Issues in Monetary Policy and Economic Expectations

Dottorato di Ricerca
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Economia e Politiche dei Mercati e delle Imprese

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Outline

- Questions of research
- Financial stability and economic expectations
- Unconventional monetary policy and financial markets
- Conclusions

This work

1 - What are the effect of uncertainty on real economy and expectations?

- Investigate the effect of “financial instability” on expectations of consumption and investments;

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2 - How unconventional monetary policy affects financial markets?

- Study the effects of CSP Programme on bonds market liquidity and prices;

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2 - How unconventional monetary policy affects financial markets?

- Study the effects of CSP Programme on market liquidity and prices;

Uncertainty and financial shocks

1 - Uncertainty shock

- Less predictability of an aggregate variable (Basu-Bundick 2012)
- Increase in the uncertainty that firms have about their own outcomes due to changes in idiosyncratic variables (Arellano 2012, Gilchrist 2013)
- Uncertainty that people have about others' beliefs, high-order uncertainty (Woodford 2003, Angeletos et al. 2018)

2 - Financial shock:

- Reflects stochastic variations in the parameters that characterize the enforcement/incentive compatibility constraint for the contract between entrepreneurs and supplier of funds (Jermann and Quadrini 2012)
- Exogenous disturbance to the wedge between the cost of funds for the borrowers and the rate of return paid to lenders (Hall 2011)

Financial Instability

- Problem: financial shocks and uncertainty are highly correlated
  i) Difficult to distinguish between financial and uncertainty shocks

- Solution: construct a "new" measure that captures the key aspects of the financial market conditions
  i) "Financial Instability" as a synthetic measure of uncertainty and volatility condition of the financial system;
  ii) Study the effect of financial instability on expectations

Empirical Analysis

Two steps:

i) Construct an index of Financial Stability (SEMFSI)
   - Equity market returns and volatility index, Government bond market volatility, Volatility index, Banking stock return and volatility, Foreign exchange volatility, TED spread and Interbank offered rates volatility;

ii) Estimate the effect of financial instability shock on expectations
   - Business confidence index (BCI)
   - Consumption confidence index (CCI)

Identification strategy

We would like to estimate:

$$E\left[Y_{t+1}|I_t\right] = \alpha + \beta FSI_t + \varepsilon_t \tag{1}$$

The innovations and the FSI can be written as:

$$\varepsilon_t = \sum_{i=1}^{K} \varepsilon_t^i \tag{2}$$

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$$\varepsilon_t = \sum_{i=1}^{K} \varepsilon_t^i \tag{2}$$

$$FSI_t = \sum_{i=1}^{K} b_t \varepsilon_t^i + \sum_{j=1}^{Q} \omega_t^j \tag{3}$$

Substitute (3) in (1):

$$E\left[Y_{t+1}|I_t\right] = \alpha + \beta\left[\sum_{i=1}^{K} b_t^i \varepsilon_t^i + \sum_{j=1}^{Q} \omega_t^j\right] + \varepsilon_t \tag{4}$$

Fixing Endogeneity

i) Rewrite (4) as the following:

$$E\left[Y_{t+1}|I_t\right] = \alpha + \beta\omega_t^{j*} + \left[\sum_{i=1}^{K}\left(1+b_t^i\right)\varepsilon_t^i + \sum_{j\neq j*}^{Q}\omega_t^j\right] \quad (5)$$

where ω_t^{j*} is an exogenous shock uncorrelated with error term;

ii) Identify a variable ω_t^{j*} that is unrelated to the business cycle;

- Exogenous shock ω_t^{j*} $\Rightarrow$ Announcements made by ECB in the period 2001-2016 in favor of financial stability;
- Estimate the effect of *Announcements* on *Confidence Indexes* using linear regression model;

Model specification

- The regression equation is:

$$Y_{i,t} = \alpha + \gamma Fixed_{country} + \delta X_{i,t-1} + \beta Announcement_t + \epsilon_t$$

  where:
  - $Y_{i,t}$ is a measure of consumption and investment expectations;
  - We add country fixed effects to control for time in-varying unobservables;
  - $X_{i,t-1}$ controls for last period economic conditions;
- Under the assumption that the variable *Announcement* is exogenous, β capture the effect of financial instability shock on economic expectations;

Results OLS regression

Figure 1: Results of OLS regression

	(1) BCI		(2) CCI	
Announcement	-0.0693***	(-3.53)	-0.0308*	(-1.95)
BCI_1	0.964***	(241.12)		
GDPCurrentPrice1	-2.365	(-1.29)	-1.996	(-1.57)
FinalConsumptionExp1	-3.436	(-0.79)	3.651	(1.02)
HouseholdFinalconsumption1	5.286	(1.54)	-2.640	(-0.94)
GrossCapitalFormation1	1.332***	(3.05)	0.740**	(2.19)
GrossFixedCapitalFormation1	-1.309	(-0.98)	-0.817	(-0.77)
ImportGoodService1	1.247*	(1.88)	-1.293**	(-2.40)
TaxlessSubsidies1	-0.0260	(-0.16)	0.0417	(0.36)
PublicConsumption1	1.365	(1.21)	-0.559	(-0.59)
InterbankReturn_1	0.105***	(5.55)	0.0177	(1.13)
GovBondReturn_1	-0.128	(-0.84)	-0.186	(-1.50)
StockMarketReturn_1	0.725***	(9.45)	0.800***	(12.77)
BankStockReturn_1	-0.408***	(-9.30)	-0.401***	(-11.91)
SEMFSI_1	-0.0601***	(-9.34)	-0.0254***	(-5.11)
Crisis	0.00759	(0.72)	0.0264***	(3.12)
CCI_1			0.986***	(359.16)
_cons	-0.00112	(-0.15)	-0.00165	(-0.27)
N	2946		3048	
adj. R^2	0.968		0.981	

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Dynamic response of economic expectations

- We use Jorda's (2005) Local Projection to estimate IR:

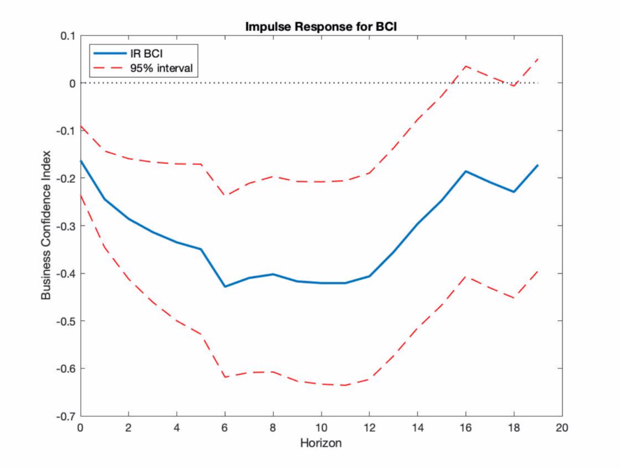
$$Y_{t+h} = \alpha_h + \delta_h X_{t-1} + \beta_h Announcement_t + \epsilon_{t+h}$$

where:

- β_h capture the response of variable Y after h periods;
- $Announcement_t$ is the exogenous shock;
- X_{t-1} controls for the underline economic conditions;

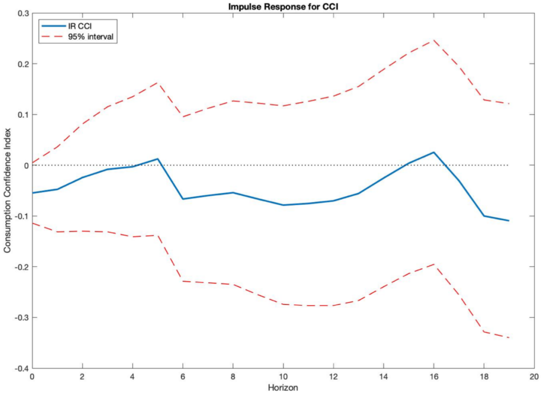
IR using Local Projection - Investment

Figure 2: Dynamic Response of BCI



IR using Local Projection - Consumption

Figure3: Dynamic Response of CCI



Conclusion

We find that:

- A financial instability shock depress investment confidence;
- The effect on consumption confidence is not statistically significant;
- The effect on investment confidence last for 14 periods;

This work

1 - What are the effect of uncertainty on real economy and expectations?

- Investigate the effect of "financial instability" on expectations of consumption and investments;

2 - How unconventional monetary policy affects financial markets?

- Study the effects of CSP Programme on bonds market liquidity and prices;[1]

[1] This work is co-authored with dott. Fulvio Ferretti (McKinsey)

Motivation

- On 10 March 2016, the Governing Council of the ECB announced the Corporate Sector Purchase Programme (CSPP);
- The program officially started on the 8th of June 2016;
- The program involved all bonds with the following characteristics:
  - Be eligible as collateral for Euro system credit operations;
  - Be denominated in euro;
  - Fulfil a minimum first-best credit assessment of at least credit quality step 3 (rating of BBB- or equivalent);
  - Hold a minimum remaining maturity of six months and a maximum remaining maturity of 30 years at the time of purchase;
  - Be issued by a corporation established in the euro area;
  - The issuer cannot have a parent company which is subject to banking supervision outside the euro area;
  - The issuers cannot be an asset management vehicle or a national asset management and divestment fund established to support financial sector restructuring and/or resolution.

What we do

We carry out a natural experiment from the CSPP to evaluate:

i) The average response of unconventional monetary policy on prices and liquidity;

ii) The response of the CSP Program over time (i.e., Impulse Response Function);

Data

Data from Thomson Reuters Eikon database:

- List of corporate bonds bought under the CSP Programme (i.e. treatment group);
- List of corporate bonds with same characteristics but excluded from the program (i.e. control group);
- We add yields and bid-ask spread as a proxy for liquidity for each bond;

Identification Strategy: setup

Denote:

- Observations: $i \in 1, 2, ..., N$;
- Time periods: $t \in [0, 1]$ before and after treatment;
- Group indicator G_i:

$$G_i = \begin{cases} 1 & (\text{ treatment group }) \\ 0 & (\text{ control group }) \end{cases}$$

- Treatment indicator: $Z_{it} \in [0, 1]$

Potential outcome and ATT

Potential outcomes $Y_{it}(z)$:

- $Y_{it}(0)$: potential outcome for unit i in period t when not treated
- $Y_{it}(1)$: potential outcome for unit i in period t when treated

Causal effect for unit i at time t is:

$$\tau_{it} = Y_{it}(1) - Y_{it}(0)$$

The Average Treatment Effect on Treated:

$$\tau_{ATT} = \mathbb{E}\left[Y_{i1}(1) | G_i = 1\right] - \mathbb{E}\left[Y_{i1}(0) | G_i = 1\right]$$

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The Average Treatment Effect on Treated:

$$\tau_{ATT} = \mathbb{E}\left[Y_{i1}(1)|G_i = 1\right] - \mathbb{E}\left[Y_{i1}(0)|G_i = 1\right]$$

Problem: Missing potential outcome: $E[Y_{i1}(0)|G_i = 1]$, i.e. what is the average post-period outcome for the treated group in the absence of the treatment?

Identification Strategy

Control strategy: Difference-in-Differences (DD)

$$\{\mathbb{E}[Y_{i1}|G_i = 1] - \mathbb{E}[Y_{i1}|G_i = 0]\} - \{\mathbb{E}[Y_{i0}|G_i = 1] - \mathbb{E}[Y_{i0}|G_i = 0]\}$$

Under the parallel trend assumption:

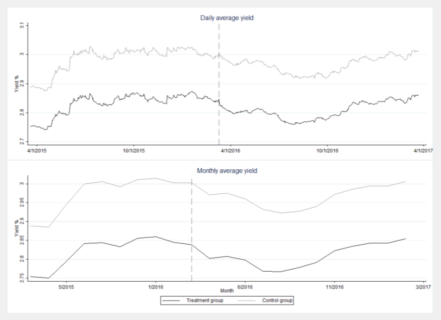
$$\mathbb{E}[Y_{i1}(0) - Y_{i0}(0)|G_i = 1] = \mathbb{E}[Y_{i1}(0) - Y_{i0}(0)|G_i = 0]$$

Difference in Differences is equal to ATT (i.e., effect of the policy on treated)

Yields parallel trend assumption

Figure 2: Monthly yields parallel trend assumption check.

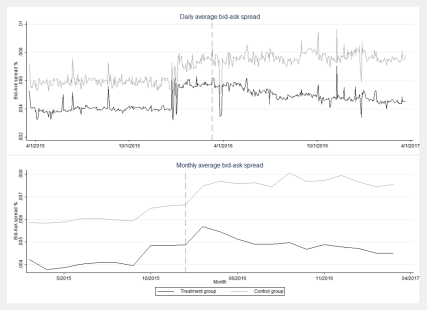
Figure 2 provides graphical evidence of the parallel trend assumption. Our identification strategy is based on the assumption that on the announcement date of the policy, there are no differences in the behaviour of control and treated bonds. In this figure we provide graphical evidence that the 'parallel trend assumption' is verified for yields, i.e. before the announcement control and treated bonds follow the same trend. The graph above shows the average pattern of yields of both bonds' groups at daily frequencies over the observed time-frame, while in the second row we plot the monthly average pattern of the same variable. The vertical axis is positioned in correspondence of the announcement date of the CSPP. The black line report the average yields of treated bonds while in grey the average yield of control group at different time frequencies. The figure clearly shows that before the announcement, there are not significant differences between the two groups while straight after, yields are sharply decreasing for both groups.



Liquidity parallel trend assumption

Figure 3: Monthly Bid-ask parallel trend assumption check.

Figure 3 provides graphical evidence of the parallel trend assumption for liquidity. The graph above shows the average pattern of bid-ask spread of both bonds' groups at daily (first row) and monthly (second row) frequencies over the observed time-frame. Whereas for the yields' regression analysis the reference date was the announcement one, the literature suggest that policy announcements are less relevant for the case of market liquidity. Therefore, we fix the reference date in correspondence of the effective start date of the policy (vertical grey line). As before, the black line report the average bid ask of treated bonds while in grey the average bid ask of control group at different time frequencies. Even in this case, before the programme, control and treated bonds follow the same path while after the policy the average bid ask spread significantly decreases for the treated group compared to the control one. After the policy announcement the trend of the treated bonds' series becomes clearly decreasing, meaning that bid-ask spreads of treated bonds declined probably as a consequence of quantitative easing, in line with theoretical predictions.



Model specification

- The regression equations are:

$$Bidask_{i,t} = \alpha'_{i,t} + \beta_{\text{spread}}(\text{Announcement} * \text{ Treatment }) + \epsilon_{i,t}$$

$$Yield_{i,t} = \alpha_{i,t} + \beta_{\text{yield}}(\text{Announcement} * \text{ Treatment }) + \eta_{i,t}$$

- Under the Parallel Trend Assumption β_{spread} and β_{yield} consistently estimate the effect of the CSPP on yield and liquidity;

Results for yields model

Table 5. Regression Yield model, sample 'without on the run'

In table 5 we report OLS regression output for yield's diff-in-diff estimation. All models are estimated including country fixed effects. In model (1), we regress variable Yield on 'Annoucement', 'Treatment' and interaction term 'didYield'. In model (2) and (3) we control respectively for macro events and micro differences. Finally, model (4) reports the estimated coefficients including both groups of controls. The estimated effect of didYield capture the effect of CSPP program on market yields. The model, attributes to the policy an average reduction of 0.236% for treated bonds' yield with a confidence level of 95% after including all controls.

Yield	(1) Basic model	(2) Macro cont.	(3) Micro cont.	(4) Complete model
didYield	-0.00238	-0.00245	-0.0235**	-0.0236**
	(-0.20)	(-0.21)	(-2.09)	(-2.07)
Announcement	-0.0219**	-0.0140	-0.0718***	-0.0360***
	(-2.01)	(-1.14)	(-6.84)	(-3.04)
Treatment	-0.248***	-0.248***	-0.537***	-0.537***
	(-19.07)	(-18.73)	(-42.27)	(-41.58)
Brexit		-0.0361		0.00997
		(-0.79)		(0.23)
Eurozone		1.034***		1.286***
		(18.38)		(23.70)
Vix		0.00226***		0.00114**
		(4.28)		(2.25)
StartProgram		0.00127		-0.0413***
		(0.19)		(-6.50)
EndEffect		-0.00115		-0.00259
		(-0.22)		(-0.52)
Bidask			0	-3.714***
			(.)	(-6.82)
Amount			0.000000476***	0.000000476***
			(82.83)	(81.33)
GroupMaturity			-0.328***	-0.329***
			(-124.67)	(-122.62)
_cons	4.477***	2.243***	5.030***	2.681***
	(89.47)	(83.28)	(104.35)	(98.75)
N	314400	303600	314400	303600
adj. R^2	0.095	0.095	0.166	0.166

t statistics in parentheses

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* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Results for liquidity model

Table 4. Regression Liquidity model, sample 'without on the run'

In table 4 we report OLS regression output for liquidity's diff-in-diff estimation. All models are estimated including country fixed effects. In model (1), we regress variable Bid-ask on 'Annoucement', 'Treatment' and interaction term 'didBidask'. In model (2) and (3) we control respectively for macro events and micro effects. Finally, model (4) reports the estimated coefficients including both groups of controls. The estimated effect of didBidask capture the effect of CSPP program on market liquidity. The model, attributes to the policy an average reduction of 0.0720% for treated bonds' liquidity with a confidence level of 99% after including all controls.

Bid-ask	(1) Basic model	(2) Macro cont.	(3) Micro cont.	(4) Complete model
didBidask	-0.000815***	-0.000801***	-0.000734***	-0.000720***
	(-20.68)	(-20.00)	(-19.59)	(-18.93)
Announcement	0.00143***	0.00205***	0.00168***	0.00219***
	(39.04)	(49.76)	(48.11)	(55.73)
Treatment	-0.00298***	-0.00299***	-0.00216***	-0.00217***
	(-67.72)	(-66.91)	(-50.90)	(-50.39)
Brexit		-0.000188		-0.000398***
		(-1.22)		(-2.72)
Eurozone		0.00238***		0.00255***
		(12.57)		(14.07)
Vix		0.0000599***		0.0000660***
		(33.79)		(39.17)
StartProgram		-0.000515***		-0.000334***
		(-23.17)		(-15.79)
EndEffect		-0.0000522***		-0.0000467***
		(-2.98)		(-2.80)
Yield			-0.0000396***	-0.0000412***
			(-6.65)	(-6.82)
Amount			-6.96e-10***	-6.96e-10***
			(-35.93)	(-35.41)
GroupMaturity			0.00147***	0.00146***
			(170.80)	(167.43)
_cons	0.00488***	0.00352***	0.00275***	0.000539***
	(28.91)	(38.81)	(16.78)	(5.86)
N	314400	303600	314400	303600
adj. R^2	0.115	0.121	0.202	0.207

t statistics in parentheses

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* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Interpreting the results

- How do we interpret the coefficient of β_{spread} and β_{yield}?
- A measure of the average percentage variation of the relative bid-ask spreads/yield with respect to a hypothetical no-policy scenario:

$$\text{Spread}_{\text{policy/nopolicy}} = \frac{\text{Spread}_{\text{treated,post}} + \beta_{\text{spread}}}{\text{Spread}_{\text{treated,post}}} - 1 = -15.44\% \tag{6}$$

$$\text{Yield}_{\text{policy/nopolicy}} = \frac{\text{Yield}_{\text{treated,post}} + \beta_{\text{yield}}}{\text{Yield}_{\text{treated,post}}} - 1 = -2.36\% \tag{7}$$

Impulse Response of the Policy

- We estimate the average treatment effect of the policy over time

$$Bidask_{i,03/2015 \to m} = \alpha + \beta' \text{ Fixed } + \beta_{spread,m}(\text{Announcement} * \text{Treatment}) + \gamma' X_{i,03/2015 \to m} + \epsilon_{i,t}$$

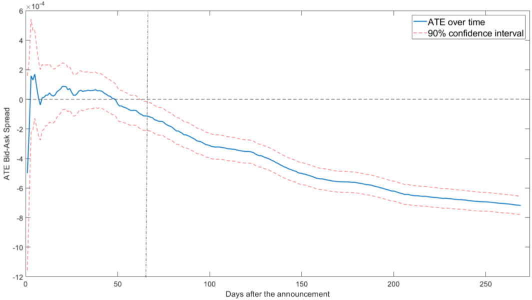
$$Yield_{i,03/2015 \to m} = \alpha_{i,t} + \beta Fixed + \beta_{yield,m}(\text{Announcement} * \text{Treatment}) + \gamma X_{i,03/2015 \to m} + \eta_{i,t}$$

- We set the reference month to March 2015, and we change the end month m across regressions.

Results for liquidity model

Figure 4: Average Treatment Effect over time of CSPP program on liquidity.

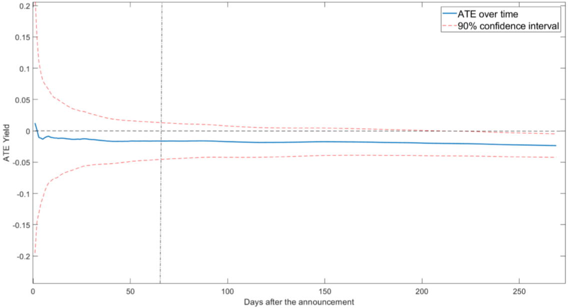
In Figure 4, we plot the the β_{bidask} coefficient (solid line) of $Bidask_{i,03/2015\to m} = \alpha + \beta Fixed + \beta_{spread,m}(Announcement * Treatment) + \gamma X_{i,03/2015\to m} + \epsilon_{i,t}$ and 90% confidence interval (dashed line). The vertical line point the date of starting program. $Bidask_{i,03/2015\to m}$ is the vector of observation of liquidity index from the beginning of the sample to time m; $X_{i,03/2015\to m}$ is a matrix that include set of controls specified in section 2.3; 'Announcement*Treatment' in the interaction term between two variables; $\beta_{spread,m}$ captures the effect on liquidity of CSPP program after m periods after the announcement of the policy.



Results for yields model

Figure 5: Average Treatment Effect over time of CSPP program on yields.

In Figure 5, we plot the the β_{yield} coefficient (solid line) of $Yield_{i,03/2015\rightarrow m} = \alpha' + \beta' Fixed + \beta_{yield,m}(Announcement * Treatment) + \gamma' X_{i,03/2015\rightarrow m} + \nu_{i,t}$ and 90% confidence interval (dashed line). The vertical line point the date of starting program. $Yield_{i,03/2015\rightarrow m}$ is the vector of observation of yields' bonds from the beginning of the sample to time m; $X_{i,03/2015\rightarrow m}$ is a matrix that include set of controls specified in section 2.3; 'Announcement*Treatment' in the interaction term between two variables; $\beta_{yield,m}$ captures the effect on liquidity of CSPP program after m periods after the announcement of the policy.



Conclusion

- Corporate sector purchases programme had a significative impact on prices and market liquidity
- Liquidity market has a statistically significant effect after the implementation of the policy while prices react starting from the announcement date