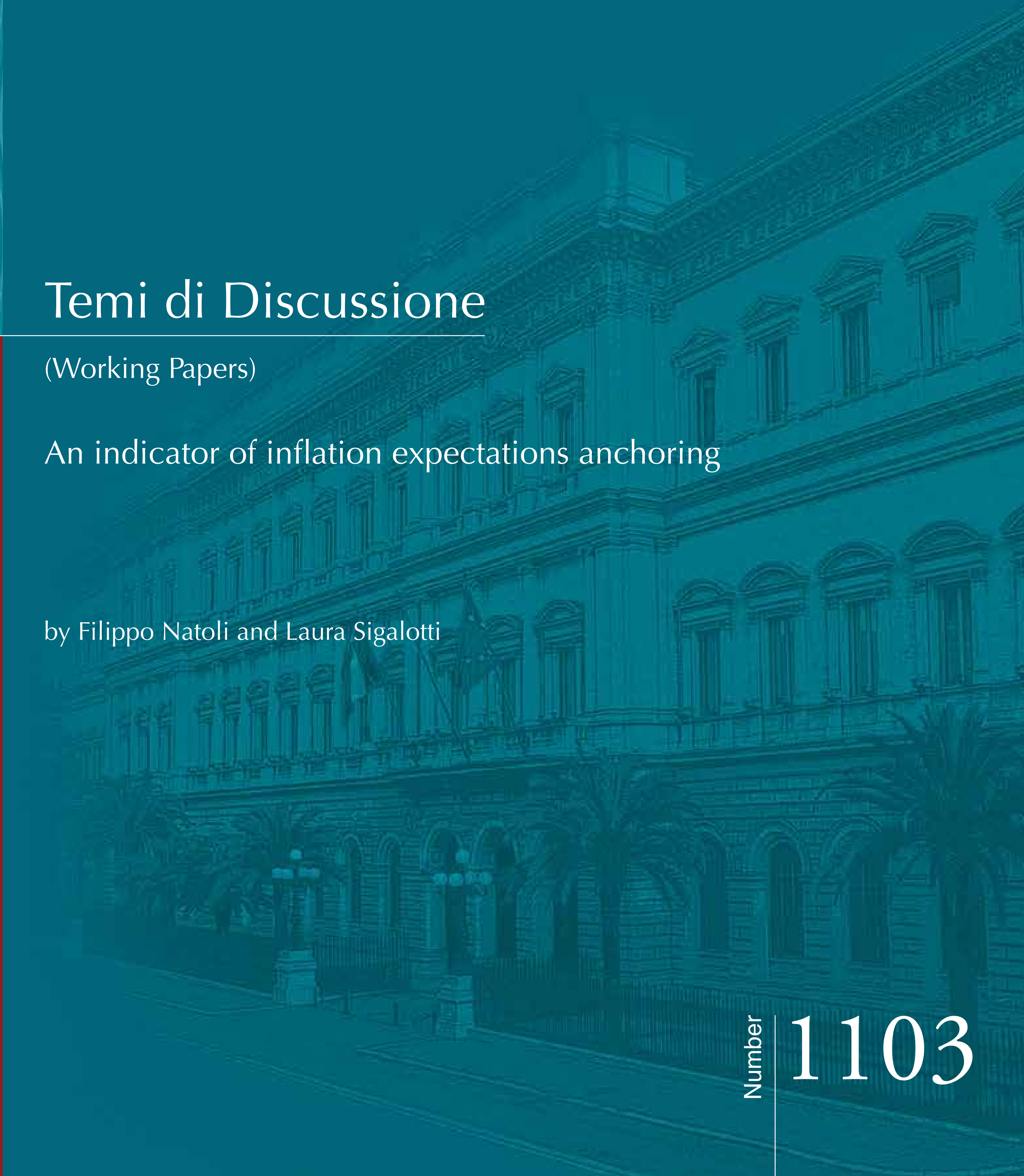
BANCA D'ITALIA
EUROSISTEMA



Temi di Discussione

(Working Papers)

An indicator of inflation expectations anchoring

by Filippo Natoli and Laura Sigalotti

February 2017

Number 1103

BANCA D'ITALIA
EUROSISTEMA

Temi di discussione

(Working papers)

An indicator of inflation expectations anchoring

by Filippo Natoli and Laura Sigalotti

Number 1103 - February 2017

The purpose of the Temi di discussione *series is to promote the circulation of working papers prepared within the Bank of Italy or presented in Bank seminars by outside economists with the aim of stimulating comments and suggestions.*

The views expressed in the articles are those of the authors and do not involve the responsibility of the Bank.

ISSN 1594-7939 (print)
ISSN 2281-3950 (online)

Printed by the Printing and Publishing Division of the Bank of Italy

AN INDICATOR OF INFLATION EXPECTATIONS ANCHORING

by Filippo Natoli* and Laura Sigalotti**

Abstract

We compare the degree of anchoring of inflation expectations in the euro area, the United States and the United Kingdom, focusing on the post-crisis period. First of all, we estimate a set of measures of average and tail correlation using inflation swaps and options, as proposed by Natoli and Sigalotti (2016). To quantify the degree of anchoring, we also propose a new indicator based on the results of a logistic regression, obtained by measuring the odds that strong negative shocks to short-term expectations are connected to large declines in long-term expectations. The results reveal an increase in the risk of de-anchoring during the last quarter of 2014 for the euro area. While showing a significant reduction after the peak, our de-anchoring indicator remains high and volatile for 2015 and 2016. Inflation expectations in the US and the UK are instead found to be firmly anchored.

JEL Classification: C14, C58, E31, E44, G13.
Keywords: inflation expectations, anchoring, inflation swaps, inflation options, tail comovement, odds ratio.

Contents

* Bank of Italy, Directorate General for Economics, Statistics and Research.
** Bank of Italy, Economic Research Unit, Ancona Branch.

1. Introduction[1]

Since the end of 2011, the euro area, the United States and the United Kingdom have been experiencing a steady disinflation, which has become more pronounced since 2013 (see Figure 1). In addition, during 2014 long-term inflation expectations, both survey-based and derived from the prices of inflation swap contracts, have also edged downwards in the three economies (see Figure 2, 3, 4). These developments differ substantially from the 2008-2009 episode, when oil prices collapsed from the peak reached in July 2008 in the wake of the global financial crisis. In that period, long-term inflation expectations, although substantially revised downwards, remained well anchored to the definition of price stability in all three economies.

Sharp disinflation and deflation are a source of special concern. The presence of nominal constraints in the economy – namely, the zero lower bound on nominal interest rates, borrowing limits and downward nominal wage rigidities - causes the costs of negative shocks to inflation to exceed those of positive ones. As inflation declines, those constraints could become binding, eventually preventing monetary policy from closing the inflation gap, agents from deleveraging, and the labour market from clearing. A persistent departure from the target could entail a de-anchoring of expectations, revealing a loss of credibility of the monetary authority and inducing agents to postpone consumption and investment, leading to a deflationary spiral that might become entrenched.

In this paper we test a sufficient condition for de-anchoring of long-term inflation expectations below the central bank's target (henceforth *downside de-anchoring*) in the euro area, the United States and the United Kingdom; for this purpose, we rely only on market-based indicators of inflation expectations implied by inflation swaps and options quotes.[2] Only a handful of papers address this topic for the euro area after the global financial crisis. A study by Autrup and Grothe (2014) looks at the responsiveness of inflation expectations to macroeconomic announcements, finding that they remained firmly anchored during the crisis, with the sample ending in 2012. Using market quotes of options on inflation from 2009 to 2013, Scharnagl and Stapf (2015) conduct a time-varying event study and find that market beliefs react to macro news only mildly.

[1]We would like to thank David Altig, Andrea Finicelli, Giuseppe Grande and the participants to the October 2015 Bank of Italy workshop on *Low inflation and its implications for monetary policy* for their helpful comments and suggestions.The views expressed in this paper are those of the authors and do not necessarily reflect those of the Bank of Italy. All the remaining errors are ours. E-mail: filippo.natoli@bancaditalia.it, laura.sigalotti@bancaditalia.it.

[2]Without further identification assumptions, estimates based on market quotes jointly represent inflation expectations and the inflation risk premium attached to them: while inflation risk premia are also informative, as well as expectations, in assessing the degree of anchoring, we choose not to extract risk premia and to loosely refer to breakeven inflation as inflation expectations throughout the analysis. A discussion of the role of risk premia in market based estimates is provided in Section 2.1.

Signals of de-anchoring of long-term inflation expectations up to February 2015 have been detected in Natoli and Sigalotti (2016). Studying the pass-through of inflation expectations using probability distributions estimated from quoted derivatives, they find that, since mid-2014, negative tail events affecting short-term inflation expectations have been increasingly channelled onto long-term ones: this has ignited both downward revisions in expectations and upward changes in uncertainty. By contrast, positive short-term tail events have left long-term views mostly unaffected. This result is in line with the high sensitivity of medium-to-long term expectations to inflation surprises observed in Miccoli and Neri (2015).

Concerning the US, two important contributions point out that inflation expectations have been less anchored since the outbreak of the financial crisis. Galati et al. (2011) observe that expected inflation became more volatile in 2007 and that its sensitivity to news about current inflation and other domestic macroeconomic variables increased during the turmoil triggered by the collapse of Lehmann Brothers. Autrup and Grothe (2014) analyze the price formation in nominal and inflation-linked bonds, finding that the degree of inflation anchoring in the US decreased to a lower level than the euro area as of 2012. For the subsequent years, mixed results are reported: using news-regressions with multiple endogenous breaks, Nautz and Strohsal (2015) confirm the evidence of a de-anchoring of expectations driven by the outbreak of the crisis, and no evidence of re-anchoring as of 2014; on the other hand, in Nechio (2015) survey-based long-term expectations are judged as firmly anchored, and their recent decline is ascribed to downward revisions made by forecasters who overestimated inflation in the aftermath of the Great Recession.

As far as we know, there are no contributions claiming a heightened de-anchoring risk during the most recent period for the United Kingdom, one of the first countries to have adopted inflation targeting. Gurkaynak et al. (2010) compare the level of anchoring in the US and the UK from the 90's onwards, finding that, form initially high levels, the volatility and responsiveness to macro news of UK inflation compensation was substantially reduced after the adoption of the inflation target (the same result is reported in Mehrotra and Yetman, 2014). Current expectations are assessed to be broadly consistent with the target, even though some measures of long-term expectations lying below past average levels are being closely monitored (BoE, 2015).

We propose a comparative analysis of the degree of anchoring of inflation expectations in the three economies using both the tools elaborated in Natoli and Sigalotti (2016) and a new indicator. In Natoli and Sigalotti (2016), the point was made that ordinary *pass-through models* based on linear correlations between short and long term inflation expectations are not enough to assess the degree of anchoring to the central banks' target, for two main reasons: (i) correlations treat the comovement between negative shocks to short- and long-term expectations in the same way as the comovement between positive shocks; (ii) the transmission of uncertainty about future inflation from the short to the long-run, a worry barometer of market sentiment, is totally disregarded. A transition from anchored to unanchored expectations implies a departure of beliefs on one side with respect to the target that is likely to modify the shape of the distribution of expectations: linear correlations help in identifying possible breaks in the average comovement, but are not enough to capture asymmetric changes in beliefs (skewness) or variations in uncertainty (variance). Using both copula-based estimates and a nonparametric indicator of tail dependence, a set of indicators including both average and tail comovements, also looking at left and right tails separately, is produced.

A new estimation technique is here developed to obtain a statistical indicator of downside de-anchoring. This new measure (called *Left-tail Pass-Through indicator* or LTPT) selects some of the information embedded in the previous set of indicators to produce a synthetic estimate, adds statistical significance to the results obtained in Natoli and Sigalotti (2016) and allows a quantitative comparison among countries. Following the idea that extreme short-term shocks might affect long-term beliefs and that only a *negative* pass-through (i.e., downward revisions of long-term expectations) can signal a possible downside de-anchoring, we specify our new measure as an *odds ratio*, i.e. the ratio of the odds that left-tail revisions to long-term expectations are coupled to strong negative shocks to short-term expectations over the odds that the same revisions are associated to different short-run variations. The more this ratio increases, the tighter is the link between negative shocks and strong negative variations in long-term views; with long-term inflation expectations drifting away from the the central bank's target, it might signal a growing de-anchoring risk.

The odds ratio is estimated as the exponential of the slope coefficient of a logistic regression, in which the binary dependent variable takes the value 1 when revisions of long-term expectations are below the 10th percentile (left tail) and 0 otherwise, and the regressor is a binary variable equal to 1 when daily changes in short-term expectations fall in the left tail, 0 otherwise. Short and long-term inflation expectations are proxied by forward 1y1y and 5y5y inflation swaps, respectively and regressions are carried out on rolling windows of 250 daily observations (about one calendar year); the sample starts in 2004, when inflation swap quotes started to be available on Bloomberg, and ends in May 2016.

Concerning the euro area, no relevant episodes of downside de-anchoring are detected before the global financial crisis. By contrast, both the comovement measures of Natoli and Sigalotti (2016) and the new indicator suggest an increased shock transmission at the end of 2014; the left-tail pass-through suggests that, following the announcement of the Quantitative Easing program launched by the European Central Bank, concerns about possible de-anchoring have slightly declined, even though the indicator remains substantially volatile in 2015 and 2016. Using US and UK data, the indicators of pass-through show some fluctuations but remain mostly non-significant throughout the sample. Since late 2014, the measures of Natoli and Sigalotti (2016) show rising tail correlations; however, despite a moderate increase in both countries, the new indicators remain not significant.

This paper is structured as follows: Section 2 describes the available data sets of inflation swaps and options for the three economies, while Section 3 briefly reviews the estimation methods elaborated in Natoli and Sigalotti (2016) (Section 3.1) and explains in detail how the new estimator is constructed (Section 3.2). Section 4 discusses the results obtained using our range of indicators to assess the anchoring of inflation expectations in the United Kingdom, the United States and the euro area. Section 5 concludes.

2. Data

The market for inflation-linked derivatives has witnessed a considerable development in the past few years. The most popular inflation derivatives include inflation swaps and inflation options (caps and floors). An inflation swap is a derivative contract in which two parties agree to exchange a fixed amount of money with a floating amount linked to realized inflation on particular dates in the future. Inflation caps (floors) are derivative contracts in which the holder has the right to receive compensation payments at the end of each period in which the inflation rate exceeds (falls below) an agreed-upon strike rate; these latter contracts involve no obligations when the realized inflation is below the strike, and in exchange for the contingent future payment, the holder pays a price (option premium) upfront. Inflation swaps, caps and floors can be zero-coupon or year-on-year: for our purpose, we only rely on prices of zero-coupon ones.[3]

The underlying assets of quoted swaps and options are: Harmonized Index of Consumer Prices excluding Tobaccos (HICPxT) for the euro area, the Consumer Price Index (CPI) for the United States and the Retail Price Index (RPI) for the United Kingdom; the three indexes are lagged by three months in order to be known at the maturity date of the option.[4]

For each of the three economies, the time series of inflation swaps (1 to 30 years ahead) is available since 2004, while caps and floors on future inflation (1,2, 3, 5, 7 and 10 years ahead) since October 2009. We exploit the full length of the series of the 1-, 2-, 5- and 10-year swaps

[3]Zero-coupon contracts consist of a single compensation payment at maturity, while year-on-year ones include intermediate payments depending on the level of the inflation rate in each year of the reference period. Bloomberg provides quotes for both types.

[4]Since the inflation indexes are not observed daily, the fixed leg of an inflation swap contract, which is traded daily, is taken as a proxy.

and 1- ad 10-year options; each indicator is computed on a sample ending on August 14, 2015.

2.1. Expectations and risk premia

Throughout the paper, we need to bear in mind that probability distributions extracted from option quotes are risk-neutral by assumption, i.e. they are not adjusted for investors' risk preferences. Risk-neutral distributions incorporate an inflation risk premium in addition to the expectation of future inflation, as well as a liquidity premium. Concerning the inflation risk premium, term structure estimates show that risk premia are significantly volatile, especially on long maturities.

However, inflation risk premia, whose identification gave mixed results in the literature in terms of magnitude and sign, are informative, as well as expectations, in assessing the degree of anchoring: indeed, the investors willingness to pay large premia in order to protect themselves against a scenario of persistently low inflation would also signal high risks in terms of the central banks credibility and ability to bring inflation back to target.[5] Bauer and Christensen (2014) point out that risk-neutral probabilities are useful for policy analysis, as policymakers are worried about extreme outcomes just like investors. As stated by Kocherlakota (2013), policy decision making should take into account the evolution of risk-neutral probabilities, since it reflects changes in market participants' views about future possible outcomes.

3. Anchoring indicators

3.1. Comovement indicators

In the first part of the empirical analysis we compare some measures of co-dependence between short- and long-term beliefs about future inflation in the United Kingdom, the United States and the euro area; the estimation extends the one conducted in Natoli and Sigalotti (2016) for the euro area. Our working hypothesis is that a high sensitivity of medium-to-long term inflation expectations to changes in short term expectations is an indicator of de-anchoring. In particular, an increased comovement in the tails could signal a higher sensitivity of long-term beliefs to short-term developments, per se a warning of possible de-anchoring; moreover, an asymmetric response to extreme shocks (i.e., increasing comovement

[5] The heterogeneity of the available estimates of inflation risk premia is highlighted also by Pericoli (2012), who provides a comparison of some estimates found in the literature and shows that there indeed are stark differences among them.

in one tail and constant or decreasing comovement in the other one) might suggest that the balance of risk is tilted to one side.

In order to detect possible signs of de-anchoring, we thus look at the degree of comovement between short- and long-term average expectations and between the dispersion of views about future inflation in the short and long run. For this purpose, we use three different indicators: (1) Pearson's correlation coefficient; (2) a parametric indicator based on copula functions; (3) non-parametric indicators based the so-called TailCor measure.

Inflation expectations in the short and medium-to-long run are proxied by forward rates computed from daily market quotes of inflation swaps for the United Kingdom, the United States and the euro area. Short-term expectations are measured by 1y1y forward rates, while medium-to-long term expectations are described by 5y5y forward rates. The dispersion of market-based inflation expectations, interpreted as uncertainty around future inflation, is computed as the standard deviation of the risk-neutral probability distributions extracted from option prices. Probability distributions of future inflation at different maturities are derived from quoted caps and floors for the United Kingdom, the United States and the euro area, on a daily basis for all the available strike prices. The extraction of option-implied densities relies on the semi-nonparametric technique developed in Taboga (2016), which is computationally inexpensive and robust to outliers. For each economy, the level of uncertainty around short-term and long-term expectations is proxied by the standard deviation of the distributions of expected inflation 1-year and 10-year ahead, respectively.

From the series of inflation expectations and standard deviations, we compute first differences for both short- and long-term variables and we filter them in order to remove autocorrelation and heteroskedasticity.[6] Then, in order to assess the level of comovement between daily revisions of short- and longer-term average expectations we perform a rolling estimate of the following indicators:

- Pearson's ρ correlation coefficient, which measures average comovement;
- Student's t copula-based coefficient of conditional tail dependence, which measures the degree of comovement between the tails of the distributions, i.e. it estimates to what extent large revisions in short-term expectations tend to be associated with large changes in long-term beliefs; it is an asymptotic indicator and does not distinguish between comovement in the upper and lower tail (see Natoli and Sigalotti (2016), Appendix B for the details);
- TailCor index, which measures the degree of comovement between the tails of the distributions and, unlike the previous one, does not require any distributional

[6]See Natoli and Sigalotti (2016) for the details.

assumption; it does not distinguish between comovement in the upper and the lower tail;

- UpTailCor, which measures the degree of comovement between the upper tails of the two distributions, and DownTailCor, which quantifies the co-dependence between large downswings (lower tails) (see Natoli and Sigalotti (2016), Appendix C for the details).

The same set of indicators is used to also measure the co-dependence between daily changes in the standard deviations of the distribution of short- and long-term inflation expectations: this allows to estimate the transmission of uncertainty about future inflation from the short to the long run.

3.2. The Left-Tail Pass-through Indicator

In the previous section we described some indicators of interdependence between daily revisions in short- and medium-to-long term inflation expectations, which look either at the whole distribution (correlation) or at extreme changes only (coefficient of conditional tail dependence based on copulas; TailCor; UpTailCor and DownTailCor). Although these measures convey a great amount of information, in some cases their complexity can make the interpretation of the results less straightforward.

In this section we introduce an alternative indicator of downside de-anchoring based on a simple econometric analysis, which only relies on quoted inflation swaps, with no use of inflation options and of the burdensome calculations required for copula-based and TailCor estimates. The idea is not to investigate the *level* of the co-movement between left tail revisions (as the DownTailCor index) but the *relative importance* of this association with respect to any other co-variation between short- and long-term expectations, e.g. left tail short-term revisions associated with positive long-run variations or left tail revisions of expectations associated with negative (but not extreme) long-term changes.

One way to achieve this is to decompose the distributions of both short- and long-run revisions into different sections and group the observations that belong to each section as a single event: this allows to construct the conditional probabilities of each event involving short-term changes with respect to every possible event involving long-term revisions, and construct relative measures of co-dependence based on the ratio between these probabilities.

Fixed sample In a sample of daily variations of short and long-term inflation swaps, we divide the observations for each variable into two groups, using dummy variables. While we focus on the reactions to extreme negative short-term variations, we only need to cluster our observations into left-tail and non-left-tail events. We therefore construct our dummies in the following way: the first one takes the value 1 if daily revisions in short-term inflation swaps are below a specific quantile in the left tail area of the distribution and 0 otherwise; the second variable is equal to 1 in case of long-term revisions below the same quantile and 0 otherwise.[7]

Namely, let $\{s_t\}$ and $\{l_t\}$ be the time series of daily short term and long term inflation expectations, computed from inflation swap quotes; $\{\Delta s_t\}$ and $\{\Delta l_t\}$ are the time series of daily changes. Let q^s and q^l be the chosen quantile of the empirical distributions of Δs_t and Δl_t, respectively. Then at a given date t, we define the binary variables x_t and y_t as

$$x_t = \begin{cases} 1 & \text{if } \Delta s_t \leq q^s \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

and

$$y_t = \begin{cases} 1 & \text{if } \Delta l_t \leq q^l \\ 0 & \text{otherwise} \end{cases} . \tag{2}$$

Our indicator of de-anchoring is based on the following logistic regression:

$$p(y_t = 1|x_t) = \frac{e^{\alpha+\beta x_t}}{1 + e^{\alpha+\beta x_t}} \tag{3}$$

where $p(y_t = 1|x_t)$ is the conditional probability of a left-tail revision of long-run expectations at time t.[8] The ratio of the latter probability to its complement $(p(y_t = 0|x_t))$ defines the odds of y being equal to 1 with respect to y being 0, i.e. the odds of a left-tail revision in long-term expectations versus a non-extreme change, conditional on the value of x. Being x dichotomous, one can assess the relative probability of the events of interest by calculating the ratio of the odds when $x = 1$ against $x = 0$, i.e. the ratio of the odds of a large downward revision in long-term expectations when the change in short-term expectations is extremely negative over the odds of the same revision being associated to a different short-term variation, either mildly negative or positive. This quantity, that we name *Left-Tail Pass-Through* (LTPT) indicator, is known as the odds ratio and is given by the exponential

[7] Note that short-term inflation swaps normally have wider daily fluctuations than longer-term ones. Applying the quantile computed on short-term (long-term) changes to the distribution of long-term (short-term) ones leads to underestimate (overestimate) the number of tail variations in long-term (short-term) expectations.

[8] In order to obtain a meaningful interpretation of the estimated slope coefficient in terms of odds ratio, the logit model is preferred to a probit.

of β:

$$LTPT = \frac{p(y=1|x=1)}{p(y=0|x=1)} \bigg/ \frac{p(y=1|x=0)}{p(y=0|x=0)} = e^{\beta}. \tag{4}$$

Values of the LTPT above (below) one indicate that the odds that left tail long-term revisions are associated to variations in the left tail of short-term ones are greater (smaller) than the odds that variations in long-term expectations are coupled with other changes in short-term views. Obviously, the statistical significance of the LTPT is linked to the statistical significance of the β coefficient.[9]

Tracking the pass-through over time To observe the evolution of the LTPT over time, we need to split the sample and estimate regression (3) on rolling windows. One of the main issues that arise is the choice of the quantiles q^s and q^l in each subsample.

The two most straightforward ways to set the quantiles are to compute them in the whole sample and refer to them in each rolling window estimate (*absolute thresholds*) or to re-calculate quantiles at each iteration on the current subsample of observations (*time-varying thresholds*). If $\bar{q}^s$ and $\bar{q}^l$ are the quantiles estimated over the whole sample, and $\{q_t^s\}$ and $\{q_t^l\}$ are ones computed on each rolling window, equation (3) might be rewritten as:

$$p_t\left(y_t(\bar{q}^l) = 1 | x_t(\bar{q}^s)\right) = \frac{e^{\alpha+\beta_t x_t(\bar{q}^s)}}{1+e^{\alpha+\beta_t x_t(\bar{q}^s)}} \qquad \textit{absolute thresholds} \tag{5}$$

and

$$p_t\left(y_t(q_t^l) = 1 | x_t(q_t^s)\right) = \frac{e^{\alpha+\beta_t x_t(q_t^s)}}{1+e^{\alpha+\beta_t x_t(q_t^s)}} \qquad \textit{time-varying thresholds} \tag{6}$$

Defining tail variations with respect to the whole sample or relatively to each subsample entails two different views on the underlying inflation swap process. If the risk-neutral distribution of expected inflation is considered to be quite stable over time, then it could be preferable to identify tail variations as extreme variations with respect to the whole sample; on the contrary, if market-based expectations are significantly time-varying, then defining tail changes on the whole sample might lead to misleading results.

From option-implied densities we noted that, as inflation swaps, also standard deviations of option-implied expectations, at both short and long maturities, have decreased over time since 2012. To construct input to tail comovement measures, Natoli and Sigalotti (2016)

[9] The significance of the coefficient β_t can be assessed by testing the hypothesis $H_0 : \beta_t = 0$. The z-statistic is computed as

$$z = \frac{\hat{\beta}_t}{\sqrt{\hat{var}(\hat{\beta}_t)}}$$

and is distributed as a standard normal distribution in large samples. Standard errors for e^{β_t} are the exponential of those of β_t.

filtered out the inflation swap series using an AR(1)-GARCH(1,1) model to to remove autocorrelation and heteroskedastciity. We inspect the inflation swap process of US and UK finding that, as for the EA, it is significantly autocorrelated and heteroskedastic.[10][11]

In our analysis, we observe that, in the post-crisis period, average daily variations are decreasing in magnitude over time: big downswings or upswings in absolute terms are, in the last part of the sample, extremely rare, and even more so concomitant tail variations in short and long swaps. This could significantly decrease the power of a fixed-threshold LTPT indicator in testing anchoring. The alternative fixed-threshold estimate is provided as a robustness check (Section 4.4).

Right-Tail Pass-Through Long-term expectations may also depart above the target, entailing a risk of *upside* de-anchoring. While, with long-term expectations drifting down, this is currently not an issue in the three observed economies, we construct the *Right Tail Pass Through indicator* to investigate episodes of responsiveness to positive shocks since 2004 and to evaluate righ tail comovements in the recent low expectation environment.

In the same spirit as Section 3.2, we construct our input dummies for the logistic regression in the following way: the first one takes the value 1 if daily revisions in short-term inflation swaps are *above* a specific quantile in the right tail area of the distribution and 0 otherwise; the second variable is equal to 1 in case of long-term revisions *above* the same quantile and 0 otherwise.

Defining Q^s and Q^l as the chosen quantiles of the empirical distributions of Δs_t and Δl_t, x_t and y_t are now defined as

$$X_t = \begin{cases} 1 & \text{if } \Delta s_t \geq Q^s \\ 0 & \text{otherwise} \end{cases} \tag{7}$$

and

$$Y_t = \begin{cases} 1 & \text{if } \Delta l_t \geq Q^l \\ 0 & \text{otherwise} \end{cases} . \tag{8}$$

Equation 3 and equation 5 will become

$$p(Y_t = 1|X_t) = \frac{e^{\gamma+\delta X_t}}{1+e^{\gamma+\delta X_t}} \tag{9}$$

[10]These results remain true even avoiding the highly volatile crisis period. All results are available upon request.

[11]Obviously, provided that we work with risk-neutral expectations, we cannot disentangle whether autocorrelation and heteroskedasticity are driven by the dynamics of the risk premia or they are a genuine feature of market-based inflation expectations. In any case, dealing with inflation swaps, we consider the process as it is.

$$p_t\left(y_t(\bar{Q}^l) = 1|x_t(\bar{Q}^s)\right) = \frac{e^{\gamma+\delta_t x_t(\bar{Q}^s)}}{1 + e^{\gamma+\delta_t x_t(\bar{Q}^s)}} \tag{10}$$

4. Empirical estimates

In this section we compare the evolution of the measures of anchoring of inflation expectations discussed in Section 3 for the United Kingdom, the United States and the euro area. For each economy, we discuss the results implied by the set of measures described in Section 3.1 first, extending the analysis of Natoli and Sigalotti (2016), then we go through the estimation of the LTPT presented in Section 3.2. Our attention is mainly focused on the last part of the sample (2014-2016), when a de-anchoring of inflation expectations from the central banks' target became a widely debated issue.

The estimates are conducted on rolling windows with 250 daily observations (approximately one year). We choose 10th percentile (LTPT) and 90th percentile (RTPT) absolute thresholds, computed over the whole sample period excluding the recent financial crisis (i.e., from April,1 2007 to April 1, 2009).

4.1. United Kingdom

Figure 5 shows the evolution of the comovement indicators of Section 3.1 in the United Kingdom. The measures indicate that the degree of comovement between short-and long-term inflation expectations remained low during the 2014 and the first part of 2015. During the summer of 2015, both linear correlations and the TailCor indicator increased steadily; a closer look at the Up and DownTailcor indexes suggests that the rise in tail correlations was mostly driven by an increase in the co-movement in the left-tail (Figure 5, bottom right panel). Figure 6 shows no signifcant corrrelations between standard deviation of short and long-term expectations; however, the last panel (Up and DownTailcor) indicates that this increase was due to a peak in the pass-through in the left tail, i.e. sharp reductions in uncertainty were transmitted from short- to long-term beliefs, which is not an undesirable phenomenon.

The moderate increase in the pass-through of shocks from short-to long-term beliefs in the early months of 2015 lead to a moderate increase of the LTPT (Figure 7); while on an increasing tend, the current level is not comparable to the spike we observed for the euro area at the end of 2014. While we do not see any actual concern for a de-anchoring risk, the recent upswings deserve attention. No significant differences between left and right tail comovements are reported (lower panel).

Overall, these estimates suggest that long-term inflation expectations in the United Kingdom remained anchored to the monetary policy objective.

4.2. United States

The degree of comovement between revisions in short- and long-term inflation expectations for the United States has been increasing moderately since early 2014 (Figure 8). The rise in the pass-through intensity affected also the tails of the distribution, which account for extreme daily revisions of inflation expectations; nevertheless, no significant asymmetry between co-variations of right and left tails emerges, thus contrasting with a downside de-anchoring scenario (bottom right panel). Figure 9 shows that in the first half of 2014 there was an increase in the intensity of comovement between the uncertainty around short- and long-term inflation expectations in the US, but this increase was reversed by the end of the year. The recent increase in the copula-based indicator of standard deviation pass-through does not match the evidence of TailCor-type measures: according to them, tail correlations between short- and long-term standard deviations had a spike in 2014, but no asymmetry between the right and the left tails was detected (Up and DownTailCor move together, bottom right panel).

Figure 10 highlights that, according to the estimates based on the LTPT indicator, there is no evidence of de-anchoring of long-term inflation expectations in the United States in the aftermath of the crisis (upper panel), and no significant differences between left and right tail comovements (lower panel).

4.3. Euro area

A comparison between Figures 5 and 8 (UK and US) on one hand and Figure 11 (euro area) on the other hand highlights that the intensification of the pass-through in the last part of the sample was stronger in the euro area than in the other two economies, according to the indicators presented in Section 3.1.

Figures 11 and 12, overall, indicate that linear and tail correlations remained high in the euro area during 2015 and 2016, but confirm an attenuation in the pass-through of expectations and uncertainty, as it was also suggested in Natoli and Sigalotti (2016) based on the empirical evidence available until mid February 2015. Moreover, the most recent data suggest that the asymmetry between the co-movements in the left tail and in the right tail, that was evident during 2014, is no longer in place (Figure 11, bottom right panel).[12]

[12] In Natoli and Sigalotti (2016) it was noted that, in addition to increasing average and tail correlations in the euro area, correlations between left tails (DownTailCor) progressively increased throughout 2014, while

Figure 13 shows the evolution of the LTPT indicator in the euro area. No relevant episodes of downside de-anchoring are detected before the global financial crisis. Between mid-2013 and mid-2014 the indicator started to grow, reaching a peak in late 2014. Its interesting to compare its evolution with the one of the RTPT (lower panel): while the LTPT started to increase in October 2014, the RTPT only followed in December, reaching a lower peak than the LTPT and then retrenching to 2013 levels. On the contrary, the LTPT remained high and volatile also in 2015 and 2016. This evidence is key in interpreting anchoring: while the *level* of comovement between left and right tail variations is quite similar to each other, the left tail covariations are much more importance than right tail ones *in relative terms*, i.e. with respect to any other association between short and long-term expectations.

4.4. Robustness checks

The empirical analysis shows a sharp increase in the de-anchoring risk for the euro area in late 2014, partly reversed during 2015, and no relevant episodes of de-anchoring for the United States and United Kingdom. In this section we propose alternative estimates of the LTPT and RTPT indicators as a robustness check.

Fixed-threshold LTPT First of all, referring to the issue raised in Section 3.2, we compute alternative estimates of the LTPT using fixed thresholds. Results for the euro area are shown in Figure 14.[13] As our indicator, the fixed-threshold LTPT peaked around end-2014; however, confirming our intuition, the very low number of identified tail variations makes confidence bands extremely large, suggesting very low power as an anchoring test.

Window length and tail level Secondly, we re-estimate the indicators using different specifications of the parameters: (i) different absolute tails; (ii) different sizes of the rolling window. Results for the euro area for the LTPT (left panels) and RTPT (right panels) are shown in Figure 15.[14]

Upper panels compare the baseline specification of the left and right tail cutoffs (10th and 90th percentiles) and two alternative ones (5th-95th and 15th-85th percentiles). Overall, the narrative remains the same for the three specifications. The higher volatility in the LTPT indicator based on a left-tail threshold at 5% can be explained by the smaller number of tail-labeled observations. Lower panels compare estimates carried out using 180- and 360-

correlations in the right tails (UpTailCor) followed the same trend only in the last part of the year. This signalled a higher likelihood of negative shocks being transmitted to long-term expectations.

[13] LTPT with fixed thresholds for the US and UK are available upon request.

[14] As before, results for the US and UK are available upon request.

day rolling windows in addition to out 250-day baseline specification: results remain broadly unchanged under the alternative specifications of the window size.

Controlling for daily oil returns Third, as in other papers dealing with the pass-through of inflation expectations, we control for a possible direct effect of oil returns on long-term expectations (see Miccoli and Neri (2015) and Buono and Formai (2016)). This is motivated by the – puzzling – increased correlation between oil returns and 5y5y forward inflation swaps observed as of recently: from a theoretical point of view, oil shocks should affect long-term expectations only through their effect on short-run inflation expectations. We expand our logit model by including daily oil returns, so that Equation 6 becomes

$$p_t\left(y_t(q_t^l) = 1 | x_t(q_t^s)\right) = \frac{e^{\alpha + \beta_t x_t(q_t^s) + \gamma_t oilret_t}}{1 + e^{\alpha + \beta_t x_t(q_t^s) + \gamma_t oilret_t}} \tag{11}$$

Results reported in Figure 16 show that the LTPT does not change if daily oil returns are included in the model.

5. Conclusions

In this paper, we propose a comparative analysis of the degree of anchoring of inflation expectations in the euro area, United States and United Kingdom using both the market-based measures used in Natoli and Sigalotti (2016) (Pearson's correlations, copula-based tail correlations and TailCor indexes) and a new market-based indicator. First of all, we extend the analysis conducted in Natoli and Sigalotti (2016) to the United States and United Kingdom, using data on quoted inflation swaps and options. The results suggest that average and tail correlations have increased during the last year in the United States and, more recently, in the United Kingdom; however, even though no asymmetry in the transmission of shocks is found for the US, some signs of asymmetric behaviour in the tails are observed for the UK as of recently. For the euro area, linear and tail correlations increased at the end of 2014, remaining high and volatile during 2015 and 2016.

Secondly, we introduce a new indicator (called Left-tail Pass-Through indicator) derived from rolling logistic regressions, a simple measure which quantifies how strongly the presence or absence of large downswings in long-term expectations is associated with the presence or absence of large negative revisions in short-term ones. The results from the estimate of the LTPT indicator confirm, for the euro area, a strong increase in the de-anchoring risk during the last quarter of 2014; expectations in the US and UK are instead judged to be firmly anchored.

References

Autrup, S.L. and M. Grothe (2014), "Economic surprises and inflation expectations: has anchoring of expectations survived the crisis?" *ECB Working paper series nr. 1671.*

Bauer, M. and J. Christensen (2014), "Financial market outlook for inflation." *FRBSF Economic Letter.*

BoE (2015), "Inflation report." *May 2015.*

Buono, I. and S. Formai (2016), "The evolution of the anchoring of inflation expectations." *Bank of Italy Occasional Papers nr. 321.*

Galati, G., S. Poelhekke, and C. Zhoua (2011), "Did the crisis affect inflation expectations?" *International Journal of Central Banking*, 7(1).

Gurkaynak, R.S., A. Levin, and E.T. Swanson (2010), "Does inflation targeting anchor long-run inflation expectations? Evidence from the US, UK, and Sweden." *Journal of the European Economic Association*, 8(6), 1208–1242.

Kocherlakota, N. (2013), "Optimal outlooks." *Speech at the Conference on Extracting and Understanding the Risk Neutral Probability Density from Option Prices, NYU Stern School of Business.*

Mehrotra, A. and J. Yetman (2014), "Decaying expectations: what inflation forecasts tell us about the anchoring of inflation expectations." *BIS Working Papers*, 464.

Miccoli, M. and S. Neri (2015), "Inflation surprises and inflation expectations in the euro area." *Bank of Italy Occasional Papers nr. 265.*

Natoli, F. and L. Sigalotti (2016), "Tail comovement in inflation expectations as an indicator of anchoring." *International Journal of Central Banking, forthcoming.*

Nautz, T. and D. Strohsal (2015), "Are us inflation expectations re-anchored?" *Economics Letters*, 127, 6–9.

Nechio, F. (2015), "Have long-term inflation expectations declined?" *FRBSF ECONOMIC LETTER nr. 11.*

Pericoli, M. (2012), "Expected inflation and inflation risk premium in the euro area and in the united states." *Bank of Italy Working Paper Series*, 842.

Scharnagl, M. and J. Stapf (2015), “Inflation, deflation, and uncertainty: What drives euro area option-implied inflation expectations and are they still anchored in the sovereign debt crisis?” *Economic Modeling*, 48.

Taboga, M. (2016), “Option-implied probability distributions: how reliable? how jagged?” *International Review of Economics and Finance*, 45, 453–469.

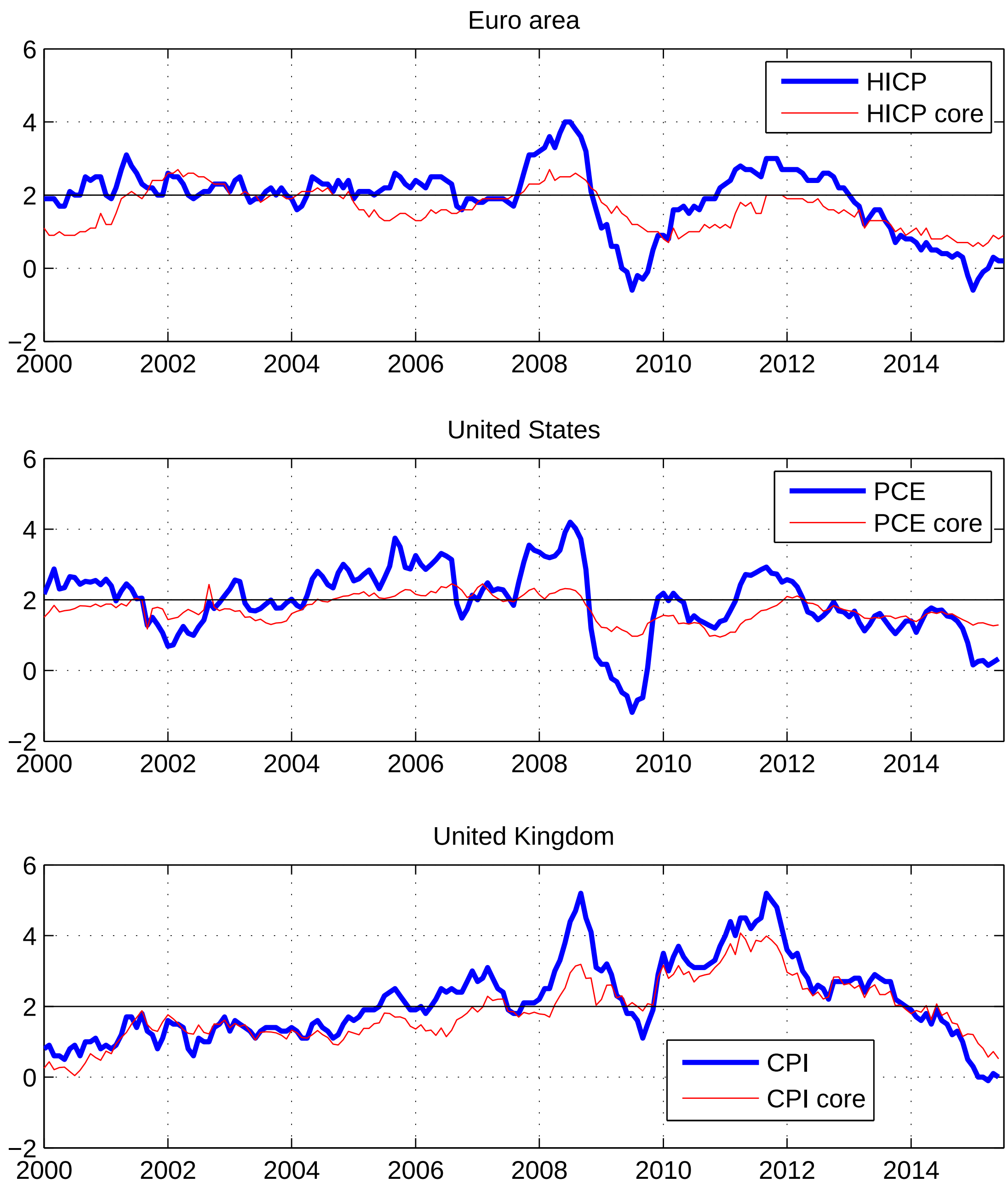


Figure 1. Inflation targets in the Euro Area, US and UK. Core indices are all items less food and energy.

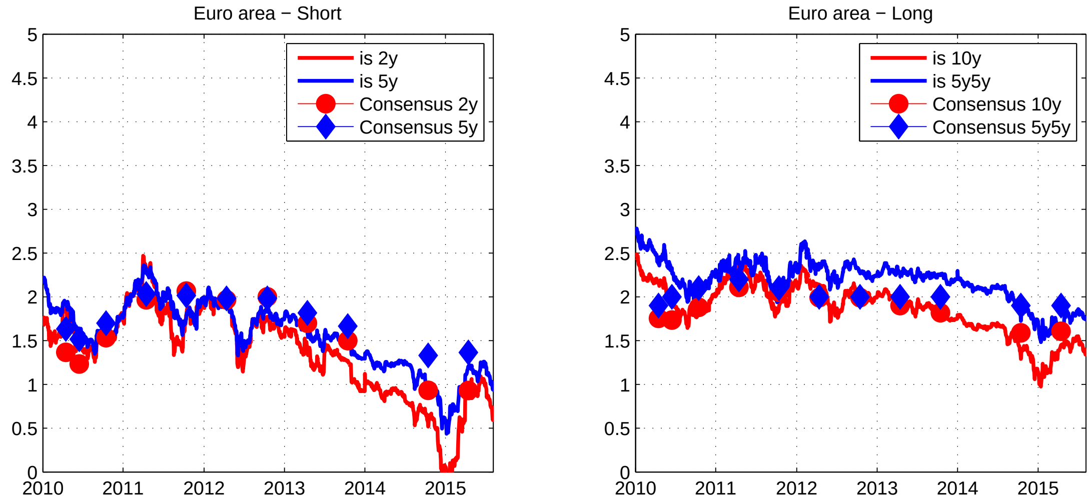


Figure 2. Market-based and survey based inflation expectations for the euro area. The underlying measures of inflation are HICPxT (inflation swaps) and CPI (survey-based).

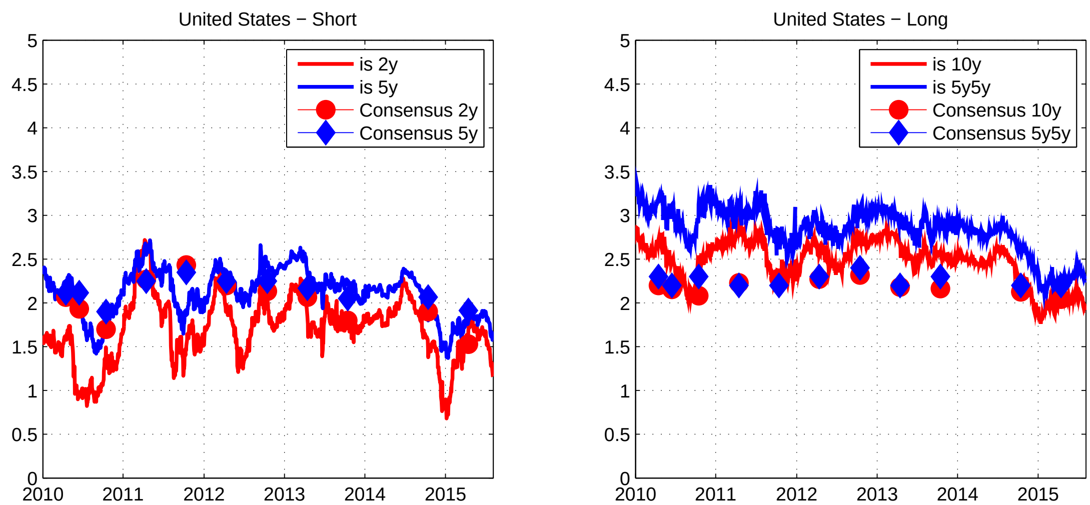


Figure 3. Market-based and survey based inflation expectations for the United States. The underlying measure of inflation is the CPI index (inflation swaps and survey-based).

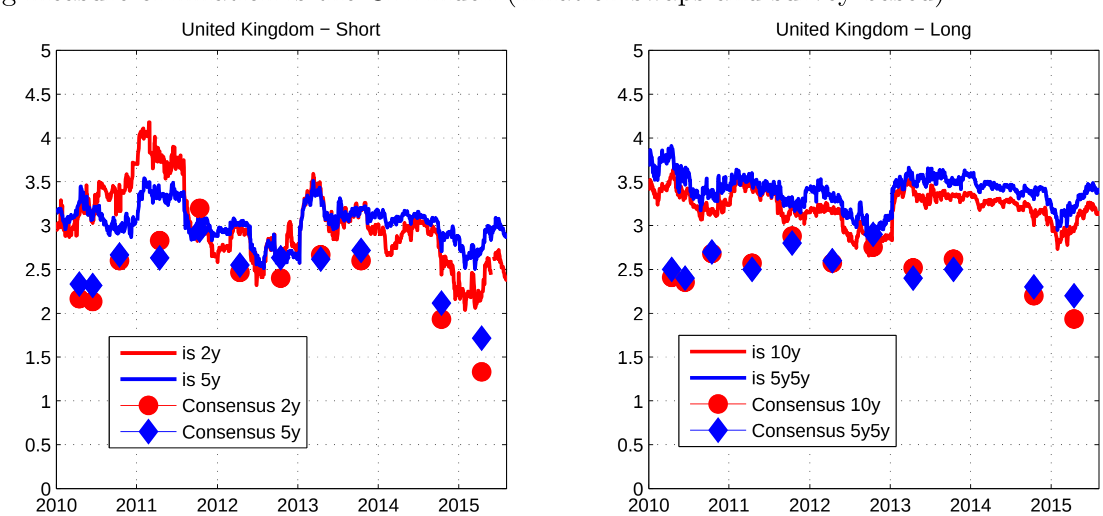


Figure 4. Market-based and survey based inflation expectations for the United Kingdom. The underlying measures of inflation are RPI (inflation swaps) and CPI (survey-based).

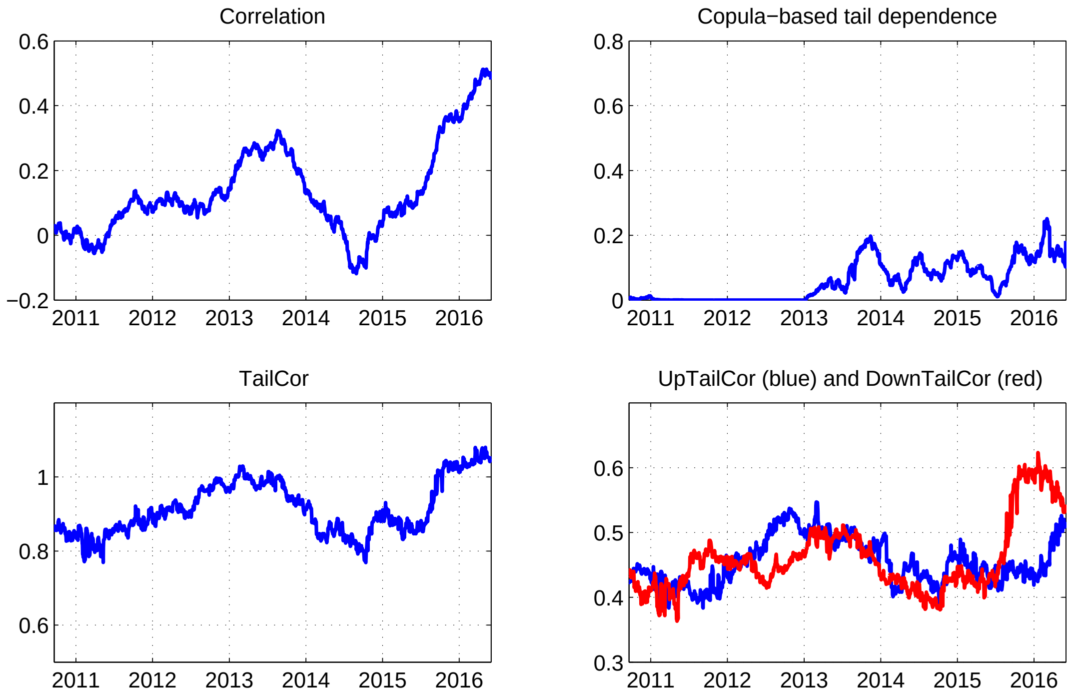


Figure 5. Four indicators of short- vs. medium-to-long term inflation expectations pass-through in the **United Kingdom**: (i) Pearson's ρ correlation coefficient; (ii) Student's t copula-based coefficient of tail dependence; (iii) TailCor index; (iv) UpTailCor (blue line) and DownTailCor (red line). Short-term expectations are 1y ahead after 1 year (1y1y forward inflation swaps), while medium-to-long term ones are 5 years ahead after 5 years (5y5y forward). Sample: 5-Oct-2009 to 31-May-2016.

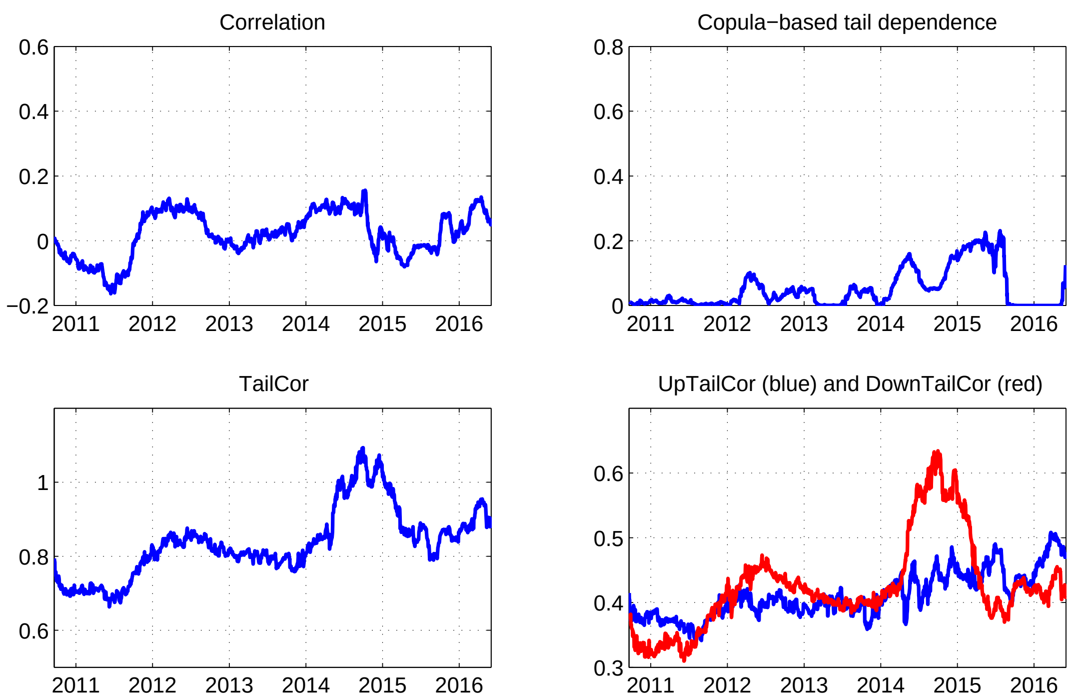


Figure 6. Four indicators of short- vs. medium-to-long term inflation uncertainty pass-through in the **United Kingdom**: (i) Pearson's ρ correlation coefficient; (ii) Student's t copula-based coefficient of tail dependence; (iii) TailCor index; (iv) UpTailCor (blue line) and DownTailCor (red line). Uncertainty about future inflation is proxied by the standard deviation of option-implied distributions of future inflation. Short-term uncertainty is 1 year head, while long-term one is 10 years ahead. Sample: 5-Oct-2009 to 31-May-2016.

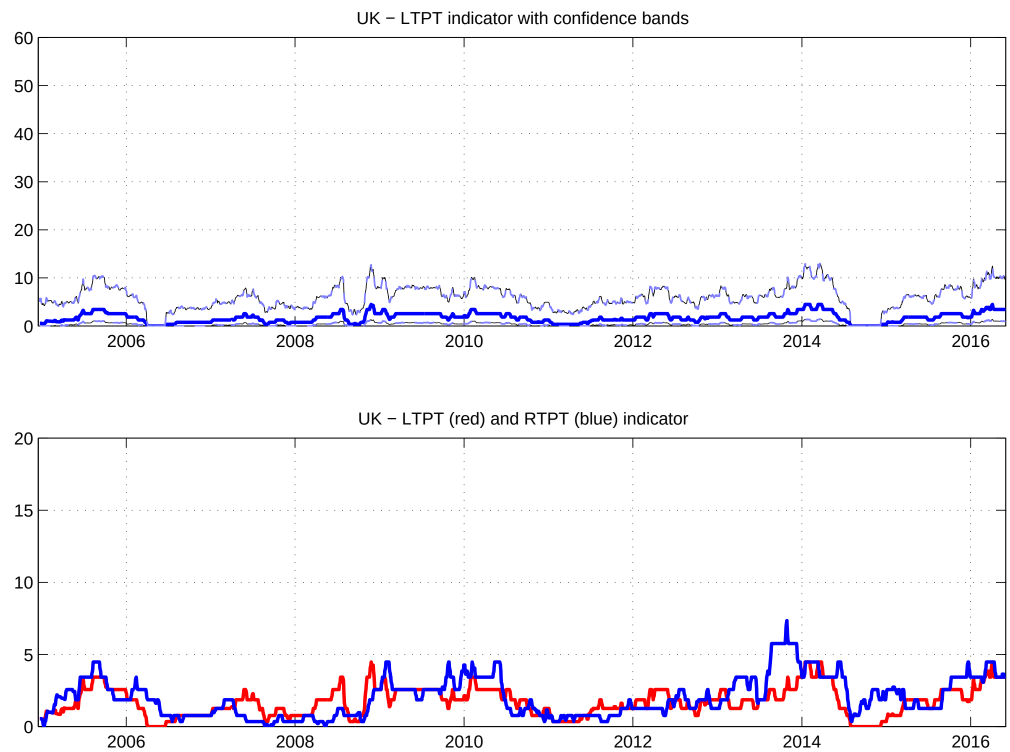


Figure 7. Panel (a): Left-tail pass-through (LTPT) indicator for the **United Kingdom** computed from a logistic regression; 5-day moving averages are reported. Panel (b): Left-tail pass-through indicator (red) and right-tail pass-through indicator (blue). Rolling estimates with a window of 250 observations in the period 1-Jan-2004 to 31-May-2016.

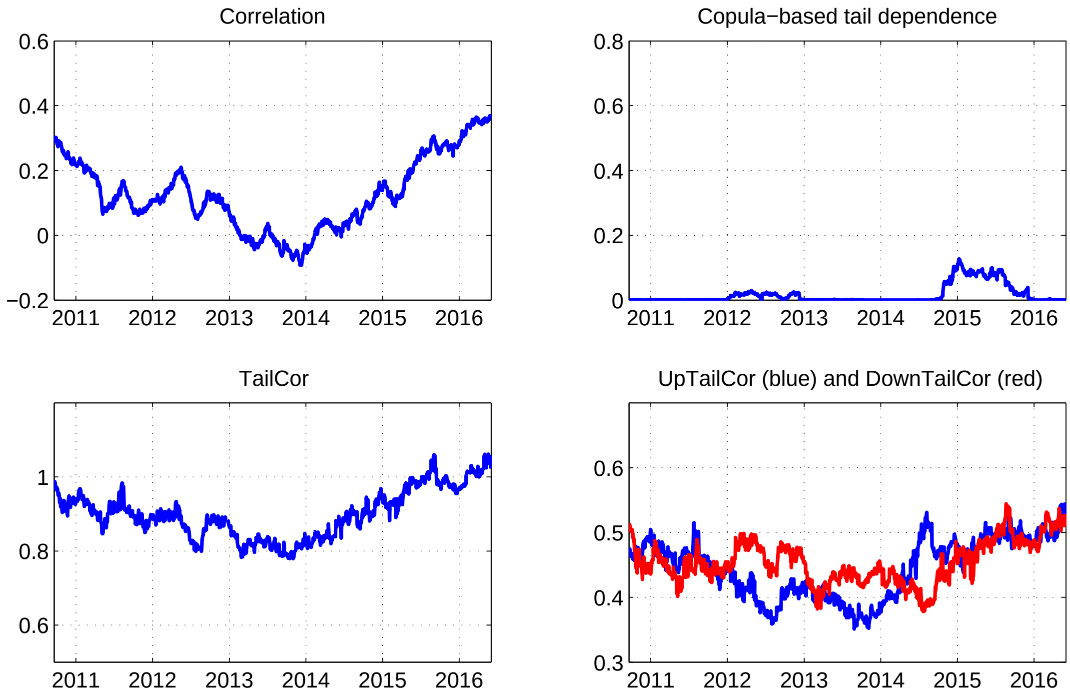


Figure 8. Four indicators of short- vs. medium-to-long term inflation expectations pass-through in the **United States**: (i) Pearson's ρ correlation coefficient; (ii) Student's t copula-based coefficient of tail dependence; (iii) TailCor index; (iv) UpTailCor (blue line) and DownTailCor (red line). Short-term expectations are 1y ahead after 1 year (1y1y forward inflation swaps), while medium-to-long term ones are 5 years ahead after 5 years (5y5y forward). Sample: 5-Oct-2009 to 31-May-2016.

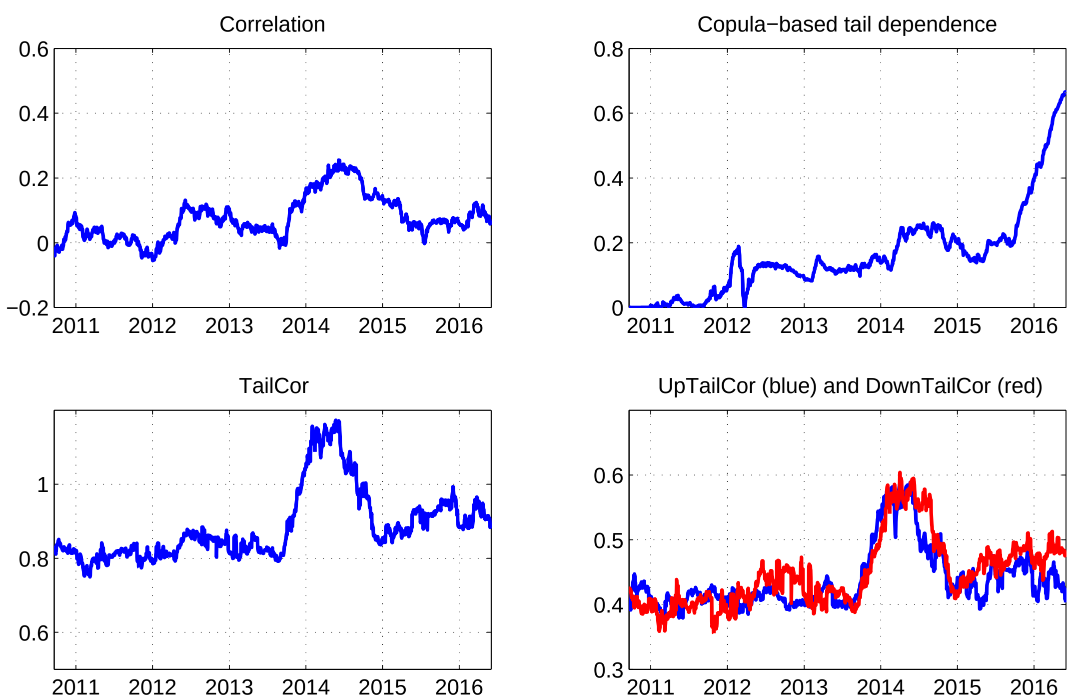


Figure 9. Four indicators of short- vs. medium-to-long term inflation uncertainty pass-through in the **United States**: (i) Pearson's ρ correlation coefficient; (ii) Student's t copula-based coefficient of tail dependence; (iii) TailCor index; (iv) UpTailCor (blue line) and DownTailCor (red line). Uncertainty about future inflation is proxied by the standard deviation of option-implied distributions of future inflation. Short-term uncertainty is 1 year head, while long-term one is 10 years ahead. Sample: 5-Oct-2009 to 31-May-2016.

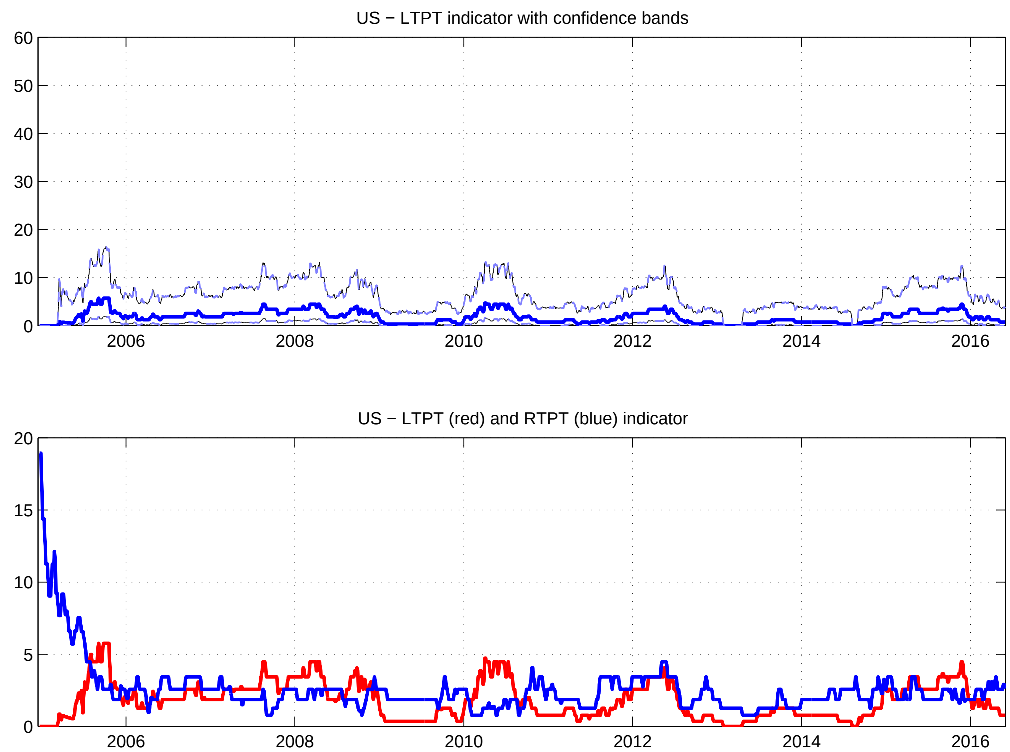


Figure 10. Panel (a): Left-tail pass-through (LTPT) indicator for the **United States** computed from a logistic regression; 5-day moving averages are reported. Panel (b): Left-tail pass-through indicator (red) and right-tail pass-through indicator (blue). Rolling estimates with a window of 250 observations in the period 1-Jan-2004 to 31-May-2016.

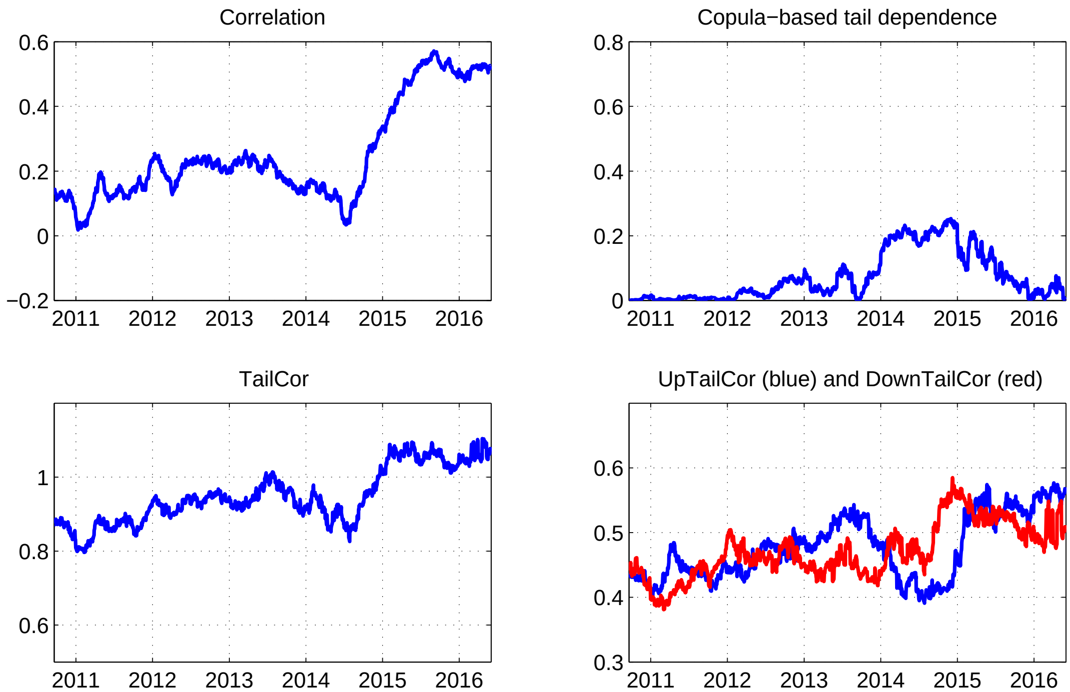


Figure 11. Four indicators of short- vs. medium-to-long term inflation expectations pass-through in the **euro area**: (i) Pearson's ρ correlation coefficient; (ii) Student's t copula-based coefficient of tail dependence; (iii) TailCor index; (iv) UpTailCor (blue line) and DownTailCor (red line). Short-term expectations are 1y ahead after 1 year (1y1y forward inflation swaps), while medium-to-long term ones are 5 years ahead after 5 years (5y5y forward). Sample: 5-Oct-2009 to 31-May-2016.

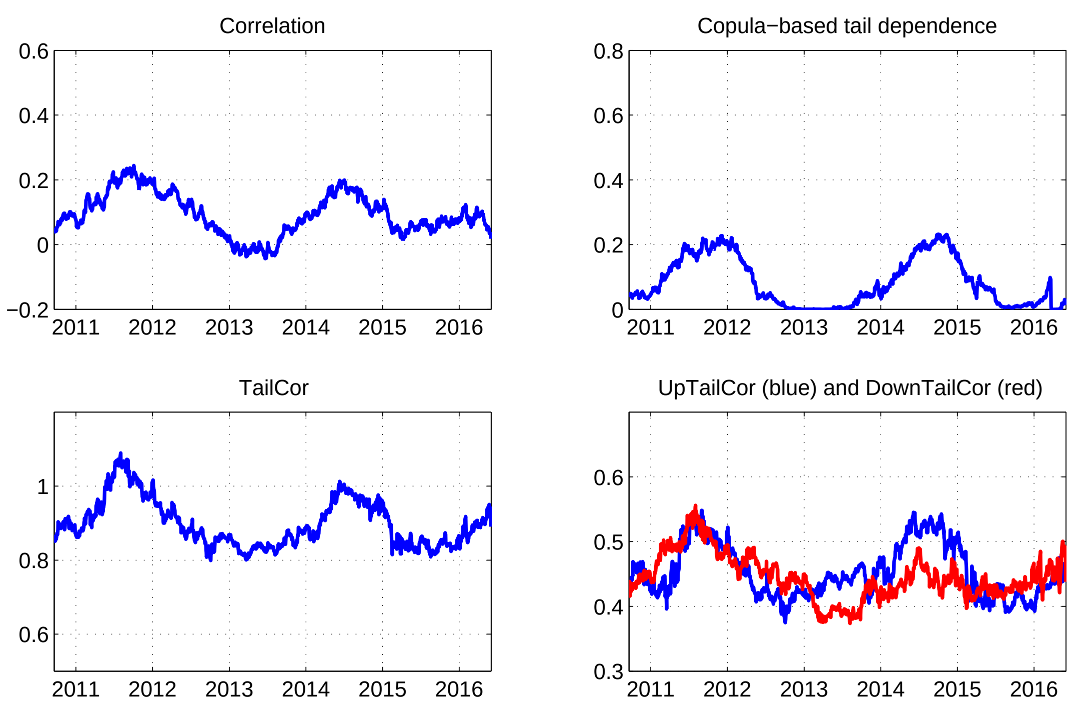


Figure 12. Four indicators of short- vs. medium-to-long term inflation uncertainty pass-through in the **euro area**: (i) Pearson's ρ correlation coefficient; (ii) Student's t copula-based coefficient of tail dependence; (iii) TailCor index; (iv) UpTailCor (blue line) and DownTailCor (red line). Uncertainty about future inflation is proxied by the standard deviation of option-implied distributions of future inflation. Short-term uncertainty is 1 year head, while long-term one is 10 years ahead. Sample: 5-Oct-2009 to 31-May-2016.

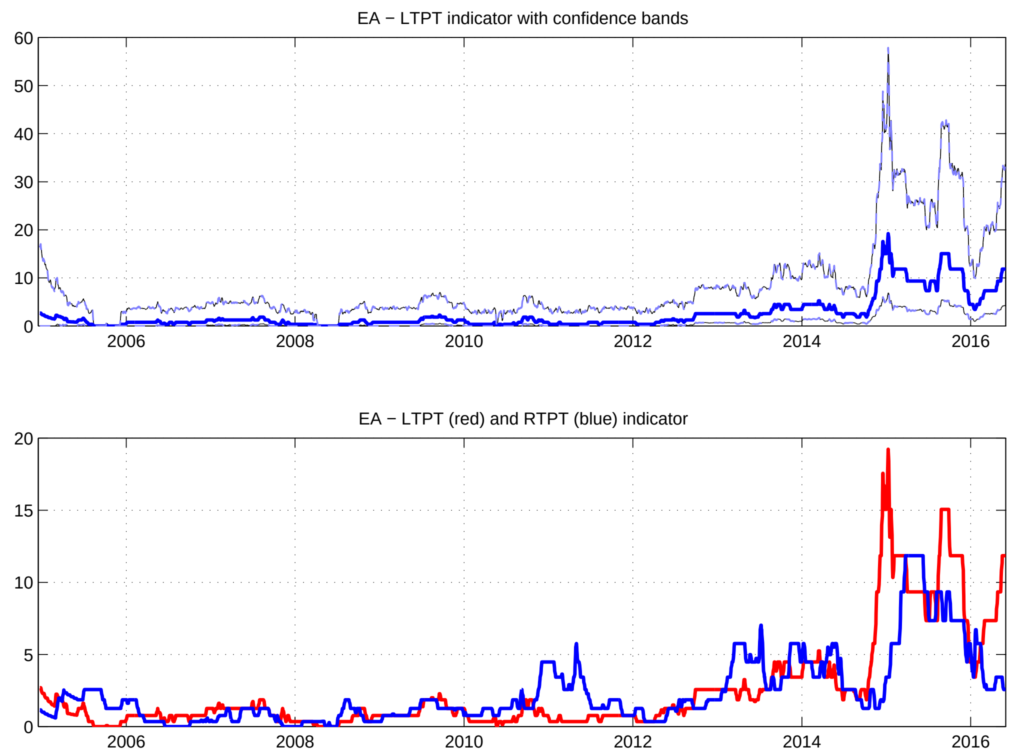


Figure 13. Panel (a): Left-tail pass-through (LTPT) indicator for the **euro area** computed from a logistic regression; 5-day moving averages are reported. Panel (b): Left-tail pass-through indicator (red) and right-tail pass-through indicator (blue). Rolling estimates with a window of 250 observations in the period 1-Jan-2004 to 31-May-2016.

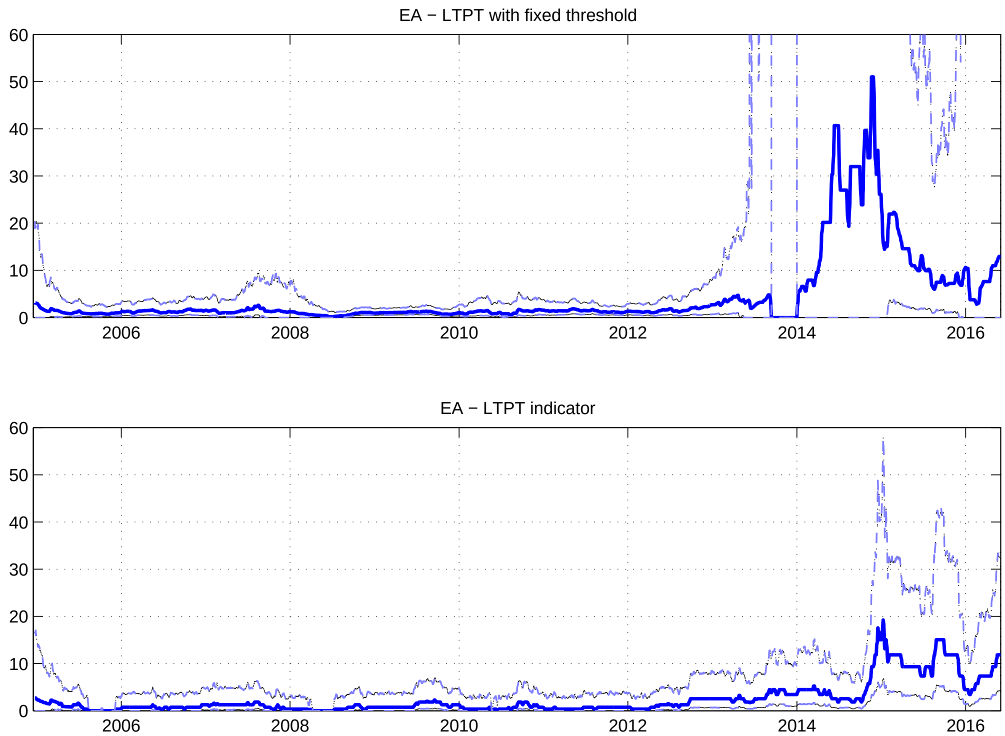


Figure 14. LTPT computed with fixed thresholds (upper panel) vs LTPT (lower panel). Bootstrapped confidence bands in both panels are computed with 1000 replications. Sample: 5-Oct-2009 to 31-May-2016.

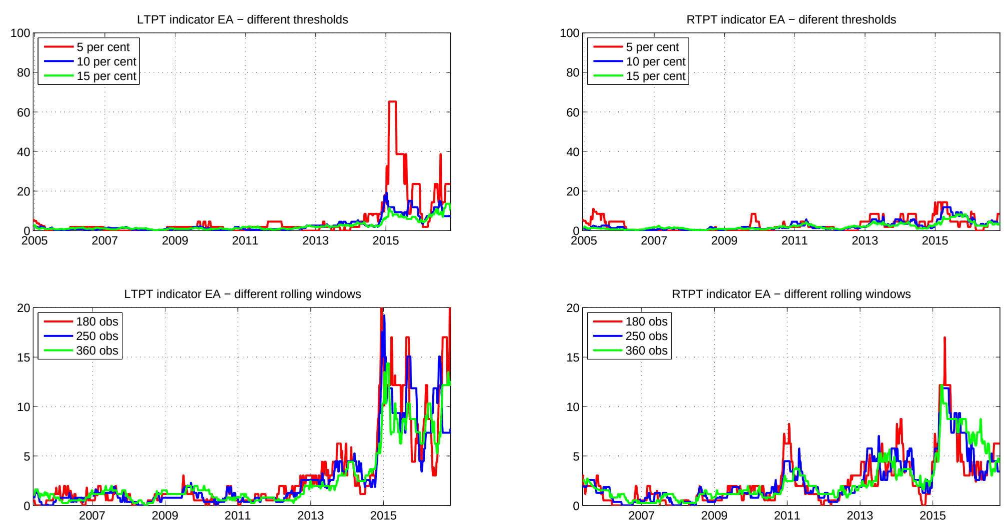


Figure 15. Robustness checks for the LTPT and RTPT. Sample: 5-Oct-2009 to 31-May-2016.

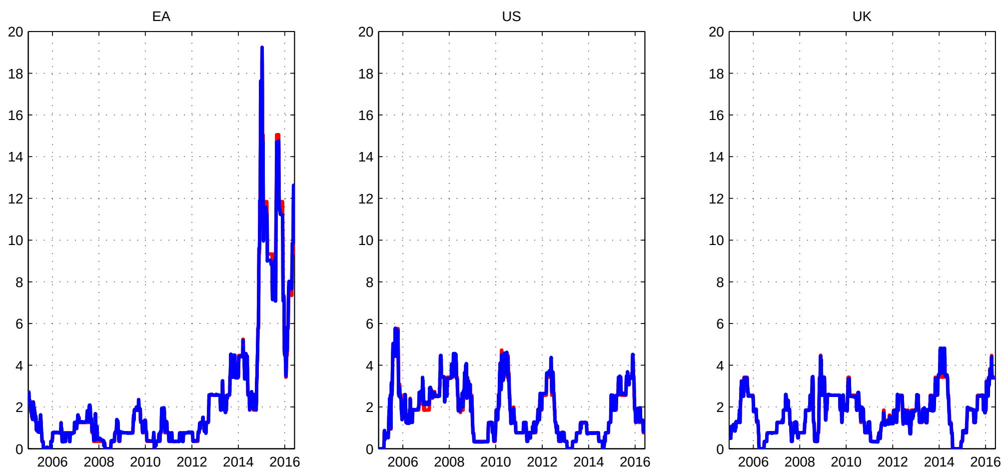


Figure 16. Robustness checks for the LTPT to a logit model that controls for daily oil returns. Sample: 5-Oct-2009 to 31-May-2016.

RECENTLY PUBLISHED "TEMI" (*)

N. 1073 – *Search costs and the severity of adverse selection,* by Francesco Palazzo (July 2016).

N. 1074 – *Macroeconomic effectiveness of non-standard monetary policy and early exit. A model-based evaluation*, by Lorenzo Burlon, Andrea Gerali, Alessandro Notarpietro and Massimiliano Pisani (July 2016).

N. 1075 – *Quantifying the productivity effects of global sourcing,* by Sara Formai and Filippo Vergara Caffarelli (July 2016).

N. 1076 – *Intergovernmental transfers and expenditure arrears,* by Paolo Chiades, Luciano Greco, Vanni Mengotto, Luigi Moretti and Paola Valbonesi (July 2016).

N. 1077 – *A "reverse Robin Hood"? The distributional implications of non-standard monetary policy for Italian households*, by Marco Casiraghi, Eugenio Gaiotti, Lisa Rodano and Alessandro Secchi (July 2016).

N. 1078 – *Global macroeconomic effects of exiting from unconventional monetary policy,* by Pietro Cova, Patrizio Pagano and Massimiliano Pisani (September 2016).

N. 1079 – *Parents, schools and human capital differences across countries*, by Marta De Philippis and Federico Rossi (September 2016).

N. 1080 – *Self-fulfilling deflations*, by Roberto Piazza, (September 2016).

N. 1081 – *Dealing with student heterogeneity: curriculum implementation strategies and student achievement*, by Rosario Maria Ballatore and Paolo Sestito, (September 2016).

N. 1082 – *Price dispersion and consumer inattention: evidence from the market of bank accounts*, by Nicola Branzoli, (September 2016).

N. 1083 – *BTP futures and cash relationships: a high frequency data analysis*, by Onofrio Panzarino, Francesco Potente and Alfonso Puorro, (September 2016).

N. 1084 – *Women at work: the impact of welfare and fiscal policies in a dynamic labor supply model*, by Maria Rosaria Marino, Marzia Romanelli and Martino Tasso, (September 2016).

N. 1085 – *Foreign ownership and performance: evidence from a panel of Italian firms*, by Chiara Bentivogli and Litterio Mirenda (October 2016).

N. 1086 – *Should I stay or should I go? Firms' mobility across banks in the aftermath of financial turmoil*, by Davide Arnaudo, Giacinto Micucci, Massimiliano Rigon and Paola Rossi (October 2016).

N. 1087 – *Housing and credit markets in Italy in times of crisis*, by Michele Loberto and Francesco Zollino (October 2016).

N. 1088 – *Search peer monitoring via loss mutualization*, by Francesco Palazzo (October 2016).

N. 1089 – *Non-standard monetary policy, asset prices and macroprudential policy in a monetary union*, by Lorenzo Burlon, Andrea Gerali, Alessandro Notarpietro and Massimiliano Pisani (October 2016).

N. 1090 – *Does credit scoring improve the selection of borrowers and credit quality?*, by Giorgio Albareto, Roberto Felici and Enrico Sette (October 2016).

N. 1091 – *Asymmetric information and the securitization of SME loans*, by Ugo Albertazzi, Margherita Bottero, Leonardo Gambacorta and Steven Ongena (December 2016).

N. 1092 – *Copula-based random effects models for clustered data*, by Santiago Pereda Fernández (December 2016).

N. 1093 – *Structural transformation and allocation efficiency in China and India*, by Enrica Di Stefano and Daniela Marconi (December 2016).

N. 1094 – *The bank lending channel of conventional and unconventional monetary policy*, by Ugo Albertazzi, Andrea Nobili and Federico M. Signoretti (December 2016).

N. 1095 – *Household debt and income inequality: evidence from Italian survey data*, by David Loschiavo (December 2016).

(*) Requests for copies should be sent to:
Banca d'Italia – Servizio Studi di struttura economica e finanziaria – Divisione Biblioteca e Archivio storico – Via Nazionale, 91 – 00184 Rome – (fax 0039 06 47922059). They are available on the Internet www.bancaditalia.it.

2015

AABERGE R. and A. BRANDOLINI, *Multidimensional poverty and inequality,* in A. B. Atkinson and F. Bourguignon (eds.), Handbook of Income Distribution, Volume 2A, Amsterdam, Elsevier, **TD No. 976 (October 2014).**

ALBERTAZZI U., G. ERAMO, L. GAMBACORTA and C. SALLEO, *Asymmetric information in securitization: an empirical assessment*, Journal of Monetary Economics, v. 71, pp. 33-49, **TD No. 796 (February 2011).**

ALESSANDRI P. and B. NELSON, *Simple banking: profitability and the yield curve,* Journal of Money, Credit and Banking, v. 47, 1, pp. 143-175, **TD No. 945 (January 2014).**

ANTONIETTI R., R. BRONZINI and G. CAINELLI, *Inward greenfield FDI and innovation,* Economia e Politica Industriale, v. 42, 1, pp. 93-116, **TD No. 1006 (March 2015).**

BARDOZZETTI A. and D. DOTTORI, *Collective Action Clauses: how do they Affect Sovereign Bond Yields?,* Journal of International Economics , v 92, 2, pp. 286-303, **TD No. 897 (January 2013).**

BARONE G. and G. NARCISO, *Organized crime and business subsidies: Where does the money go?,* Journal of Urban Economics, v. 86, pp. 98-110, **TD No. 916 (June 2013).**

BRONZINI R., *The effects of extensive and intensive margins of FDI on domestic employment: microeconomic evidence from Italy,* B.E. Journal of Economic Analysis & Policy, v. 15, 4, pp. 2079-2109, **TD No. 769 (July 2010).**

BUGAMELLI M., S. FABIANI and E. SETTE, *The age of the dragon: the effect of imports from China on firm-level prices*, Journal of Money, Credit and Banking, v. 47, 6, pp. 1091-1118, **TD No. 737 (January 2010).**

BULLIGAN G., M. MARCELLINO and F. VENDITTI, *Forecasting economic activity with targeted predictors,* International Journal of Forecasting, v. 31, 1, pp. 188-206, **TD No. 847 (February 2012).**

CESARONI T., *Procyclicality of credit rating systems: how to manage it,* Journal of Economics and Business, v. 82. pp. 62-83, **TD No. 1034 (October 2015).**

CUCINIELLO V. and F. M. SIGNORETTI, *Large banks,loan rate markup and monetary policy,* International Journal of Central Banking, v. 11, 3, pp. 141-177, **TD No. 987 (November 2014).**

DE BLASIO G., D. FANTINO and G. PELLEGRINI, *Evaluating the impact of innovation incentives: evidence from an unexpected shortage of funds,* Industrial and Corporate Change, , v. 24, 6, pp. 1285-1314, **TD No. 792 (February 2011).**

DEPALO D., R. GIORDANO and E. PAPAPETROU, *Public-private wage differentials in euro area countries: evidence from quantile decomposition analysis,* Empirical Economics, v. 49, 3, pp. 985-1115, **TD No. 907 (April 2013).**

DI CESARE A., A. P. STORK and C. DE VRIES, *Risk measures for autocorrelated hedge fund returns,* Journal of Financial Econometrics, v. 13, 4, pp. 868-895, **TD No. 831 (October 2011).**

CIARLONE A., *House price cycles in emerging economies,* Studies in Economics and Finance, v. 32, 1, **TD No. 863 (May 2012).**

FANTINO D., A. MORI and D. SCALISE, *Collaboration between firms and universities in Italy: the role of a firm's proximity to top-rated departments,* Rivista Italiana degli economisti, v. 1, 2, pp. 219-251, **TD No. 884 (October 2012).**

FRATZSCHER M., D. RIMEC, L. SARNOB and G. ZINNA, *The scapegoat theory of exchange rates: the first tests,* Journal of Monetary Economics, v. 70, 1, pp. 1-21, **TD No. 991 (November 2014).**

NOTARPIETRO A. and S. SIVIERO, *Optimal monetary policy rules and house prices: the role of financial frictions,* Journal of Money, Credit and Banking, v. 47, S1, pp. 383-410, **TD No. 993 (November 2014).**

RIGGI M. and F. VENDITTI, *The time varying effect of oil price shocks on euro-area exports,* Journal of Economic Dynamics and Control, v. 59, pp. 75-94, **TD No. 1035 (October 2015).**

TANELI M. and B. OHL, *Information acquisition and learning from prices over the business cycle,* Journal of Economic Theory, 158 B, pp. 585–633, **TD No. 946 (January 2014).**

2016

ALBANESE G., G. DE BLASIO and P. SESTITO, *My parents taught me. evidence on the family transmission of values,* Journal of Population Economics, v. 29, 2, pp. 571-592, **TD No. 955 (March 2014).**

ANDINI M. and G. DE BLASIO, *Local development that money cannot buy: Italy's Contratti di Programma,* Journal of Economic Geography, v. 16, 2, pp. 365-393, **TD No. 915 (June 2013).**

BARONE G. and S. MOCETTI, *Inequality and trust: new evidence from panel data,* Economic Inquiry, v. 54, pp. 794-809, **TD No. 973 (October 2014).**

BELTRATTI A., B. BORTOLOTTI and M. CACCAVAIO, *Stock market efficiency in China: evidence from the split-share reform,* Quarterly Review of Economics and Finance, v. 60, pp. 125-137, **TD No. 969 (October 2014).**

BOLATTO S. and M. SBRACIA, *Deconstructing the gains from trade: selection of industries vs reallocation of workers,* Review of International Economics, v. 24, 2, pp. 344-363, **TD No. 1037 (November 2015).**

BOLTON P., X. FREIXAS, L. GAMBACORTA and P. E. MISTRULLI, *Relationship and transaction lending in a crisis*, Review of Financial Studies, v. 29, 10, pp. 2643-2676, **TD No. 917 (July 2013).**

BONACCORSI DI PATTI E. and E. SETTE, *Did the securitization market freeze affect bank lending during the financial crisis? Evidence from a credit register,* Journal of Financial Intermediation , v. 25, 1, pp. 54-76, **TD No. 848 (February 2012).**

BORIN A. and M. MANCINI, *Foreign direct investment and firm performance: an empirical analysis of Italian firms,* Review of World Economics, v. 152, 4, pp. 705-732, **TD No. 1011 (June 2015).**

BRANDOLINI A. and E. VIVIANO, *Behind and beyond the (headcount) employment rate,* Journal of the Royal Statistical Society: Series A, v. 179, 3, pp. 657-681, **TD No. 965 (July 2015).**

BRIPI F., *The role of regulation on entry: evidence from the Italian provinces,* World Bank Economic Review, v. 30, 2, pp. 383-411, **TD No. 932 (September 2013).**

BRONZINI R. and P. PISELLI, *The impact of R&D subsidies on firm innovation,* Research Policy, v. 45, 2, pp. 442-457, **TD No. 960 (April 2014).**

BURLON L. and M. VILALTA-BUFI, *A new look at technical progress and early retirement,* IZA Journal of Labor Policy, v. 5, **TD No. 963 (June 2014).**

BUSETTI F. and M. CAIVANO, *The trend–cycle decomposition of output and the Phillips Curve: bayesian estimates for Italy and the Euro Area,* Empirical Economics, V. 50, 4, pp. 1565-1587, **TD No. 941 (November 2013).**

CAIVANO M. and A. HARVEY, *Time-series models with an EGB2 conditional distribution,* Journal of Time Series Analysis, v. 35, 6, pp. 558-571, **TD No. 947 (January 2014).**

CALZA A. and A. ZAGHINI, *Shoe-leather costs in the euro area and the foreign demand for euro banknotes,* International Journal of Central Banking, v. 12, 1, pp. 231-246, **TD No. 1039 (December 2015).**

CIANI E., *Retirement, Pension eligibility and home production,* Labour Economics, v. 38, pp. 106-120, **TD No. 1056 (March 2016).**

CIARLONE A. and V. MICELI, *Escaping financial crises? Macro evidence from sovereign wealth funds' investment behaviour,* Emerging Markets Review, v. 27, 2, pp. 169-196, **TD No. 972 (October 2014).**

CORNELI F. and E. TARANTINO, *Sovereign debt and reserves with liquidity and productivity crises,* Journal of International Money and Finance, v. 65, pp. 166-194, **TD No. 1012 (June 2015).**

D'AURIZIO L. and D. DEPALO, *An evaluation of the policies on repayment of government's trade debt in Italy,* Italian Economic Journal, v. 2, 2, pp. 167-196, **TD No. 1061 (April 2016).**

DOTTORI D. and M. MANNA, *Strategy and tactics in public debt management,* Journal of Policy Modeling, v. 38, 1, pp. 1-25, **TD No. 1005 (March 2015).**

ESPOSITO L., A. NOBILI and T. ROPELE, *The management of interest rate risk during the crisis: evidence from Italian banks,* Journal of Banking & Finance, v. 59, pp. 486-504, **TD No. 933 (September 2013).**

MARCELLINO M., M. PORQUEDDU and F. VENDITTI, *Short-Term GDP forecasting with a mixed frequency dynamic factor model with stochastic volatility*, Journal of Business & Economic Statistics , v. 34, 1, pp. 118-127, **TD No. 896 (January 2013).**

RODANO G., N. SERRANO-VELARDE and E. TARANTINO, *Bankruptcy law and bank financing,* Journal of Financial Economics, v. 120, 2, pp. 363-382, **TD No. 1013 (June 2015).**

2017

ALESSANDRI P. and H. MUMTAZ, *Financial indicators and density forecasts for US output and inflation,* Review of Economic Dynamics, v. 24, pp. 66-78, **TD No. 977 (November 2014).**

MOCETTI S. and E. VIVIANO, *Looking behind mortgage delinquencies*, Journal of Banking & Finance, v. 75, pp. 53-63, **TD No. 999 (January 2015).**

PATACCHINI E., E. RAINONE and Y. ZENOU, *Heterogeneous peer effects in education,* Journal of Economic Behavior & Organization, v. 134, pp. 190–227, **TD No. 1048 (January 2016).**

FORTHCOMING

ADAMOPOULOU A. and G.M. TANZI, *Academic dropout and the great recession,* Journal of Human Capital, **TD No. 970 (October 2014).**

ALBERTAZZI U., M. BOTTERO and G. SENE, *Information externalities in the credit market and the spell of credit rationing,* Journal of Financial Intermediation, **TD No. 980 (November 2014).**

BRONZINI R. and A. D'IGNAZIO, *Bank internationalisation and firm exports: evidence from matched firm-bank data,* Review of International Economics, **TD No. 1055 (March 2016).**

BRUCHE M. and A. SEGURA, *Debt maturity and the liquidity of secondary debt markets,* Journal of Financial Economics, **TD No. 1049 (January 2016).**

BURLON L., *Public expenditure distribution, voting, and growth,* Journal of Public Economic Theory, **TD No. 961 (April 2014).**

CONTI P., D. MARELLA and A. NERI, *Statistical matching and uncertainty analysis in combining household income and expenditure data,* Statistical Methods & Applications, **TD No. 1018 (July 2015).**

DE BLASIO G. and S. POY, *The impact of local minimum wages on employment: evidence from Italy in the 1950s,* Regional Science and Urban Economics, **TD No. 953 (March 2014).**

FEDERICO S. and E. TOSTI, *Exporters and importers of services: firm-level evidence on Italy,* The World Economy, **TD No. 877 (September 2012).**

GIACOMELLI S. and C. MENON, *Does weak contract enforcement affect firm size? Evidence from the neighbour's court,* Journal of Economic Geography, **TD No. 898 (January 2013).**

MANCINI A.L., C. MONFARDINI and S. PASQUA, *Is a good example the best sermon? Children's imitation of parental reading,* Review of Economics of the Household, **TD No. 958 (April 2014).**

MEEKS R., B. NELSON and P. ALESSANDRI, *Shadow banks and macroeconomic instability,* Journal of Money, Credit and Banking, **TD No. 939 (November 2013).**

MICUCCI G. and P. ROSSI, *Debt restructuring and the role of banks' organizational structure and lending technologies,* Journal of Financial Services Research, **TD No. 763 (June 2010).**

MOCETTI S., M. PAGNINI and E. SETTE, *Information technology and banking organization,* Journal of Financial Services Research, **TD No. 752 (March 2010).**

NATOLI F. and L. SIGALOTTI, *Tail co-movement in inflation expectations as an indicator of anchoring,* International Journal of Central Banking, **TD No. 1025 (July 2015).**

RIGGI M., *Capital destruction, jobless recoveries, and the discipline device role of unemployment,* Macroeconomic Dynamics, **TD No. 871 July 2012).**

SEGURA A. and J. SUAREZ, *How excessive is banks' maturity transformation?,* Review of Financial Studies, **TD No. 1065 (April 2016).**

ZINNA G., *Price pressures on UK real rates: an empirical investigation,* Review of Finance, **TD No. 968 (July 2014).**