literature for advanced economies, e.g. Carroll, Slacalek and Sommer (2011). Second, the marginal propensity to consume out of total wealth averaged across the Big 5 is around 3 cents per euro. Thus, only slightly below what reported in the literature for Anglo-Saxon countries. Third, the average marginal propensity to consume out of financial wealth is significantly larger than that of housing wealth. Nevertheless, our results document a significant degree of heterogeneity across countries: the effect of changes in households' asset values on consumption is large and significant in France, Italy and Spain, and either smaller or not significant in the Netherlands

[3] Slacalek (2009) investigates cross-country heterogeneity in housing and financial wealth effects using the methodology in Carroll, Otsuka and Slacalek (2011) and data for 16 industrialized countries since the early 1970's to the early 2000's. His measure of housing wealth is constructed by using house prices and dwelling stocks. Also Sousa (2009) follows the approach by Carroll, Otsuka and Slacalek (2011) and estimates the wealth effects on consumption, both at the aggregate and disaggregate level, for the euro area as a whole for the period 1980-2007.

and Germany.

Further, we also distinguish across broad classes of assets held by households and we can argue that on average changes in the value of equity have a significantly large effect on consumption in Italy and Spain, and a large but less significant effect in France. Currency and deposits has remarkable effect in Spain, while debt securities explain the (small) relevance of financial wealth for the Netherlands. In contrast, changes in the value of none of these categories of assets have a significant effect on consumption in Germany.

Last, we extend the analysis to a larger number of countries and group them in (i) Big 5 vs remaining countries (no Big 5), (ii) core vs periphery. Panel estimates highlight no large differences in terms of wealth effect on consumption in the Big 5 and in the rest of the countries. In contrast, the difference in the marginal propensity to consume out of additional wealth is marked between periphery and core countries: in particular, the marginal propensity to consume out of total wealth is about 5 cents in the former, while 2.5 cents in the latter. Even more sizable is the difference in terms of the marginal propensity to consume out of financial wealth: 14 cents in periphery countries and almost 5 cents in core economies.

The remainder of the paper is organized as follows. Section 2.2 illustrates a simple theory of persistence of consumption growth. Section 2.3 describes the methodology and the dataset, and Section 2.4 presents the estimation results. Section 2.5 concludes. The Appendix provides details on the data used in this paper.

2.2 The Sticky Expectations Model

In this section we introduce a simple model of persistence of consumption growth, which constitutes the basis of the approach we follow for the wealth effects estimation. As argued by Carroll, Otsuka and Slacalek (2011) ¡¡ if there is a reliable degree of stickiness in consumption growth, an estimation method that relies upon that stickiness to estimate wealth effects using high- and medium-frequency data is less likely to be led astray by a “regime change” than a full-sample estimation technique like cointegration estimation.¿¿

One of the most popular theoretical frameworks used to illustrate the presence of serial correlation in aggregate consumption growth is the "sticky information model" proposed by Carroll and Slacalek (2006).[4] The authors argue that consumption sluggishness may arise when households are mildly *inattentive* to macroeconomic developments and consequently do not fully and immediately update their information set in response to macro news.

Let's consider an economy where consumers maximize the discounted sum of time-separable utility streams[5]:

$$\max \mathbb{E} \sum_{t=s}^{\infty} \beta^{t-s} U(C_t) \tag{2.1}$$

subject to budget constraint:

$$B_{t+1} = (B_t - C_t)R + Y_{t+1} \tag{2.2}$$

where β is the discount factor, C is the consumption level, B is the beginning-of-period net assets, R is the constant interest factor, and Y is noncapital income. In its benchmark quadratic utility model, Hall (1978) shows that, based on the assumption that households take into account the full information released through aggregate macroeconomic news, the optimal consumption level in the frictionless expectations economy follows a random walk and the consumption growth is a white noise, $\Delta C_t = \varepsilon_t$.[6] Put differently, the household's consumption growth is not predictable.

On the contrary, Carroll and Slacalek (2006) assume that consumers update their information, and therefore their behavior, only occasionally. In other words, they simulate an economy consisting of a continuum of *inattentive* time-separable constant relative risk aversion (CRRA)-utility consumers, each of whom updates the information about his permanent income with probability Π in each period. Similarly to the Calvo (1983) model for firms' price setting, their model assumes that this probability is independent of both the date of last update and the level of income or wealth. The authors show that the change in the log of aggregate consumption, $\Delta \log C_t$, approximately follows an autoregressive AR(1) process,

[4] An alternative theory is represented by the "habit formation model" suggested by Muellbauer (1988) and Dynan (2000), in which the serial correlation coefficient reflects the strength of habits. The implications of this framework are the same as in Carroll and Slacalek (2006) when applied to aggregate data. Please refer to Carroll, Slacalek and Sommer (2011) for further discussion.

[5] Contrarily, the habit formation model is based on time-nonseparable utility.

[6] The same conclusion holds with CRRA-utility consumers and perfect foresight.

whose autocorrelation coefficient approximates the share of consumers $(1-\Pi)$ who do not have up-to-date information about macroeconomic developments:[7]

$$\Delta \log C_t = \mu + \underbrace{(1-\Pi)}_{\equiv \chi} \Delta \log C_{t-1} + \varepsilon_t \tag{2.3}$$

where $\Delta \log C_t$ represents the consumption growth, χ is a parameter that captures the persistence of consumption growth, μ is a constant and ε stands for the error term. This result is more consistent with the literature arguing that the random walk model is not suitable for representing the actual dynamics of aggregate consumption (see, *inter alia*, Flavin (1981), Campbell and Deaton (1989) and Campbell and Mankiw (1989)). Indeed, several empirical works have showed the so-called "excess sensitivity puzzle", i.e. that future consumption growth is likely to be significantly affected by past variables. For example, Sommer (2007) and Carroll, Slacalek and Sommer (2011) find that past consumption growth is the strongest predictor of current consumption growth for US and thirteen advanced economies, respectively.[8]

2.3 Methodology and Dataset

2.3.1 Methodology

In this section we present the econometric methodology recently proposed by Carroll, Otsuka and Slacalek (2011) for the estimation of wealth effects on consumption.[9] First, we need to identify the contribution of a change in wealth. To this purpose, we decompose the consumption

[7] The habit formation model leads to the same result, where $(1-\Pi) \equiv \chi$ should be interpreted as the strength of habits. Also the "rational inattention" model by Reis (2006) yields to a similar consumption dynamics.

[8] Sommer (2007) and Carroll, Slacalek and Sommer (2011) estimate a slight version of Equation 2.3, where they both include income growth to test for the rule-of-thumb behavior. In addition, the former also includes consumer sentiment, while the latter control for households' assets as proxy for precautionary savings and liquidity constraints. Both papers provide estimates from univariate regressions (one regressor at time) and with all regressors included. Overall, their results strongly suggest that past consumption growth is by far the strongest predictor of current consumption growth.

[9] The conventional estimation approach imposes cointegration between consumption, wealth and income. See the pioneer work by Lettau and Ludvigson (2004).

shock ε_t in Equation 2.3 between wealth shocks ∂W_t and a vector of control variables Z_t:

$$\varepsilon_t = \beta \partial W_t + \gamma^\top Z_t \tag{2.4}$$

where $\partial W_t = \frac{\Delta W_t}{C_{t-1}} = \frac{\Delta W_t}{W_{t-1}} \times \frac{W_{t-1}}{C_{t-1}}$ denotes the rescaled wealth growth, such that β can be interpreted as the "initial" (current quarter) marginal propensity to consume out of wealth, instead of a relationship between the growth rate of wealth and the growth rate of consumption. Equation 2.3 can be rewritten in terms of its moving average representation form:

$$\Delta \log C_t = \alpha + \sum_{i=1}^{\infty} \chi^i \varepsilon_{t-i} + \varepsilon_t \tag{2.5}$$

with $\alpha = \mu/(1-\chi)$. Substituting 2.4 into 2.5 gives:

$$\Delta \log C_t = \alpha + \beta \sum_{i=1}^{\infty} \chi^i \partial W_{t-i} + \gamma^\top \sum_{i=1}^{\infty} \chi^i Z_{t-i} + \varepsilon_t \tag{2.6}$$

or

$$\Delta \log C_t = \alpha + \beta \chi \bar{\partial} W_{t-1} + \tilde{\gamma}^\top \tilde{Z}_{t-1} + \varepsilon_t \tag{2.7}$$

where $\bar{\partial} W_{t-1} \equiv \sum_{i=1}^{\infty} \chi^{i-1} \partial W_{t-i}$, $\tilde{\gamma}^\top = (\gamma^\top \chi, \gamma^\top \chi^2, \dots)$ and $\tilde{Z}_{t-1}^\top = (Z_{t-1}^\top, Z_{t-2}^\top, \dots)$.
To estimate Equation 2.7 we approximate the infinite sum $\bar{\partial} W_{t-1}$ with a finite one, $\bar{\partial} W_{t-1} \approx (\Delta W_{t-1} + \chi \Delta W_{t-2} + \chi^2 \Delta W_{t-3} + \chi^3 \Delta W_{t-4})/C_{t-5}$. Consistently, we rescale consumption with the same initial consumption level C_{t-5}.[10] In other terms, we estimate the following equation:

$$\partial C_t = \alpha + \tilde{\beta} \bar{\partial} W_{t-1} + \tilde{\gamma}^\top \tilde{Z}_{t-1} + \varepsilon_t \tag{2.8}$$

where $\tilde{\beta} \equiv \beta \chi$ provides a direct estimate of the marginal propensity to consume in quarter t out of a change in wealth in quarter $t-1$, $\partial C_t \equiv \Delta C_t / C_{t-5}$ and $\bar{\partial} W_{t-1} = (\Delta W_{t-1} + \chi \Delta W_{t-2} + \chi^2 \Delta W_{t-3} + \chi^3 \Delta W_{t-4})/C_{t-5}$.[11]
We follow the definition as in Carroll, Otsuka and Slacalek (2011) and refer to $\tilde{\beta}$ as the "immediate" (next quarter) wealth effect. Indeed, wealth in our source (the ECB quarterly

[10] Given that $\bar{\partial} W_{t-1}$ is a weighted average of past values up to one year, the initial level corresponds to five quarters before current quarter.
[11] Although ∂C_t is not equal to consumption growth $\Delta C_t / C_{t-1} \approx \Delta \log C_t$, the two variables are almost perfectly correlated as C_t is $I(1)$ and therefore C_t and C_{t-1} are very similar.

sector account) is measured at a point in time (on the last day of the quarter), while consumption is measured continuously over the quarter. Therefore, the information on wealth is revealed to the consumer only late in the quarter.

Given the estimates of χ and $\tilde{\beta}$, we define the immediate (next quarter) and eventual (after some years) marginal propensity to consume out of wealth respectively as:

$$\text{MPC}_w^{\text{im}} = \tilde{\beta} \tag{2.9}$$

$$\text{MPC}_w^{\text{ev}} = \beta \sum_{i=0}^{\infty} \chi^i = \frac{\tilde{\beta}}{\chi(1-\chi)} \tag{2.10}$$

To sum up, the estimation procedure follows three steps: (i) estimate the degree of stickiness in consumption growth in Equation 2.3; (ii) estimate the immediate marginal propensity to consume in the current quarter out of a change in wealth in the previous quarter from Equation 2.8; (iii) given the immediate MPC out of wealth and the degree of stickiness in consumption growth, construct a measure of eventual effect on the level of consumption from a unit innovation to wealth.

2.3.2 Households Wealth Data

The analysis presented in this paper is based on the use of quarterly households wealth data over the period 1999Q1-2016Q3 from the latest vintage of the euro area Household Sector Report reports for nine euro area countries: Austria, Belgium, Finland, France, Germany, Italy, Netherlands, Portugal and Spain.[12] The newly available standardized households wealth data allow us to overcome the lack of systematic cross-country comparison in the literature of wealth effects in the euro area. In addition, the report provides comparable series for several types of financial and non-financial assets, which allows us to disentangle the marginal propensity to consume out of wealth in its main components.

[12]In December 2015 the ECB has published the new statistical report on the Household Sector in response to the increasing demand for detailed data on the household sector and its central role in the economy. Although it compares the entire household sector across the euro area, the report does not contain distributional information referring to individual households or groups of households. For more information, please refer to the official website: https://www.ecb.europa.eu/press/pr/date/2015/html/pr151110.en.html For the nine countries listed in the main text we could collect consistent and comparable series over time. The data are available from the Quarterly Financial and Non-Financial Sector Accounts - ESA 2010. For Austria, Italy and Netherlands, whose series start later than 1999Q1, we cover the earlier observations by backdating the series using the corresponding data following ESA 95 accounting framework.

Specifically, we consider both aggregate and disaggregate measures of household wealth. Net total wealth is defined as the sum of total financial assets and housing wealth net of total financial liabilities. Net financial wealth is defined as the difference between financial assets and liabilities (excluding mortgage loans) whereas net housing wealth is considered as net of mortgage loans. In addition, we also explore the relative importance of different types of financial assets. In fact, changes in financial wealth value reflect changes in a variety of asset prices. Therefore, we split net financial wealth in its major sub-components, namely: (i) currency and deposits; (ii) net debt securities; (iii) net equity.[13]

Figure 2.1 shows the evolution of total wealth and its two major components, financial and housing wealth, for each country in our sample for the period 1999Q1-2016Q3[14]: total wealth grows by about 2% a year on average across all countries, reflecting about 2.2% and 1.8% of housing and financial wealth growth, respectively. In particular, the annual housing growth is the highest in France (almost 5% on average) and the lowest in Portugal (around 0.3% on average); regarding the annual growth rate of financial wealth, Italy registers the lowest value (0.3% on average) while Finland the highest (3% on average).

Figure 2.2 plots the total personal consumption growth against wealth growth multiplied by the wealth-consumption ratio between 1999Q1 and 2016Q3.[15] We also report the slope of the regression line, which suggests that about 4 cents are consumed from an additional euro of wealth. Figure 2.3 display similar plots for the disaggregate wealth: the estimated MPC is about 8 and 6 cents for financial and housing wealth, respectively.

[13]Most of "currency and deposits" are deposits with banks, although in some countries the central government is also a deposit-taker (like in the case of the post office). In the latter case, these are also included. All sorts of deposits, irrespective of maturity, are included. "Debt securities" instead includes mainly government debt securities held directly by households, that is, not via investment funds, pension schemes or life insurance schemes. Direct holdings of bank and corporate debt securities are also includes. In addition, we also include holding of debt securities (mainly corporate debt securities) that take place via investment funds. The EA accounts distinguish between direct holding of debt securities and claims on pension schemes (excluding social security pensions) and life insurance. "Equity" comprises the sum of quoted and unquoted shares, money market fund shares and investment fund shares schemes.

[14]Unless explicitly stated, wealth data are defined in "net" terms.

[15]The growth rate of wealth is multiplied by the wealth-consumption ratio so that the slope of the regression line can be interpreted as the marginal propensity to consume out of wealth.

Table 2.1 (Panel A) documents that on average the shares of financial and housing wealth are similar. However, while housing is systematically larger than financial wealth for Austria, France, Italy, Portugal and Spain, the reverse holds for the remaining countries. The decomposition of financial wealth into assets categories also reveals interesting heterogeneity. See Panel B of Table 2.1. On average the three categories of assets considered in the analysis, i.e. currency and deposits, debt securities and equity represent a similar fraction of total financial wealth. However, households in periphery countries hold a larger share of currency and deposits and equity, whereas the share of debt securities is larger than the other two components in core countries.[16]

2.4 Estimation

In this section we discuss in detail the consumption sluggishness results and the wealth effects on consumption for the five largest euro area countries (Germany, France, Italy, Spain and Netherlands). We conclude the discussion with the panel estimation results obtained using the extended dataset that include also a number of other euro area economies (Austria, Belgium, Finland and Portugal) for which we were able to collect consistent and comparable wealth data from the Household Sector Report. All results refer to the time period 1999Q1-2016Q3.

2.4.1 Estimates of Consumption Growth Sluggishness

We first provide estimates of the degree of consumption growth stickiness for the five largest euro area countries. For the purpose of our analysis, we use total personal consumption expenditure, so that we can investigate whether and the extent to which a unit innovation of wealth has an effect on aggregate demand.[17]

To get an unbiased and consistent estimate of χ in Equation 2.8, we follow the standard

[16]Core Countries: Austria, Belgium, Germany, Finland, France, Netherlands. Non-Core Countries: Italy, Spain, Portugal.

[17]Results are robust to a measure of non-durables consumption, constructed as difference between total consumption and durables. However, total consumption expenditure is our preferred measure for two main reasons: (i) it can be considered the variable of interest for investigating the link between consumption and wealth, as pointed out by Mehra (2001); (ii) it is not possible to construct a measure of non-durables consumption for all countries in the extended dataset used for the panel estimations.

approach based on IV regression. In fact, there are at least three reasons to expect OLS estimate to be inconsistent and biased towards zero[18]: (i) quarterly consumption data may contained substantial measurement error (Wilcox (1992), Bureau of Economic Analysis (2006) and Sommer (2007)); (ii) existence of large transitory fluctuations in consumption not included in the theory (e.g. related to unusual weather); (iii) time aggregation bias.[19]

In order to address these three estimations issues in quarterly consumption data, we follow the econometric method developed by Sommer (2007), which consists of estimating Equation 2.3 with instrumental variables dated $t-2$. This approach only requires that the instruments are correlated with next-period consumption growth and uncorrelated with measurement error. Our baseline instrument set for the IV regressions consists of variables that are strongly correlated with consumption growth: the growth rate of total wealth and of disposable income, the growth rate of stock prices, the change in unemployment rate, and interest rate spreads.[20] Consumption, income and wealth were deflated with consumption deflators and express in per capita terms.

Table 2.2 shows the baseline estimation results. The average χ in the five largest EA countries is 0.72 with an average standard deviation of 0.28, implying that the persistence of consumption growth is statistically significantly different from zero. Panel C and D display the p-value testing $\chi = 0$ with the Moreira (2003) conditional likelihood ratio statistic (CLR) for weak instruments[21] and the adjusted $\bar{R}^2$ from the first-stage regressions. The null hypothesis is clearly rejected for all countries, except Germany for which the p-value is close to 0.1 and the $\bar{R}^2$ is quite small. Our estimates are in line with the findings of Carroll, Slacalek and Sommer (2011), which provide international evidence for the stickiness in aggregate consumption

[18] Please refer to Carroll, Slacalek and Sommer (2011) for a deeper discussion of the relevance of these issues on US data.

[19] As shown by Muellbauer (1988) and Sommer (2007), in a simple habit formation or sticky information model, time aggregation causes a moving average MA(2) process in consumption growth, but the MA(2) coefficient is generally negligible.

[20] We use the same set of instruments as in Carroll, Otsuka and Slacalek (2011) for US. The growth rates of wealth and disposable income are defined consistently with the consumption growth as $\frac{\Delta W_t}{C_{t-1}}$ and $\frac{\Delta Y_t}{C_{t-1}}$, respectively. The interest rate spread is defined as difference between the interest rate for house purchases and a measure of risk-free rate. Please see the Appendix B.1 for a detailed description. The series are seasonally adjusted using the X-12 method when necessary.

[21] See Andrews, Moreira and Stock (2006) for a proof of powerful CLR test.

growth for thirteen advanced economies. Using both instrumental variables and Kalman Filter structural estimations, they document that the estimates of χ for the five largest EA economies are 0.66 and 0.918 on average, respectively. Carroll, Otsuka and Slacalek (2011) estimate the degree of consumption sluggishness in US to be around 0.73 using the same set of instrumental variables[22], whereas Sousa (2009) finds a similar value, 0.7969, for the euro area as a whole. Finally, our results support the conclusion of the sticky expectations model presented in the previous section and provide a strong rejection of the random walk theory, according to which the persistence of consumption growth is null.

2.4.2 Country-Specific Wealth Effects

We estimate Equation 2.8 separately for Germany, France, Italy, Spain and the Netherlands using ordinary least squares with Newey-West correction of standard errors. The results are robust to a change in the maximum number of lags, here fixed to be 4. We consider two definitions for wealth, W: aggregate net wealth, net financial wealth and net housing wealth. In addition, we also estimate the wealth effects of changes in the main sub-components of financial wealth. See section 2.3.2 for the definition of the various wealth concepts.

The set of control variables in the estimation, Z, consists of: the growth rate of disposable income, unemployment rate, interest rate spread, change in the short-term interest rate and consumer sentiment. By including these variable, we filter out some endogeneity which naturally arises when estimating the relationship between wealth and consumption.

Table 2.3 display two sets of estimates of immediate and eventual marginal propensity to consume out of *aggregate* wealth (first and second columns): in the top panel we use for each country the degree of consumption sluggishness reported in Table 2.2, whereas in the bottom panel we restrict the degree of consumption sluggishness to be equal to the average consumption persistence $\chi = 0.72$ for all countries. In both cases, the cross-country averages of immediate and eventual MPC out of total wealth lie in the neighborhood of 0.6 and 3 cents

[22]Using another set of instruments (i.e. wealth growth, nominal federal funds rate and Michigan University unemployment expectations) the authors find a similar value too.

per euro, respectively. These results are somewhat lower than what obtained by Carroll, Otsuka and Slacalek (2011) for the US, where they estimated 0.9 and 4.8 cents per dollar, respectively. The MPCs are large and significant in Spain and Italy, about average in France, more modest but still significant in the Netherlands. In contrast, we find no wealth effect on consumption for Germany. Slacalek (2009) obtains similar results for Spain and the Netherlands, whereas Hamburg, Hoffmann and Keller (2008) study the link between consumption and wealth in Germany during 1980-2003 and find that permanent shocks to income rather than wealth seem to be the predominant driving force behind German private consumption.

Next, we investigate the MPC out of financial and housing wealth separately (columns 3-4 e 5-6 of Table 2.3, respectively). The cross-country averages of MPC out of financial wealth are around 0.8 and 5 cents per euro in the short- and medium-run, respectively. Regarding housing wealth, the MPC is on average almost 0.5 cents in the immediate and stands between 2-3 cents in the medium-term. Contrary to the results reported by Carroll, Otsuka and Slacalek (2011) for US, in the largest EA economies the average MPC out of financial wealth is on average larger than the MPC out of housing wealth. However, cross-country comparison shows significant heterogeneity: (i) both financial and housing wealth effects are highest in Spain with financial wealth effects larger than housing; (ii) Italy displays sizable financial wealth effects and not significant housing wealth effects; [23] (iii) the Netherlands displays a larger but not significant housing wealth effect, while a small but significant MPC out of financial wealth; (iv) in France the two effects are quite similar although the marginal propensity to consume out of financial assets tends to be higher compared with the effect of housing assets;[24] (v) Germany reports non-significant effects of changes in either types of wealth on consumption. The results are similar for the restricted and unrestricted degree of consumption sluggishness, and qualitatively consistent with Slacalek (2009).

Finally, Table 2.4 reports the results for disaggregate financial wealth. In the estimation

[23] Paiella (2007) using the Bank of Italy's Survey of Household Income and Wealth over the period 1991-2002 also finds that the marginal propensity to consume out of financial wealth is considerably larger than housing wealth in Italy.

[24] Arrondel, Lamarche and Savignac (2015) use the French Wealth Survey1 (INSEE) combined with the Household Budget Survey (INSEE-EUROSTAT) and find that the estimated marginal propensity to consume out of financial wealth is slightly lower than for other assets.

we also control for housing wealth. The estimates show a high degree of heterogeneity among countries.[25] Changes in the value of equity seems to have a large and significant effect on consumption in Spain. The effect is also remarkable in France and Italy. In the Netherlands the effect of debt securities results to be positive and significant, thus, explaining the estimated relevance of financial wealth. Currency and deposits have a large effect in Spain. The results on housing wealth effects remain robust in Spain and France. Also in this case, the results are robust to the alternative specifications of the degree of consumption sluggishness.

2.4.3 Group-Specific Wealth Effects

Now, we extend our analysis to include four more countries and group them in the following way: (i) All Countries; (ii) Big 5 (Germany, France, Italy, Spain, Netherlands) and Small Countries (Austria, Belgium, Finland, Portugal); (iii) Core (Austria, Belgium, Finland, France, Germany, Netherlands) and Periphery (Italy, Portugal, Spain).

We estimate the MPC out of aggregate and dissagregate wealth by seemingly unrelated regressions (SUR). This allow us to increase the efficiency in case of correlation among errors from individual regressions and to impose cross-equations restrictions. Specifically, we estimate the following equations:

$$\partial C_{t,i} = \alpha_i + \tilde{\beta}_i \bar{\partial} W_{t-1,i} + \tilde{\gamma}_i^{\top} \tilde{Z}_{t-1,i} + \varepsilon_{t,i} \qquad i = 1, \ldots, 9 \tag{2.11}$$

where i denotes the country. The estimates of the two key drivers of consumption, wealth and income, were restricted to be the same across countries of the same group.

Table 2.5 shows the eventual wealth effects for the three groups. The MPCs out of total wealth, financial and housing for all countries are very similar to the ones we get for the largest euro area countries, both quantitatively and qualitatively. The smaller countries are characterized by a null housing wealth effect and a large and significant MPCs out of debt securities. The MPCs out of total wealth is somewhat larger for the "Big 5" whereas the MPCs

[25] At euro area level, Sousa (2009) also finds that the financial wealth effect is larger than the housing wealth effect. In addition, he also reports that changes in the value of currency and deposits, and equities have a larger effect on consumption than the other financial assets.

out of financial wealth is larger for the rest of the sample. Our results document remarkable differences between periphery and core countries. The former display MPCs out of total wealth that is about 2 times larger than what reported for the latter. The difference is remarkable in terms of the MPCs out of financial wealth which is about 4 time larger. Among all financial assets components, the wealth effect of changes in the value of equity result to be about 3 times larger in the periphery economies. In contrast, no significant differences are reported in terms of housing wealth effect, which remains around 3 cent per euro across different groups of countries.

2.4.4 Robustness Checks

In this section we perform two robustness analysis.[26] First, we re-estimate the wealth effects based on an alternative estimate of consumption growth sluggishness for the five largest euro area countries. We consider a different set of instrumental variables for Equation 2.3, namely consumption growth, disposable income growth, unemployment rate, differenced short-term interest rate, interest rate spread. Table 2.6 reports the results. The average degree of consumption growth persistence is 0.59, with a standard deviation equal to 0.24. Slacalek (2009) obtains a similar value, 0.49, averaged across Germany, France, Italy, Spain and the Netherlands, by using the same set of instrumental variables. As the values of χ remain similar among countries, the wealth effects are robust both at aggregate and disaggregate level, as shown in Table 2.7.

Second, we repeat the whole analysis for a sub-sample period 1999Q1-2010Q1, which ends before the sovereign debt crisis took place. Interestingly, the results are robust to a change in the sample period. Indeed, the estimation of both the consumption growth sluggishness (Table 2.9) and wealth effects (Tables 2.10, 2.11 2.12) are qualitatively and quantitatively similar. This suggests that the crisis has not affected the dynamics of consumption growth and the impact of wealth changes in the short- and medium-run.

[26] In the Appendix B.2 we also report additional results of cointegration tests. Given that the evidence on the existence of a stable cointegration among consumption, wealth and income is mixed, we estimate the wealth effects on consumption in log-levels and growth rates (B.3).

2.5 Conclusion

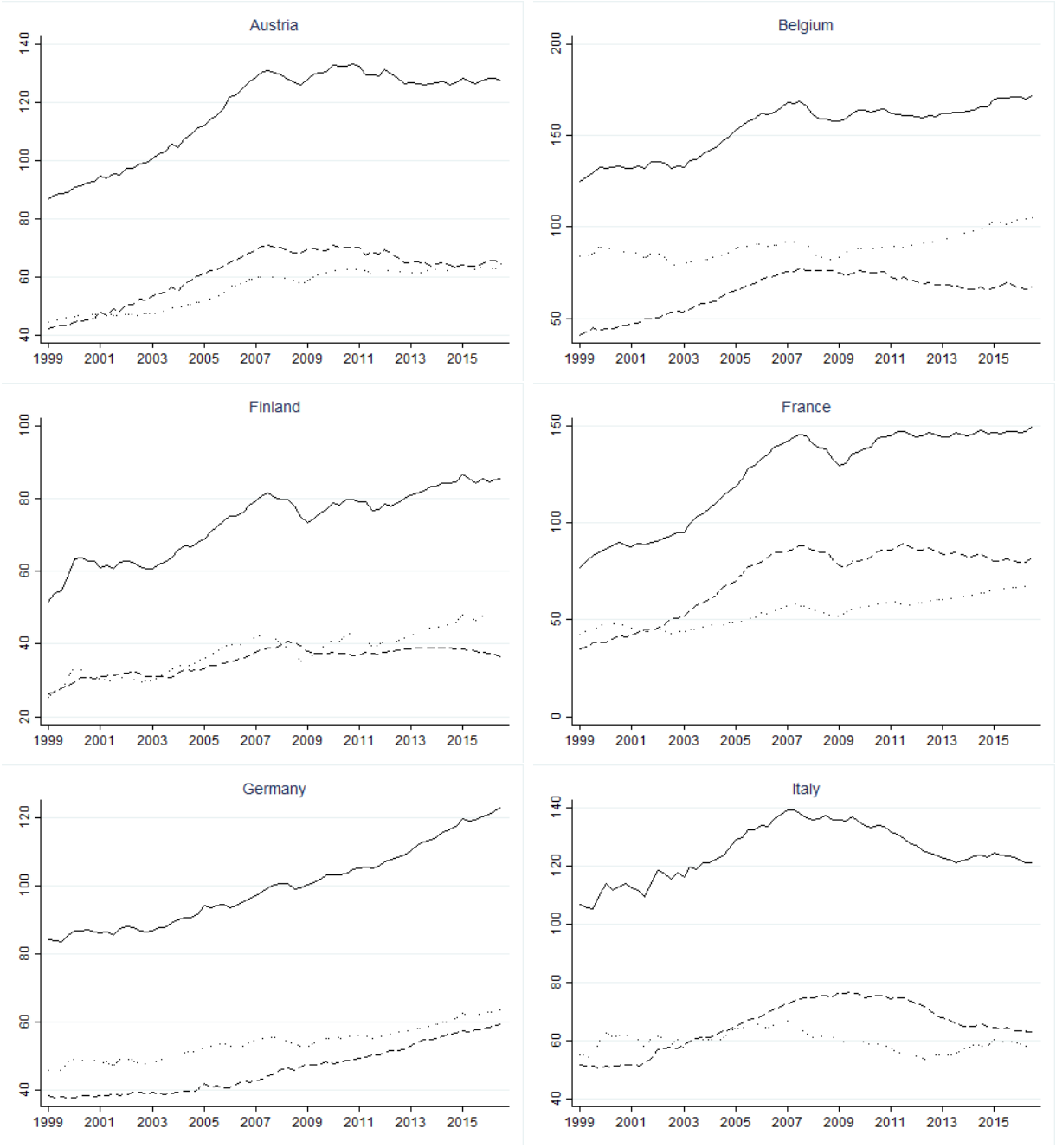
This paper provides new insights into the consumption wealth effect in the euro area. We use the methodology proposed by Carroll, Otsuka and Slacalek (2011) and newly harmonized aggregated and disaggregated wealth data across euro area countries.

Our results indicate that:

- the marginal propensity to consume out of total wealth averaged across the largest euro area economies is significant but somewhat lower than what reported in the literature for Anglo-Saxon countries;
- financial wealth effects are significantly larger than housing wealth effects;
- heterogeneity points towards large and significant effects in France, Italy and Spain, and either smaller or not significant in the Netherlands and Germany;

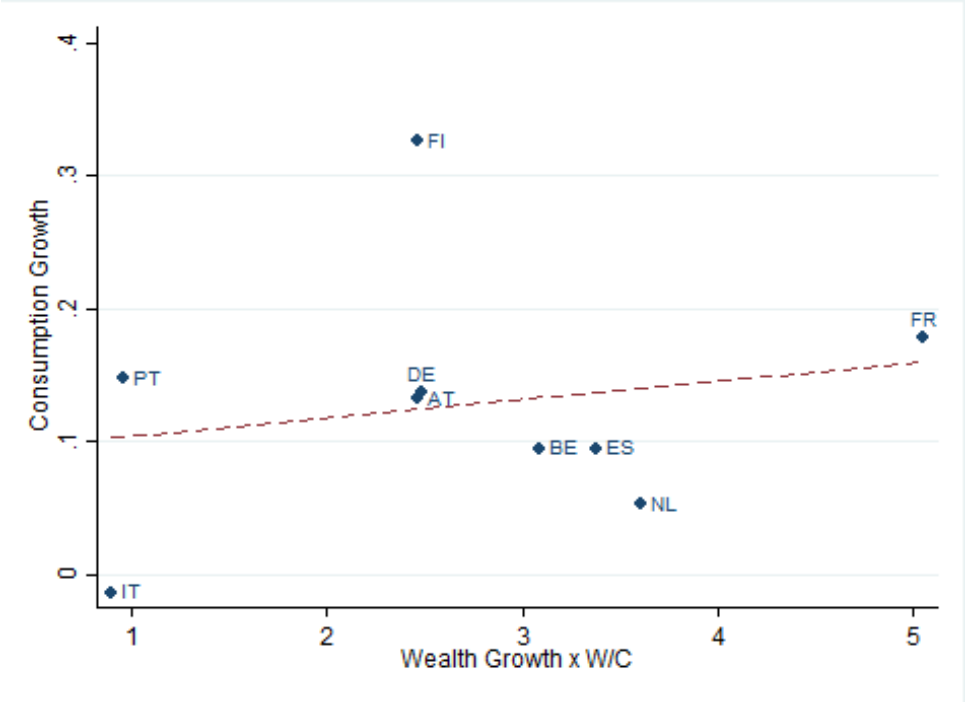
In addition, we also find that the high degree of heterogeneity across countries is also reflected in the marginal propensity to consume out of the sub-components of financial wealth: the wealth effect of equity is large and significant in Spain and also relevant for Italy and France, whereas debt securities have significant effects in the Netherlands. To the best of our knowledge we are the first to explore the wealth effect at such a disaggregated level for euro area countries. Adding more countries to the analysis also convey interesting results and remarkable differences across core and periphery countries. Our results are robust to alternative measures of consumption growth sluggishness and to different samples.

Figure 2.1: Financial and Housing Wealth



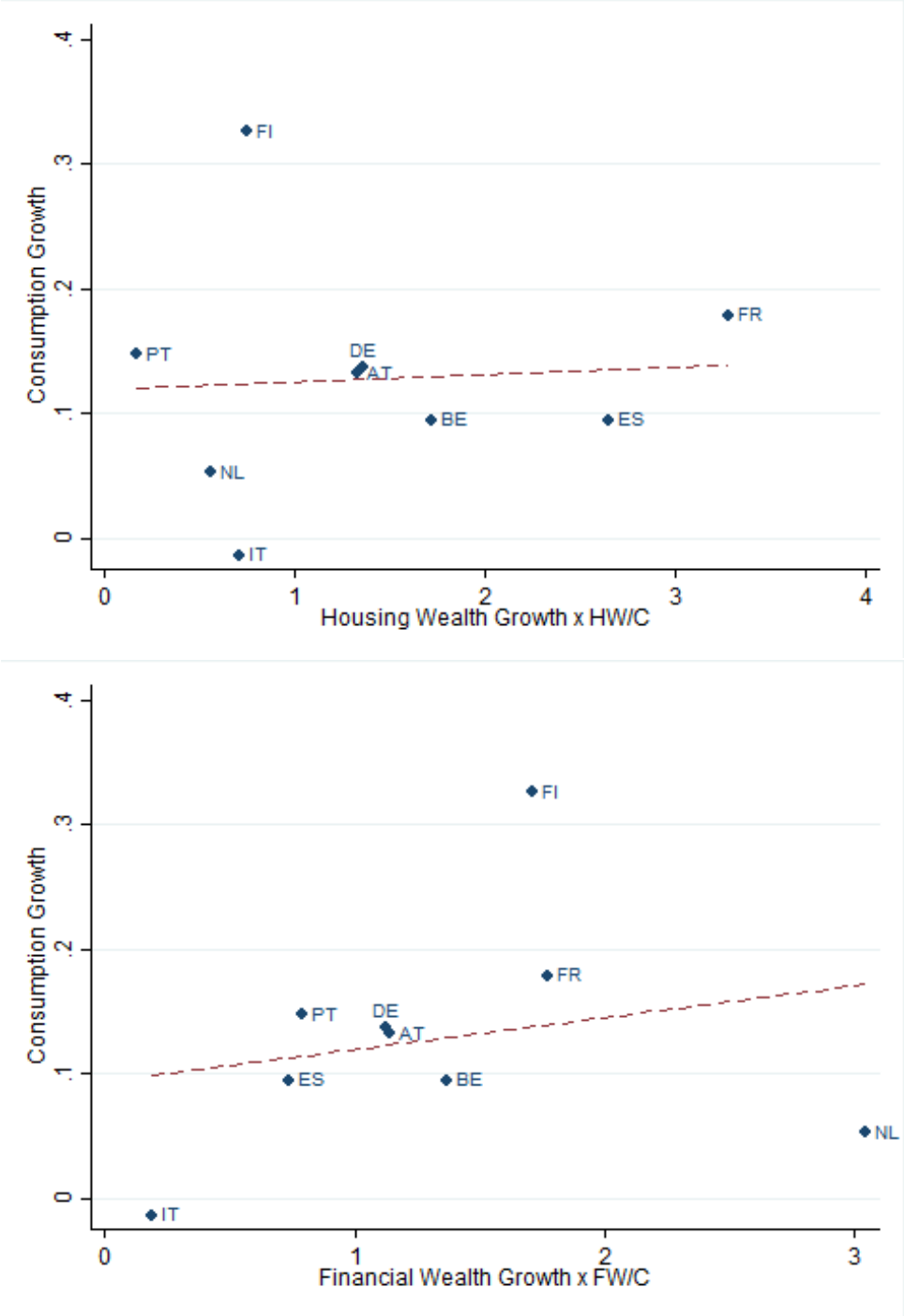
Notes: The graphs report the total wealth (solid line) and its two components, the net housing wealth (dashed line) and the net financial wealth (dotted line). Quarterly observations, 1999Q1 - 2016Q3. The series are in per capita real terms.

Figure 2.2: Consumption Growth and Wealth Growth 1999-2016



Notes: The graph reports consumption growth and rescaled wealth growth between 1999Q1 and 2016Q3; wealth growth is rescaled by multiplying with the wealth-consumption ratio of 1999Q1. Slope of the regression line: MPC_w^{ev}=.041565 (p-value: 0.006).

Figure 2.3: Consumption Growth and Housing/Financial Wealth Growth 1999-2016



Notes: The top (bottom) graph reports consumption growth and rescaled housing (financial) wealth growth between 1999Q1 and 2016Q3; housing (financial) wealth growth is rescaled by multiplying with the housing (financial) wealth-consumption ratio of 1999Q1. Slope of the regression line: MPC^{ev}_{hw}=.0641967 (p-value: 0.025); MPC^{ev}_{fw}=.0787343 (p-value: 0.008)

Table 2.1: Wealth Composition

	(A) Assets shares of Wealth		(B) Assets shares of Financial Wealth			
Country	Financial	Housing	Curr.&Dep.	Debt Sec.	Equity	Other
Austria	47.93	52.07	44.15	28.12	26.14	1.59
Belgium	58.43	41.57	28.27	32.75	38.49	0.49
Finland	51.72	48.28	34.26	21.06	45.23	-0.55
France	43.88	56.12	31.96	37.91	31.02	-0.89
Germany	54.20	45.80	37.71	39.46	22.10	0.72
Italy	47.92	52.08	29.16	35.70	36.97	-1.84
Netherlands	68.29	31.71	21.16	61.74	17.12	-0.02
Portugal	43.23	56.77	46.79	25.96	29.24	-2.00
Spain	30.30	69.70	43.13	18.44	38.99	-0.56
	(A) Assets shares of Wealth		(B) Assets shares of Financial Wealth			
Group	Financial	Housing	Curr.&Dep.	Debt Sec.	Equity	Other
Big5	48.92	51.08	32.62	38.65	29.24	-0.52
NoBig5	50.32	49.68	38.37	26.98	34.77	-0.12
Core	54.07	45.93	32.92	36.84	30.01	0.22
Periphery	40.48	59.52	39.69	26.70	35.07	-1.47
All	49.54	50.46	35.18	33.46	31.70	-0.34

Notes: Shares in percentage as average over the period 1999Q1-2016Q3.
All counties: AT, BE, FI, FR, DE, IT, NL, PT, ES.
Big 5: DE, FR, IT, NL, ES.
Core: AT, BE, DE, FI, FR, NL.

Table 2.2: Consumption Sluggishness

$$\Delta \log C_t = \mu + \chi \Delta \log C_{t-1} + \varepsilon_t$$

Country	(A) χ	(B) se_χ	(C) $\text{H}_0 : \chi = 0$	(D) $\bar{R}_1^2$
Germany	0.70	0.54	0.073	0.02
France	0.81	0.34	0.004	0.12
Italy	0.68	0.14	0.001	0.34
Spain	0.88	0.13	0.000	0.56
Netherlands	0.53	0.26	0.019	0.18
Mean	0.72	0.28	-	-

Notes: Quarterly observations, 1999Q1 - 2016Q3. Instruments: Lag $t-2$ of net wealth growth, growth rate of stock prices, change in unemployment rate, growth rate of disposable income, interest rate spread. Regressions estimated with instrumental variables. Robust p val denotes the p value testing $\chi = 0$ with Moreira's CLR test (robust to weak instruments). $\bar{R}_1^2$ is the adjusted R^2 from the first-stage regressions of ΔC_t on instruments.

Table 2.3: Immediate and Eventual Effects of Wealth on Consumption

$$\partial C_t = \alpha + \tilde{\beta}\bar{\partial}W_{t-1}(\tilde{\beta_{fw}}\bar{\partial}FW_{t-1} + \tilde{\beta_{hw}}\bar{\partial}HW_{t-1}) + \tilde{\gamma}^{\top}\tilde{Z}_{t-1} + \varepsilon_t$$

	χ Unrestricted					
	Wealth		Financial		Housing	
Country	$\text{MPC}_{w}^{\text{im}}$	$\text{MPC}_{w}^{\text{ev}}$	$\text{MPC}_{fw}^{\text{im}}$	$\text{MPC}_{fw}^{\text{ev}}$	$\text{MPC}_{hw}^{\text{im}}$	$\text{MPC}_{hw}^{\text{ev}}$
Germany	-0.80	-3.80	-0.77	-3.65	-0.90	-4.29
France	0.54^{**}	3.51^{**}	0.84^{*}	5.40^{*}	0.48^{**}	3.11^{**}
Italy	1.47^{***}	6.74^{***}	1.67^{***}	7.62^{***}	1.01	4.61
Spain	1.00^{***}	9.35^{***}	1.70^{***}	15.80^{***}	0.76^{***}	7.08^{***}
Netherlands	0.49^{**}	1.95^{**}	0.45^{*}	1.79^{*}	1.00	4.03
Mean	0.54	3.55	0.78	5.39	0.47	2.91
	$\chi = 0.72$					
	Wealth		Financial		Housing	
Country	$\text{MPC}_{w}^{\text{im}}$	$\text{MPC}_{w}^{\text{ev}}$	$\text{MPC}_{fw}^{\text{im}}$	$\text{MPC}_{fw}^{\text{ev}}$	$\text{MPC}_{hw}^{\text{im}}$	$\text{MPC}_{hw}^{\text{ev}}$
Germany	-0.78	-3.88	-0.73	-3.62	-0.95	-4.72
France	0.65^{**}	3.20^{**}	0.99^{*}	4.91^{*}	0.57^{**}	2.83^{**}
Italy	1.46^{***}	7.22^{***}	1.68^{***}	8.34^{***}	0.92	4.58
Spain	1.25^{***}	6.19^{***}	2.17^{***}	10.75^{***}	0.93^{***}	4.60^{***}
Netherlands	0.41^{**}	2.04^{**}	0.38^{*}	1.90^{*}	0.72	3.57
Mean	0.60	2.95	0.90	4.46	0.44	2.17

Notes: Quarterly observations, 1999Q1 - 2016Q3. Control Variables: income growth, unemployment rate, sentiment, differenced short-term interest rate and interest rate spread. Marginal propensities to consume in cents per euro of additional wealth. $\{^{*}, ^{**}, ^{***}\}$ = Statistical significance at $\{10, 5, 1\}$ percent.

Table 2.4: Immediate and Eventual Effects of Financial Assets

$$\partial C_t = \alpha + \tilde{\beta_{cd}}\bar{\partial} CD_{t-1} + \tilde{\beta_{ds}}\bar{\partial} DS_{t-1} + \tilde{\beta_{eq}}\bar{\partial} EQD_{t-1} + \tilde{\beta_{hw}}\bar{\partial} HW_{t-1} + \tilde{\gamma}^{\top}\tilde{Z}_{t-1} + \varepsilon_t$$

	χ Unrestricted							
	Currency and Deposits		Debt Securities		Equity		Housing	
Country	MPC^{im}_{curdep}	MPC^{ev}_{curdep}	MPC^{im}_{debsec}	MPC^{ev}_{debsec}	MPC^{im}_{invequ}	MPC^{ev}_{invequ}	MPC^{im}_{hw}	MPC^{ev}_{hw}
Germany	2.81	13.33	-8.29^{***}	-39.37^{***}	0.73	3.46	-0.53	-2.52
France	-2.25	-14.46	0.68	4.39	1.27^{*}	8.16^{*}	0.48^{**}	3.12^{**}
Italy	0.79	3.63	-2.89^{*}	-13.22^{*}	1.94^{***}	8.85^{***}	1.17	5.37
Spain	6.20^{**}	57.68^{**}	1.14	10.56	1.46^{***}	13.61^{***}	0.82^{***}	7.62^{***}
Netherlands	0.09	0.37	0.71^{*}	2.87^{*}	-0.58	-2.32	0.54	2.17
Mean	1.53	12.11	-1.73	-6.95	0.96	6.35	0.50	3.15

	$\chi = 0.72$							
	Currency and Deposits		Debt Securities		Equity		Housing	
Country	MPC^{im}_{curdep}	MPC^{ev}_{curdep}	MPC^{im}_{debsec}	MPC^{ev}_{debsec}	MPC^{im}_{invequ}	MPC^{ev}_{invequ}	MPC^{im}_{hw}	MPC^{ev}_{hw}
Germany	2.65	13.14	-8.06^{***}	-39.96^{***}	0.72	3.58	-0.59	-2.94
France	-1.71	-8.50	0.86	4.26	1.42^{*}	7.02^{*}	0.58^{*}	2.87^{*}
Italy	1.43	7.11	-2.81^{**}	-13.93^{**}	1.91^{***}	9.46^{***}	1.13	5.60
Spain	6.85	33.96	1.99	9.87	1.97^{***}	9.76^{***}	0.94^{***}	4.67^{***}
Netherlands	-1.46	-7.25	0.68^{*}	3.40^{*}	-0.44	-2.19	0.32	1.58
Mean	1.55	7.69	-1.47	-7.27	1.11	5.53	0.47	2.36

Notes: Quarterly observations, 1999Q1 - 2016Q3. Control Variables: income growth, unemployment rate, sentiment, differenced short-term interest rate and interest rate spread. Marginal propensities to consume in cents per euro of additional wealth. $\{^{*},^{**},^{***}\}$ = Statistical significance at $\{10,5,1\}$ percent.

Table 2.5: Wealth Effects - Panel SUR Estimation

	χ	Wealth	Financial	Housing	Curr.&Dep.	Debt Sec.	Equity	Housing
All Countries	0.61	3.48^{***}	4.49^{***}	2.95^{***}	-6.27	2.05^{*}	7.37^{***}	2.96^{***}
Big 5	0.72	3.72^{***}	4.46^{***}	3.34^{***}	-7.45	1.29	8.67^{***}	3.33^{***}
No Big 5	0.48	2.47^{**}	5.84^{***}	0.01	-2.19	15.63^{***}	5.85^{***}	0.30
Core	0.54	2.54^{***}	3.14^{***}	2.31^{***}	-4.22	2.31^{*}	4.78^{***}	2.21^{**}
Periphery	0.77	4.89^{***}	13.80^{***}	3.00^{***}	-1.44	9.48	14.82^{***}	3.40^{***}

Notes: Quarterly observations, 1999Q1 - 2016Q3. Eventual marginal propensities to consume in cents per euro of additional wealth. SUR Estimates, $\{^{*},^{**},^{***}\}$ = Statistical significance at $\{10,5,1\}$ percent.
All counties: AT, BE, FI, FR, DE, IT, NL, PT, ES.
Big 5: DE, FR, IT, NL, ES.
Core: AT, BE, DE, FI, FR, NL.

Table 2.6: RA1 Consumption Sluggishness

$$\Delta \log C_t = \mu + \chi \Delta \log C_{t-1} + \varepsilon_t$$

Country	χ	se_χ	$\text{H}_0 : \chi = 0$	$\bar{R}_1^2$
Germany	0.48	0.40	0.071	0.07
France	0.57	0.26	0.003	0.20
Italy	0.81	0.13	0.000	0.50
Spain	0.82	0.16	0.000	0.36
Netherlands	0.25	0.26	0.431	0.14
Mean	0.59	0.24	-	-

Notes: Quarterly observations, 1999Q1 - 2016Q3. Instruments: Lag $t-2$ of consumption growth, disposable income growth, unemployment rate, differenced short-term interest rate, interest rate spread. Regressions estimated with instrumental variables. Robust p val denotes the p value testing $\chi = 0$ with Moreira's CLR test (robust to weak instruments). $\bar{R}_1^2$ is the adjusted R^2 from the first-stage regressions of ΔC_t on instruments.

Table 2.7: RA1 Immediate and Eventual Effects of Wealth on Consumption

$$\partial C_t = \alpha + \tilde{\beta}\bar{\partial}W_{t-1}(\tilde{\beta_{fw}}\bar{\partial}FW_{t-1} + \tilde{\beta_{hw}}\bar{\partial}HW_{t-1}) + \tilde{\gamma}^{\top}\tilde{Z}_{t-1} + \varepsilon_t$$

	χ Unrestricted					
	Wealth		Financial		Housing	
Country	$\text{MPC}_{w}^{\text{im}}$	$\text{MPC}_{w}^{\text{ev}}$	$\text{MPC}_{fw}^{\text{im}}$	$\text{MPC}_{fw}^{\text{ev}}$	$\text{MPC}_{hw}^{\text{im}}$	$\text{MPC}_{hw}^{\text{ev}}$
Germany	-0.83	-3.32	-1.10	-4.41	-0.04	-0.16
France	0.80^{**}	3.27^{**}	1.22^{**}	4.97^{**}	0.71^{*}	2.89^{*}
Italy	1.38^{***}	8.96^{***}	1.65^{***}	10.68^{***}	0.78	5.05
Spain	1.09^{***}	7.41^{***}	1.86^{***}	12.64^{***}	0.82^{***}	5.57^{***}
Netherlands	0.49^{**}	2.57^{**}	0.42^{*}	2.22^{*}	1.63	8.66
Mean	0.59	3.78	0.81	5.22	0.78	4.40
	$\chi = 0.59$					
	Wealth		Financial		Housing	
Country	$\text{MPC}_{w}^{\text{im}}$	$\text{MPC}_{w}^{\text{ev}}$	$\text{MPC}_{fw}^{\text{im}}$	$\text{MPC}_{fw}^{\text{ev}}$	$\text{MPC}_{hw}^{\text{im}}$	$\text{MPC}_{hw}^{\text{ev}}$
Germany	-0.85	-3.50	-0.94	-3.90	-0.54	-2.25
France	0.78^{**}	3.24^{**}	1.19^{**}	4.93^{**}	0.69^{*}	2.86^{*}
Italy	1.48^{**}	6.12^{**}	1.59^{**}	6.59^{**}	1.19	4.93
Spain	1.43^{***}	5.92^{***}	2.56^{***}	10.58^{***}	1.05^{***}	4.34^{***}
Netherlands	0.47^{**}	1.94^{**}	0.43^{*}	1.79^{*}	0.91	3.74
Mean	0.66	2.75	0.97	4.00	0.66	2.72

Notes: Quarterly observations, 1999Q1 - 2016Q3. Control Variables: income growth, unemployment rate, sentiment, differenced short-term interest rate and interest rate spread. Marginal propensities to consume in cents per euro of additional wealth. $\{^{*}, ^{**}, ^{***}\}$ = Statistical significance at $\{10, 5, 1\}$ percent.

Table 2.8: RA1 Immediate and Eventual Effects of Financial Assets

$$\partial C_t = \alpha + \tilde{\beta_{cd}}\bar{\partial} CD_{t-1} + \tilde{\beta_{ds}}\bar{\partial} DS_{t-1} + \tilde{\beta_{eq}}\bar{\partial} EQD_{t-1} + \tilde{\beta_{hw}}\bar{\partial} HW_{t-1} + \tilde{\gamma}^{\top}\tilde{Z}_{t-1} + \varepsilon_t$$

	χ Unrestricted							
	Currency and Deposits		Debt Securities		Equity		Housing	
Country	MPC^{im}_{curdep}	MPC^{ev}_{curdep}	MPC^{im}_{debsec}	MPC^{ev}_{debsec}	MPC^{im}_{invequ}	MPC^{ev}_{invequ}	MPC^{im}_{hw}	MPC^{ev}_{hw}
Germany	4.24	16.97	-9.37^{**}	-37.57^{**}	0.63	2.53	0.43	1.73
France	-0.59	-2.42	1.04	4.26	1.65^{**}	6.76^{**}	0.72^{*}	2.96^{*}
Italy	2.74	17.79	-2.56^{**}	-16.61^{**}	1.78^{***}	11.55^{***}	1.01	6.55
Spain	6.50^{*}	44.04^{*}	1.48	10.01	1.63^{***}	11.08^{***}	0.87^{***}	5.88^{***}
Netherlands	1.23	6.52	0.60^{*}	3.16^{*}	-0.53	-2.81	1.21	6.43
Mean	2.82	16.58	-1.76	-7.35	1.03	5.82	0.85	4.71
	$\chi = 0.59$							
	Currency and Deposits		Debt Securities		Equity		Housing	
Country	MPC^{im}_{curdep}	MPC^{ev}_{curdep}	MPC^{im}_{debsec}	MPC^{ev}_{debsec}	MPC^{im}_{invequ}	MPC^{ev}_{invequ}	MPC^{im}_{hw}	MPC^{ev}_{hw}
Germany	3.57	14.76	-9.13^{**}	-37.75^{**}	0.72	2.99	-0.11	-0.45
France	-0.73	-3.03	1.04	4.28	1.63^{**}	6.72^{**}	0.71^{*}	2.93^{*}
Italy	-0.30	-1.26	-2.98^{*}	-12.34^{*}	1.94^{***}	8.01^{***}	1.24	5.12
Spain	6.92	28.60	2.48	10.26	2.43^{***}	10.04^{***}	1.03^{***}	4.24^{***}
Netherlands	-0.30	-1.22	0.72^{*}	2.96^{*}	-0.55	-2.29	0.45	1.88
Mean	1.83	7.57	-1.58	-6.52	1.23	5.09	0.66	2.74

Notes: Quarterly observations, 1999Q1 - 2016Q3. Control Variables: income growth, unemployment rate, sentiment, differenced short-term interest rate and interest rate spread. Marginal propensities to consume in cents per euro of additional wealth. $\{^{*},^{**},^{***}\}$ = Statistical significance at $\{10,5,1\}$ percent.

Table 2.9: RA2 Consumption Sluggishness

$$\Delta \log C_t = \mu + \chi \Delta \log C_{t-1} + \varepsilon_t$$

			Robust p val	
Country	χ	se_χ	$\text{H}_0 : \chi = 0$	$\bar{R}_1^2$
Germany	0.67	0.53	0.117	0.04
France	0.72	0.24	0.001	0.29
Italy	0.89	0.22	0.000	0.33
Spain	0.82	0.18	0.000	0.50
Netherlands	0.42	0.26	0.081	0.29
Mean	0.70	0.29	-	-

Notes: Quarterly observations, 1999Q1 - 2010Q1. Instruments: Lag $t-2$ of net wealth growth, growth rate of stock prices, change in unemployment rate, growth rate of disposable income, interest rate spread. Regressions estimated with instrumental variables. Robust p val denotes the p value testing $\chi = 0$ with Moreira's CLR test (robust to weak instruments). $\bar{R}_1^2$ is the adjusted R^2 from the first-stage regressions of ΔC_t on instruments.

Table 2.10: RA2 Immediate and Eventual Effects of Wealth on Consumption

$$\partial C_t = \alpha + \tilde{\beta}\bar{\partial}W_{t-1}(\tilde{\beta_{fw}}\bar{\partial}FW_{t-1} + \tilde{\beta_{hw}}\bar{\partial}HW_{t-1}) + \tilde{\gamma}^{\top}\tilde{Z}_{t-1} + \varepsilon_t$$

	χ Unrestricted					
	Net Wealth		Financial		Housing	
Country	$\text{MPC}_{w}^{\text{im}}$	$\text{MPC}_{w}^{\text{ev}}$	$\text{MPC}_{fw}^{\text{im}}$	$\text{MPC}_{fw}^{\text{ev}}$	$\text{MPC}_{hw}^{\text{im}}$	$\text{MPC}_{hw}^{\text{ev}}$
Germany	-2.02	-9.08	-2.33	-10.47	-0.92	-4.15
France	0.46	2.24	0.87	4.29	0.41	2.02
Italy	1.35^{***}	13.97^{***}	1.44^{***}	14.86^{***}	1.09	11.27
Spain	1.69^{***}	11.54^{***}	2.74^{**}	18.73^{**}	1.20^{**}	8.19^{**}
Netherlands	0.15	0.60	0.14	0.57	0.78	3.20
Mean	0.32	3.85	0.57	5.60	0.51	4.11
	$\chi = 0.7$					
	Net Wealth		Financial		Housing	
Country	$\text{MPC}_{w}^{\text{im}}$	$\text{MPC}_{w}^{\text{ev}}$	$\text{MPC}_{fw}^{\text{im}}$	$\text{MPC}_{fw}^{\text{ev}}$	$\text{MPC}_{hw}^{\text{im}}$	$\text{MPC}_{hw}^{\text{ev}}$
Germany	-1.93	-9.21	-2.19	-10.44	-1.01	-4.80
France	0.47	2.25	0.92	4.38	0.42	2.02
Italy	1.39^{***}	6.64^{***}	1.28^{***}	6.10^{***}	1.75	8.34
Spain	1.90^{***}	9.04^{***}	3.23^{**}	15.36^{**}	1.27^{**}	6.03^{**}
Netherlands	0.14	0.67	0.17	0.80	-0.20	-0.94
Mean	0.39	1.88	0.68	3.24	0.45	2.13

Notes: Quarterly observations, 1999Q1 - 2010Q1. Marginal propensities to consume in cents per euro of additional wealth. $\{^{*},^{**},^{***}\}$ = Statistical significance at $\{10, 5, 1\}$ percent.

Table 2.11: RA2 Immediate and Eventual Effects of Financial Assets

$$\partial C_t = \alpha + \tilde{\beta_{cd}}\bar{\partial} CD_{t-1} + \tilde{\beta_{ds}}\bar{\partial} DS_{t-1} + \tilde{\beta_{eq}}\bar{\partial} EQD_{t-1} + \tilde{\beta_{hw}}\bar{\partial} HW_{t-1} + \tilde{\gamma}^{\top}\tilde{Z}_{t-1} + \varepsilon_t$$

	χ Unrestricted							
	Currency and Deposits		Debt Securities		Equity		Housing	
Country	$\text{MPC}^{\text{im}}_{curdep}$	$\text{MPC}^{\text{ev}}_{curdep}$	$\text{MPC}^{\text{im}}_{debsec}$	$\text{MPC}^{\text{ev}}_{debsec}$	$\text{MPC}^{\text{im}}_{invequ}$	$\text{MPC}^{\text{ev}}_{invequ}$	$\text{MPC}^{\text{im}}_{hw}$	$\text{MPC}^{\text{ev}}_{hw}$
Germany	−10.94	−49.16	−9.35**	−42.02**	−1.26	−5.66	0.25	1.13
France	2.57	12.63	−2.00	−9.84	1.62	7.96	0.30	1.45
Italy	4.64	47.96	−0.57	−5.87	1.49***	15.39***	1.39*	14.39*
Spain	−1.56	−10.65	1.92	13.16	3.42**	23.41**	0.97	6.65
Netherlands	3.23	13.23	1.30	5.32	−1.05	−4.30	1.15	4.72
Mean	−0.41	2.80	−1.74	−7.85	0.84	7.36	0.81	5.67
	$\chi = 0.7$							
	Currency and Deposits		Debt Securities		Equity		Housing	
Country	$\text{MPC}^{\text{im}}_{curdep}$	$\text{MPC}^{\text{ev}}_{curdep}$	$\text{MPC}^{\text{im}}_{debsec}$	$\text{MPC}^{\text{ev}}_{debsec}$	$\text{MPC}^{\text{im}}_{invequ}$	$\text{MPC}^{\text{ev}}_{invequ}$	$\text{MPC}^{\text{im}}_{hw}$	$\text{MPC}^{\text{ev}}_{hw}$
Germany	−11.64	−55.41	−9.03**	−42.99**	−1.19	−5.68	0.19	0.90
France	2.77	13.21	−2.13	−10.16	1.70	8.08	0.30	1.42
Italy	−2.11	−10.06	−0.43	−2.03	1.43**	6.82**	1.69	8.04
Spain	−2.42	−11.50	2.52	12.02	3.91**	18.60**	1.12**	5.33**
Netherlands	4.35	20.71	1.14	5.43	−0.85	−4.06	0.34	1.62
Mean	−1.81	−8.61	−1.58	−7.55	1.00	4.75	0.73	3.46

Notes: Quarterly observations, 1999Q1 - 2010Q1. Marginal propensities to consume in cents per euro of additional wealth. $\{^*,^{**},^{***}\}$ = Statistical significance at $\{10,5,1\}$ percent.

Table 2.12: Wealth Effects - Panel SUR Estimation

	χ	Wealth	Financial	Housing	Curr.&Dep.	Debt Securities	Equity	Housing
All Countries	0.49	4.55^{***}	5.80^{***}	3.56^{***}	-11.22	2.25	7.73^{***}	2.80^{***}
Big 5	0.70	4.70^{***}	5.74^{***}	3.94^{***}	-0.64	1.25	7.81^{***}	3.41^{***}
No Big 5	0.21	-0.05	7.20^{**}	-9.32	-34.55	10.28	10.24^{**}	-10.79
Core	0.31	3.73^{***}	5.31^{***}	3.18^{**}	-13.69	2.45	7.33^{***}	2.62^{*}
Periphery	0.85	8.39^{***}	15.55^{***}	4.79^{***}	13.03	18.99^{**}	16.04^{***}	4.64^{***}

Notes: Quarterly observations, 1999Q1 - 2010Q1. Eventual marginal propensities to consume in cents per euro of additional wealth. SUR Estimates, $\{^{*},^{**},^{***}\}$ = Statistical significance at $\{10,5,1\}$ percent.

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Appendix A

Appendix to Chapter 1

A.1 Examples of ECB policy summary

Below we provide some examples of the ECB policy summary along with the corresponding Verbal Guidance Index, computed as in eq. (1.1) (VG) and in eq. (1.2) (VG^e).

i. January 2002: " [...] The Governing Council concluded that recent developments are in line with the interest rate decisions taken in the course of last year. We have therefore decided to keep the key ECB interest rates unchanged. We also confirmed that the current level of key ECB interest rates remains appropriate for the maintenance of price stability over the medium term."
VG: 0 VG^e: 0

ii. June 2004: " [...] Nevertheless, we are still of the view that the medium-term outlook remains in line with price stability. Accordingly, we left the key ECB interest rates unchanged. The low level of interest rates continues to support the economic recovery. We will remain vigilant with regard to all developments which could affect the risks to price stability over the medium term."
VG: 0.0238 VG^e: 0.0238

iii. October 2006: "[...] Today's decision will contribute to ensuring that medium to longer-term inflation expectations in the euro area remain solidly anchored at levels consistent with price stability. Such anchoring is a prerequisite for monetary policy to make an ongoing contribution towards supporting sustainable economic growth and job creation

in the euro area. [...] Our monetary policy therefore continues to be accommodative. If our assumptions and baseline scenario are confirmed, it will remain warranted to further withdraw monetary accommodation. The Governing Council will therefore continue to monitor very closely all developments so as to ensure price stability over the medium and longer term."

VG: 0.0349 VG^e: 0.0349

iv. January 2008: " [...] The Governing Council remains prepared to act pre-emptively so that second-round effects and upside risks to price stability over the medium term do not materialise and, consequently, medium and long-term inflation expectations remain firmly anchored in line with price stability. Reflecting its mandate, such anchoring is of the highest priority to the Governing Council. The economic fundamentals of the euro area are sound. [...] We will continue to monitor very closely all developments over the coming weeks."

VG: 0.0139 VG^e: 0.0139

v. July 2010: "[...] Based on its regular economic and monetary analyses, the Governing Council views the current key ECB interest rates as appropriate. [...] Our monetary analysis confirms that inflationary pressures over the medium term remain contained, as suggested by weak money and credit growth. Overall, we expect price stability to be maintained over the medium term, thereby supporting the purchasing power of euro area households. [...] Monetary policy will do all that is needed to maintain price stability in the euro area over the medium term. [...] We remain firmly committed to price stability over the medium to longer term. The monetary policy stance and the overall provision of liquidity will be adjusted as appropriate. Accordingly, the Governing Council will continue to monitor all developments over the period ahead very closely."

VG: 0.0204 VG^e: 0.0306

vi. April 2012: " [...] Inflation rates are likely to stay above 2% in 2012, with upside risks prevailing. Over the policy-relevant horizon, we expect price developments to remain in line with price stability. Consistent with this picture, the underlying pace of monetary expansion remains subdued. [...] Medium-term inflation expectations for the euro area economy must continue to be firmly anchored in line with our aim of maintaining inflation

rates below, but close to, 2% over the medium term. [...] This combination of measures has contributed to a stabilisation in the financial environment and an improvement in the transmission of our monetary policy. We need to carefully monitor further developments. [...]"

VG: 0 VG^e: 0.0049

vii. July 2014: " Based on our regular economic and monetary analyses, we decided to keep the key ECB interest rates unchanged.[...] The monetary operations to take place over the coming months will add to this accommodation and will support bank lending. As our measures work their way through to the economy, they will contribute to a return of inflation rates to levels closer to 2%. Concerning our forward guidance, the key ECB interest rates will remain at present levels for an extended period of time in view of the current outlook for inflation. [...]"

VG: 0.1049 VG^e: 0.1049

Table A.1: Stop words

i	them	by	then	than
me	their	for	once	too
my	theirs	with	here	very
myself	themselves	about	there	ecb
we	what	against	when	government
our	which	between	where	governing
ours	who	into	why	council
ourselves	whom	through	how	today
you	this	during	all	year
your	that	before	any	
yours	these	after	both	
yourself	those	above	each	
yourselves	a	below	few	
he	an	to	more	
him	the	from	most	
his	and	up	other	
himself	but	down	some	
she	if	in	such	
her	or	out	no	
hers	because	on	nor	
herself	as	off	not	
it	until	over	only	
its	while	under	own	
itself	of	again	same	
they	at	further	so	

Notes: This table lists the stop words used for the text analysis, i.e. the words which are filtered out when computing the denominator for the Verbal Guidance Index. In content analysis stop words usually refer to the most common words in a language; here we include also the ECB-related words, such as "ECB" and "governing council".

A.2 List of the macroeconomic series

1. Euribor rate, Source: Thomson Reuters-Datastream
2. Eonia rate, Source: Bloomberg
3. ECB official policy rates, Source: Bloomberg
4. Overnight Indexed Swap rates, Source: Bloomberg
5. Euro Stoxx Volatility Index, Source: Thomson Reuters-Datastream
6. CPI Inflation and GDP growth rate Expectations Current and Next Year, Source: Consensus Economics
7. ECB Macroeconomic Projections Current and Next Year, Source: ECB-SDW
8. SPF Macroeconomic Projections Current and Next Year, Source: ECB-SDW

Table A.2: The ECB announcements of non-standard measures on press conference days

Date	Type	Description
06/09/2007	LTRO	The GovC has today decided to conduct a supplementary liquidity-providing longer-term refinancing operation with a maturity of three months.
08/11/2007	LTRO	The GovC today decided to renew the two supplementary longer-term refinancing operations.
10/01/2008	FOR	The GovC decided to conduct US dollar liquidity-providing operations.
07/02/2008	LTRO	The GovC decided to renew two outstanding supplementary longer-term refinancing operations.
04/09/2008	LTRO	The GovC decided to renew three outstanding supplementary longer-term refinancing operations.
05/03/2009	FRTFA, LTRO	The GovC decided to continue the fixed rate tender procedure with full allotment for all main refinancing operations, special-term refinancing operations and supplementary and regular longer-term refinancing operations.
07/05/2009	LTRO, CBPP1	The GovC decided to purchase euro-denominated covered bonds issued in the euro area, and to conduct liquidity-providing longer-term refinancing operations with a maturity of one year.
04/06/2009	CBPP1	The GovC decided upon the techinal modalities of the CBPP1.
03/12/2009	FRTFA, LTRO	The GovC decided to continue conducting its main refinancing operations as fixed rate tender procedures with full allotment, and to enhance the provision of longer-term refinancing operations.
04/03/2010	FRTFA, LTRO	The GovC decided to continue conducting its main refinancing operations as fixed rate tender procedures with full allotment, and to return to variable rate tender procedures in the regular 3-month longer-term refinancing operations.
10/06/2010	LTRO	The GovC decided to adopt a fixed rate tender procedure with full allotment in the regular 3-month longer-term refinancing operations.
02/09/2010	FRTFA, LTRO	The GovC decided to continue to conduct its main refinancing operations as fixed rate tender procedures with full allotment, and to conduct 3- month longer-term refinancing operations as fixed rate tender procedures with full allotment.
02/12/2010	FRTFA, LTRO	The GovC decided to continue to conduct its main refinancing operations as fixed rate tender procedures with full allotment for as long as necessary, and to conduct 3- month longer-term refinancing operations.
03/03/2011	FRTFA, LTRO	The GovC decided to continue to conduct its main refinancing operations as fixed rate tender procedures with full allotment, and to conduct 3- month longer-term refinancing operations as fixed rate tender procedures with full allotment.
09/06/2011	FRTFA, LTRO	The GovC decided to continue to conduct its main refinancing operations as fixed rate tender procedures with full allotment, and to conduct 3- month longer-term refinancing operations as fixed rate tender procedures with full allotment.
04/08/2011	FRTFA, LTRO	The GovC decided to continue conducting its main refinancing operations as fixed rate tender procedures with full allotment, to conduct 3-month longer-term refinancing operations as fixed rate tender procedures with full allotment, and to conduct a liquidity- providing supplementary longer-term refinancing operation with a maturity of six months as a fixed rate tender procedure with full allotment.
06/10/2011	FRTFA, LTRO, CBPP2	The GovC decided to continue conducting its main refinancing operations as fixed rate tender procedures with full allotment, to conduct 3-month longer-term refinancing operations as fixed rate tender procedures with full allotment, to conduct two liquidity- providing supplementary longer-term refinancing operation with a maturity of twelve and thirteen months as a fixed rate tender procedure with full allotment, and to launch a new covered bond purchase program.
03/11/2011	CBPP2	The GovC decided upon the techinal modalities of the CBPP2.
08/12/2011	LTRO, COLL	The GovC decided to conduct two longer-term refinancing operations with a maturity of three years, to increase collateral availability.

The ECB announcements of non-standard measures on press conference days (Continued)

Date	Type	Description
09/02/2012	COLL	The GovC approved specific national eligibility criteria and risk control measures for the temporary acceptance in a number of countries of additional credit claims as collateral in Eurosystem credit operations.
06/06/2012	FRTFA, LTRO	The GovC decided to continue to conduct its main refinancing operations as fixed rate tender procedures with full allotment, and to conduct 3- month longer-term refinancing operations as fixed rate tender procedures with full allotment.
02/08/2012	OMT	The GovC stated that it may undertake outright open market operations of a size adequate to reach its objective.
06/09/2012	OMT, COLL	The GovC announced the technical details of OMT and decided on additional measures to preserve collateral availability.
06/12/2012	FRTFA, LTRO	The GovC decided to continue conducting its main refinancing operations as fixed rate tender procedures with full allotment, and to conduct 3- month longer-term refinancing operations as fixed rate tender procedures with full allotment.
07/02/2013	FRTFA	The GovC stated that its monetary policy stance will remain accommodative with the full allotment mode of liquidity provision.
07/03/2013	FRTFA	The GovC stated that its monetary policy stance will remain accommodative with the full allotment mode of liquidity provision.
04/04/2013	FRTFA	The GovC decided to continue with fixed rate tender procedures with full allotment.
02/05/2013	FRTFA, LTRO	The GovC decided to continue the fixed rate tender procedures with full allotment for its main refinancing operations; this procedure applies also on 3-month longer-term refinancing operations.
07/11/2013	FRTFA, LTRO	The GovC decided to continue the fixed rate tender procedures with full allotment for its main refinancing operations; this procedure applies also on 3-month longer-term refinancing operations.
05/06/2014	TLTRO, COLL, FRTFA, LTRO, APP	The GovC decided to conduct a series of Target-LTRO with a maturity of about 4 years and to extend the existing eligibility of additional assets as collateral; to continue conducting the MROs as fixed rate tender procedures with full allotment; to conduct the three-month longer-term refinancing operations to be allotted as fixed rate tender procedures with full allotment. He decided to suspend the weekly fine-tuning operation sterilising the liquidity injected under the Securities Markets Programme and intensified preparatory work for purchases of asset-backed securities.
03/07/2014	TLTRO	The GovC decided upon the techinal modalities of the TLTRO.
04/09/2014	APP	The GovC stated that it will purchase a broad portfolio of simple and transparent asset-backed securities under an ABS purchase programme and a broad portfolio of euro-denominated covered bonds under a new covered bond purchase programme.
02/10/2014	APP	The GovC decided upon the techinal modalities of the ABSPP and CBPP, including that the programmes will last at least two years.
06/11/2014	APP	Statement on the intention to buy covered bonds and asset-backed securities in order to expand the balance sheet towards the dimension in early 2012.
22/01/2015	APP, TLTRO	The GovC decided to launch an expanded asset purchase programme, encompassing the existing purchase programmes for asset-backed securities and covered bonds, until the end of September 2016. The Governing Council decided to change the pricing of the six remaining targeted longer-term refinancing operations.
05/03/2015	APP	The GovC decided upon the techinal modalities of the EAPP, including that the programme will last until the end of 2016.
03/09/2015	APP	ECB signals the possibility of expansion of the EAPP beyond 2016.
03/12/2015	APP, FRTFA, LTRO	The GovC decided to extend the asset purchase programme until the end of March 2017, or beyond if necessary; to reinvest the principal payments on the securities purchased under the APP; to continue conducting the main refinancing operations and three-month longer-term refinancing operations as fixed rate tender procedures with full allotment.

GovC stands for Governing Council of the ECB

Appendix B

Appendix to Chapter 2

B.1 Data

1. Households Consumption: Individual consumption expenditure at market prices, Households, Chain linked volumes, reference year 2010, Euro, Calendar and seasonally adjusted. Source: ESA2010 - Eurostat National Accounts, Main Aggregate, European Central Bank.

2. Population: Total economy, Persons. Source: ESA2010 - Eurostat National Accounts, Main Aggregate, European Central Bank.

3. Consumption Deflator: Individual consumption expenditure, Deflator, Households and non profit institutions serving households, Calendar and seasonally adjusted. Source: ESA2010 - Eurostat National Accounts, Main Aggregate, European Central Bank.

4. Households Housing Wealth: Reporting institutional sector Households, non-profit institutions serving households, Closing balance sheet, Counterpart area World (all entities), Counterpart institutional sector Total economy including Rest of the World (all sectors), Current price, Euro. Source: ESA2010 - Eurostat Quarterly Sector Accounts, European Central Bank.

5. Total Financial Assets of Households: Reporting institutional sector Households, non-profit institutions serving households, Closing balance sheet, Counterpart area World (all entities), Counterpart institutional sector Total economy including Rest of the World

(all sectors), Assets (Net Acquisition of), Current price, Euro. Source: ESA2010 - Eurostat Quarterly Financial and Non-financial Sector Accounts, European Central Bank.

6. Currency and Deposits of Households: Reporting institutional sector Households, non-profit institutions serving households, Closing balance sheet, Counterpart area World (all entities), Counterpart institutional sector Total economy including Rest of the World (all sectors), Assets (Net Acquisition of), Current price, Euro. Source: ESA2010 - Eurostat Quarterly Financial and Non-financial Sector Accounts, European Central Bank.

7. Debt securities held by Households: Reporting institutional sector Households, non-profit institutions serving households, Closing balance sheet, Counterpart area World (all entities), Counterpart institutional sector Total economy including Rest of the World (all sectors), Assets (Net Acquisition of), Current price, Euro. Source: ESA2010 - Eurostat Quarterly Financial and Non-financial Sector Accounts, European Central Bank.

8. Loans granted by Households: Reporting institutional sector Households, non-profit institutions serving households, Closing balance sheet, Counterpart area World (all entities), Counterpart institutional sector Total economy including Rest of the World (all sectors), Assets (Net Acquisition of), Current price, Euro. Source: ESA2010 - Eurostat Quarterly Financial and Non-financial Sector Accounts, European Central Bank.

9. Equity and investment fund shares held by Households : Reporting institutional sector Households, non-profit institutions serving households, Closing balance sheet, Counterpart area World (all entities), Counterpart institutional sector Total economy including Rest of the World (all sectors), Assets (Net Acquisition of), Current price, Euro. Source: ESA2010 - Eurostat Quarterly Financial and Non-financial Sector Accounts, European Central Bank.

10. Insurance, pension and standardized guarantee schemes of Households: Reporting institutional sector Households, non-profit institutions serving households, Closing balance sheet, Counterpart area World (all entities), Counterpart institutional sector Total economy including Rest of the World (all sectors), Assets (Net Acquisition of), Current price, Euro. Source: ESA2010 - Eurostat Quarterly Financial and Non-financial Sector Accounts, European Central Bank.

11. Total Financial Liabilities of Households: Reporting institutional sector Households, non-profit institutions serving households, Closing balance sheet, Counterpart area World (all entities), Counterpart institutional sector Total economy including Rest of the World (all sectors), Liabilities (Net Incurrence of), Current price, Euro. Source: ESA2010 - Eurostat Quarterly Financial and Non-financial Sector Accounts, European Central Bank.

12. Debt securities issued by Households: Reporting institutional sector Households, non-profit institutions serving households, Closing balance sheet, Counterpart area World (all entities), Counterpart institutional sector Total economy including Rest of the World (all sectors), Liabilities (Net Incurrence of), Current price, Euro. Source: ESA2010 - Eurostat Quarterly Financial and Non-financial Sector Accounts, European Central Bank.

13. Loans granted to Households: Reporting institutional sector Households, non-profit institutions serving households, Closing balance sheet, Counterpart area World (all entities), Counterpart institutional sector Total economy including Rest of the World (all sectors), Liabilities (Net Incurrence of), Current price, Euro. Source: ESA2010 - Eurostat Quarterly Financial and Non-financial Sector Accounts, European Central Bank.

14. Equity and investment fund shares issued by Households : Reporting institutional sector Households, non-profit institutions serving households, Closing balance sheet, Counterpart area World (all entities), Counterpart institutional sector Total economy including Rest of the World (all sectors), Liabilities (Net Incurrence of), Current price, Euro. Source: ESA2010 - Eurostat Quarterly Financial and Non-financial Sector Accounts, European Central Bank.

15. Insurance, pension and standardized guarantee schemes of Households: Reporting institutional sector Households, non-profit institutions serving households, Closing balance sheet, Counterpart area World (all entities), Counterpart institutional sector Total economy including Rest of the World (all sectors), Liabilities (Net Incurrence of), Current price, Euro. Source: ESA2010 - Eurostat Quarterly Financial and Non-financial Sector Accounts, European Central Bank.

16. Disposable income of households: Reporting institutional sector Households and non profit institutions serving households, Counterpart area World (all entities) counterpart

institutional sector Total economy, Balance (Credits minus Debits), Current prices, Euro. Source: ESA2010 - Eurostat Quarterly Sector Accounts, European Central Bank.

17. Consumer Confidence Indicator: Total, Seasonally adjusted, Percentage balances. Source: EU Commission, DG-ECFIN, Consumer survey.

18. Unemployment Rate: Standardized unemployment rate, Total (all ages), Total (male and female), Seasonally adjusted, Percentage of civilian workforce. Source: Eurostat, European Central Bank.

19. Spreads between the composite interest rate on households loans for house purchases and the composite risk free rate is computed in two steps. First, we compute the composite loan interest rate as the weighted average of interest rates at each maturity range (up to 1 year, 1-5 years, 5-10 years, over 10 years). Second, we compute corresponding composite risk free rates that take into account the maturity breakdown of loans. The maturity-adjusted risk-free rate is the weighted average (with the same weights as in case of composite loan interest rate) of the following risk-free rates chosen for maturity ranges:

    - 3 month EURIBOR (up to 1 year)
    - German Bund 3 year yield (1-5 years)
    - German Bund 7 year yield (5-10 years)
    - German Bund 20 year yield (over 10 years).

20. Households Loans for House Purchases (for several maturities): Outstanding amounts at the end of the period (stocks), MFIs excluding ESCB reporting sector - Loans, All currencies combined - Euro area (changing composition) counterpart, Households and non-profit institutions serving households sector, denominated in Euro. Source: MFI Balance Sheet Items Statistics (BSI Statistics), European Central Bank.

21. Bank interest rates - Loans to Households for House Purchase (new business): Credit and other institutions (MFI except MMFs and central banks) reporting sector - Lending for house purchase excluding revolving loans and overdrafts, convenience and extended

credit card debt, Total initial rate fixation, New business coverage, Households and non-profit institutions serving households sector, denominated in Euro. Source: National Central Banks, European Central Bank.

22. Euribor 3-month. Source: Reuters, European Central Bank.

23. German Bund (for several maturities): Germany Government Benchmark bond yield. Source: Reuters, European Central Bank.

24. Stock Market Price: MSCI Index. Source: Datastream.

B.2 Test for Cointegration

In this section we perfom the Phillips-Ouliars and Johansen test for investigating the existence of a stable cointegration relation among log-levels of consumption, wealth and income, as in the following equation:

$$\log C_t = \alpha + \beta_w \log W_t + \beta_y \log Y_t + \varepsilon_t \tag{B.1}$$

where W_t is defined as: (i) total wealth; (ii) financial and housing wealth; (iii) currency and deposits, debt securities and equities. Y_t denotes the disposable income. The Phillips-Ouliars test applies the augmented Dickey-Fueller test on regression residuals to test whether they are $I(1)$. Also the Johansen trace and max tests the null hypothesis of no cointegration, but they differ for the alternative hypothesis: for the former, the alternative is that there *at most p* cointegrating vector; for the latter, *one* cointegrating vector. As shown in Table B.1, the results suggest that there is mixed evidence: according to the Phillips-Ouliars test, there is no evidence in a favour of a stable cointegration, except for France for which the null hypothesis of a unit root can be rejected at the 95 per cent level when wealth is defined as in (i) and (ii). On the contrary, based on both Johansen tests, the results are in favor of a stable cointegration relation in most cases.

Table B.1: Test for Cointegration in the "Levels" Model

	Wealth			Financial and Housing			Financial Split and Housing		
	Phillips-Ouliars	Johansen		Phillips-Ouliars	Johansen		Phillips-Ouliars	Johansen	
Country	$t_{\hat{\alpha}_*}$	λ_{trace}	$\lambda_{\max}$	$t_{\hat{\alpha}_*}$	λ_{trace}	$\lambda_{\max}$	$t_{\hat{\alpha}_*}$	λ_{trace}	$\lambda_{\max}$
Germany	-2.43	32.03^{**}	23.07^{**}	-3.72	51.67^{**}	27.04^{*}	-3.17	125.51^{***}	52.79^{***}
France	-4.46^{**}	47.92^{***}	28.64^{***}	-4.32^{*}	72.68^{***}	34.85^{***}	-4.72	147.19^{***}	56.52^{***}
Italy	-3.36	29.16^{*}	19.08^{*}	-2.98	69.40^{***}	28.06^{**}	-3.20	122.00^{***}	46.80^{***}
Spain	-2.33	31.90^{**}	14.61	-2.34	69.82^{***}	34.11^{***}	-3.43	126.59^{***}	43.94^{**}
Netherlands	-2.82	24.10	17.50	-2.55	54.17^{**}	29.72^{**}	-3.24	98.74^{**}	39.81^{**}

Notes: Statistical significance was calculated using the critical values from Phillips and Ouliaris (1990), Table IIc, p.190. Statistical significance for the Johansen tests was calculated using the critical values from Osterwald–Lenum (1992). ADF and Johansen test statistics are calculated with 2 lags. $\{^{*},^{**},^{***}\}$ = Statistical significance at $\{10, 5, 1\}$ percent.

B.3 Estimation in Levels and Differences

To compare the results based on the sticky expectation model with the one based on the standard cointegration approach, we estimate the wealth effects using a cointegration regression between consumption, income and wealth. Specifically, we estimate the following equation we call "the levels model" by dynamic ordinary least squares (DOLS):

$$\log C_t = \alpha + \beta_w \log W_t + \beta_y \log Y_t + \varepsilon_t \tag{B.2}$$

for three specification of W_t: (i) total wealth; (ii) financial and housing wealth; (iii) currency and deposits, debt securities and equities. Y_t denotes the disposable income. The coefficients β_w are the elasticities of consumption with respect to wealth. The marginal propensity to consume are obtained by rescaling the elasticity with the most recent value of the consumption-wealth ratio.

In addition, we estimate an "atheoretical" version of the Equation 2.8, namely:

$$\frac{\Delta C_t}{C_{t-3}} = \alpha + \sum_{i=1}^{2} \beta_{c,i} \frac{\Delta C_{t-1}}{C_{t-3}} + \sum_{i=0}^{2} \beta_{w,i} \frac{\Delta W_{t-1}}{C_{t-3}} + \sum_{i=0}^{2} \beta_{y,i} \frac{\Delta Y_{t-1}}{C_{t-3}} + \varepsilon_t \tag{B.3}$$

where the eventual MPC out of wealth is calculated as the sum of the wealth coefficients $\sum_{i=0}^{2} \beta_{w,i}$. The number of lags is set to two to keep the number of regressors manageable. This implies that all variables are rescaled with initial consumption level C_{t-3}.

Table B.2 and Table B.3 show the results for Equation B.2 and B.3, respectively. While the former are not supportive, on the contrary the latter are qualitatively consistent with the results we discuss in the main analysis. Indeed, the wealth effect is significant (but smaller) for all countries, except Germany. Moreover, financial wealth effect is larger than housing. Finally, equity is statistically significant and large for France, Italy and Spain, whereas debt securities are relevant in the Netherlands, similarly to the results reported in Table 2.4.

Table B.2: Eventual Wealth Effect: Levels

	Wealth	Financial	Housing	Curr.&Dep.	Debt Securities	Equity	Housing
Country	MPC^{ev}_{w}	MPC^{ev}_{fw}	MPC^{ev}_{hw}	MPC^{ev}_{curdep}	MPC^{ev}_{debsec}	MPC^{ev}_{invequ}	MPC^{ev}_{hw}
Germany	1.56	−1.76	3.52	−3.03	−2.77	−3.32	2.90
France	1.18^{***}	1.37^{***}	1.28^{***}	4.32^{**}	−0.39	2.93^{***}	1.08^{***}
Italy	−0.30	0.13	−0.38	−9.43	−2.97	2.54	2.64
Spain	0.66	2.93	0.42	−9.09	4.51	8.10^{**}	0.85
Netherlands	0.25	0.43	4.80^{***}	−4.87	1.07^{***}	−1.71	5.34^{***}
Mean	0.67	0.62	1.93	−4.42	−0.11	1.71	2.56

Notes: Marginal propensities to consume in cents per euro of additional wealth. $\{^{*},^{**},^{***}\}$ = Statistical significance at $\{10,5,1\}$ percent. The regression was estimated with DOLS with 1 lag and 1 lead of the explanatory variables. Statistical significance was calculated using the rescaled t-statistics as described in Hayashi (2000) for which the long-run variance of residuals from DOLS regression was computed using the Newey-West window with 4 lags.

Table B.3: Eventual Wealth Effect: Differences

	Wealth	Financial	Housing	Curr.&Dep.	Debt Securities	Equity	Housing
Country	MPC^{ev}_{w}	MPC^{ev}_{fw}	MPC^{ev}_{hw}	MPC^{ev}_{curdep}	MPC^{ev}_{debsec}	MPC^{ev}_{invequ}	MPC^{ev}_{hw}
Germany	-1.38	-1.32	-2.94	11.86	-10.52	2.91	-2.80
France	1.86^{***}	2.95^{**}	1.56^{**}	-3.46	2.81	3.53^{*}	1.46^{*}
Italy	1.87^{**}	2.30^{**}	0.84	-2.32	-0.28	2.55^{*}	1.57
Spain	1.73^{***}	5.24^{***}	0.88	-0.18	6.60	5.05^{**}	1.04
Netherlands	1.49^{***}	1.38^{***}	3.47^{**}	-10.28	1.62^{**}	0.98	4.37^{***}
Mean	1.12	2.11	0.76	-0.88	0.04	3.01	1.13

Notes: Marginal propensities to consume in cents per euro of additional wealth. $\{^{*},^{**},^{***}\}$ = Statistical significance at $\{10,5,1\}$ percent. Statistical significance was calculated as the p value of the test: $\sum_{i=0}^{2}\beta_{w,i}=0$

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