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Title "An Assessment of the ECB's Unconventional Monetary Policies"

Freelance/ Graduate of Graduate School of University of Shizuoka
Hirotaka Suzuki

Abstract (100 words):

This paper verifies whether the ECB accomplishes 2% inflation target, how and which transmission channels are indeed effective.

In the euro area, the economic fundamentals allow the euro area's exogenously given 1% HICP inflation will produce 2% HICP inflation "trend" in a year, which means that the ECB must cause "1% exogenously given HICP inflation" by their own (Unconventional) Monetary Policies.

Empirically, Negative Interest Rate Policy and especially CSPP are effective for causing exogenously given ones, through channels increasing Lending to Households, which is wealth effect or counter balance sheet recession effect, contrary to channels through increasing Lending to Corporations.

Keywords: Negative Interest Rate Policy, PSPP, CSPP, Trend Stationarity of 2% HICP Growth Rate in A Year as the Inflation Target of the ECB, VECM.

1. Introduction

This paper verifies whether the ECB accomplishes 2% inflation target, how and which transmission channels are effective for that purpose, by presenting often assumed transmission channels' hypotheses and empirical analyses of those.

Most of the earlier literatures addressing the effects of unconventional monetary policies without CSPP are ones assessed before the end of APP(Asset Purchase Programme: the end of APP was in December 2018). So, they are intermediate assessments of them.

The originality of this paper is that it firstly addresses the assessment of unconventional monetary policies effects on HICP growth rate, and also addresses its FEVD of HICP growth rate by VECM, from the start of PSPP(from March 2015) to the end of APP (to December 2018), which is the full sample assessment of the effects of especially quantitative PSPP and also CSPP(from June 2016 to December 2018). Section 2 deals with literature reviews. Section 3 presents hypotheses of transmission channels. Section 4 presents empirical methods and model specifications. Section 5 shows empirical results. Section 6 discusses the results. Section 7 concludes with implications.

2. Literature Reviews

2.1 Non-Standard Measures (from the ECB Monetary Policy Decisions)

"Since the financial crisis began in 2007, the ECB has introduced several non-standard monetary policy measures. The ECB's non-standard measures have responded to the challenges posed by the different phases of the crisis.

In the first phase of the financial crisis, the primary aim of the ECB's non-standard measures was to provide liquidity to banks and to keep financial markets functioning.

In the second phase of the crisis, which took the form of a sovereign debt crisis, the ECB's non-standard measures aimed to address markets' malfunctioning and to reduce differences in financing conditions faced by businesses and households in different euro area countries.(from the ECB)"

"The ECB's Unconventional Monetary Policies:

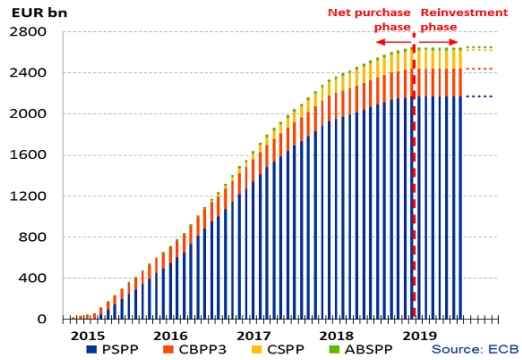
- **purchased debt securities** (Securities Markets Programme)
- carried out **very long-term refinancing operations** (VLTROs)
- announced conditional **Outright Monetary Transactions** (OMT), which acted as a powerful circuit breaker against self-reinforcing fears in sovereign bond markets.

"In the third phase of the crisis the ECB's non-standard measures addressed the onset of a credit crunch and the risk of deflation. With short-term interest rates already close to zero, the ECB's non-standard measures were intended to influence the whole constellation of interest rates that are relevant for financing conditions in the euro area."(from the ECB)

"The ECB's measures included:

- a negative interest rate on the deposit facility;
- targeted longer-term refinancing operations (TLTROs), designed to support bank lending to businesses and households;
- an asset purchase programme (APP), involving private and public sector securities, to put downward pressure on the term structure of interest rates;
- forward guidance, which means communicating how the ECB expects its policy measures to evolve in the future and what conditions would warrant a change in the policy stance."(from the ECB)

Figure 1 Accumulated APP Purchases



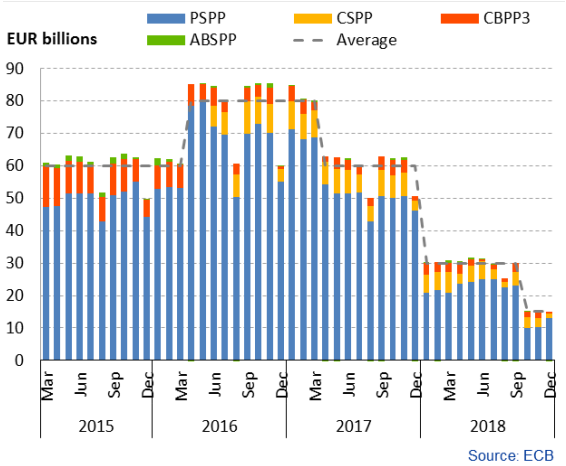
Source: the ECB

"The stock of Eurosystem APP bonds stood at EUR 2,646 billion as of end of July 2019, compared to EUR 2,650 billion as of end of December 2018(**In Figure1**).

On 13 December 2018, the Governing Council of the European Central Bank (ECB) decided to end the net purchases under the APP in December 2018 and announced that it "intends to continue reinvesting, in full, the principal payments from maturing securities purchased under the APP for an extended period of time past the date when it starts raising the key ECB interest rates, and in any case for as long as necessary to maintain favorable liquidity conditions and an ample degree of monetary accommodation. (From the ECB)

The APP is part of a package of measures that also includes targeted longer-term refinancing operations." (From the ECB)

Figure 2 History of APP Net Asset Purchases



Source: the ECB

During the net asset purchase phase, monthly purchases were conducted at average paces of **(In Figure 2)**:

- €60 billion from March 2015 until March 2016
- €80 billion from April 2016 until March 2017
- €60 billion from April 2017 to December 2017
- €30 billion from January 2018 to September 2018
- €15 billion from October 2018 to December 2018

2.2 The ECB's Monetary Policy Decisions

Table 1-1 the ECB Monetary Policy Decisions from June 2014 to June 2019

Date	the ECB Monetary Policy Decisions
5, June, 2014	we decided to lower the **interest rate** on the main refinancing operations of the Eurosystem by 10 basis points to 0.15% and the rate on the marginal facility by 35 basis points to 0.40%. The rate on the deposit facility was lowered by 10 basis points to -0.10%. These changes will come into effect June 2014. The negative rate will also apply to reserve holdings in excess of the minimum reserve requirements and certain other deposits held wit Eurosystem.
	we will be conducting a series of **targeted longer-term refinancing operations** (TLTROs). All TLTROs will mature in September 2018, i.e. in around 4 year Counterparties will be entitled to borrow, initially, 7% of the total amount of their loans to the euro area non-financial private sector, excluding loan households for house purchase, outstanding on 30 April 2014. Lending to the public sector will not be considered in this calculation. The combined i entitlement amounts to some €400 billion. To that effect, two successive TLTROs will be conducted in September and December 2014. In addition, March 2015 to June 2016, all counterparties will be able to borrow, quarterly, up to three times the amount of their net lending to the euro area no private sector, excluding loans to households for house purchase, over a specific period in excess of a specified benchmark.
4, September, 2014	Based on our regular economic and monetary analyses, the Governing Council decided today to lower the **interest rate** on the main refinancing operations of the Eurosystem by 10 basis points to 0.05% and the rate on the marginal lending facility by 10 basis points to 0.30%. The rate on the deposit fa lowered by 10 basis points to -0.20%. In addition, the Governing Council decided to start purchasing non-financial private sector assets. The Eurosy will purchase a broad portfolio of simple and transparent asset-backed securities (ABSs) with underlying assets consisting of claims against the euro non-financial private sector under an **ABS purchase programme** (ABSPP). This reflects the role of the ABS market in facilitating new credit flows to the economy and follows the intensification of preparatory work on this matter, as decided by the Governing Council in June. In parallel, the Eurosysten also purchase a broad portfolio of euro-denominated covered bonds issued by MFIs domiciled in the euro area under a **covered bond purchase programme** (CBPP3). Interventions under these programmes will start in October 2014. The detailed modalities of these programmes will be announ after the Governing Council meeting of 2 October 2014. The newly decided measures, together with the targeted longer-term refinancing operations will be conducted in two weeks, will have a sizeable impact on our balance sheet.
22, January, 2015	it decided to launch an **expanded asset purchase programme**, encompassing the existing purchase programmes for asset-backed securities and covere bonds. Under this expanded programme, the combined monthly purchases of public and private sector securities will amount to €60 billion. They ar intended to be carried out until end-September 2016 and will in any case be conducted until we see a sustained adjustment in the path of inflation consistent with our aim of achieving inflation rates below, but close to, 2% over the medium term. In March 2015 the Eurosystem will start to purch denominated investment-grade securities issued by euro area governments and agencies and European institutions in the secondary market. The purchases of securities issued by euro area governments and agencies will be based on the Eurosystem NCBs' shares in the ECB's capital key. Some additional eligibility criteria will be applied in the case of countries under an EU/IMF adjustment programme.
	the Governing Council decided to change the pricing of the six remaining **targeted longer-term refinancing operations** (TLTROs). Accordingly, the interest rate applicable to future TLTRO operations will be equal to the rate on the Eurosystem's main refinancing operations prevailing at the time when ea TLTRO is conducted, thereby removing the 10 basis point spread over the MRO rate that applied to the first two TLTROs.
5, March, 2015	Following up on our decisions of 22 January 2015, we will, on 9 March 2015, start purchasing euro-denominated public sector securities in the seco market. We will also continue purchasing asset-backed securities and covered bonds, which we started last year. As previously stated, the combine monthly purchases of public and private sector securities will amount to €60 billion. They are intended to be carried out until the end of September and will, in any case, be conducted until we see a sustained adjustment in the path of inflation which is consistent with our aim of achieving inflatio below, but close to, 2% over the medium term.
3, September, 2015	Our asset purchase programme continues to proceed smoothly. Regarding **non-standard monetary policy measures**, following the announced review of th public sector purchase programme's issue share limit after the first six months of purchases, the Governing Council decided to increase the issue sh limit from the initial limit of 25% to 33%, subject to a case-by-case verification that this would not create a situation whereby the Eurosystem woul blocking minority power, in which case the issue share limit would remain at 25%.
3, December, 2015	First, as regards the **key ECB interest rates**, we decided to lower the interest rate on the deposit facility by 10 basis points to -0.30%. The interest rat the main refinancing operations and the rate on the marginal lending facility will remain unchanged at their current levels of 0.05% and 0.30% resp
	Second, as regards **non-standard monetary policy measures**, we decided to extend the asset purchase programme (APP). The monthly purchases of €6 billion under the APP are now intended to run until the end of March 2017, or beyond, if necessary, and in any case until the Governing Council sees sustained adjustment in the path of inflation consistent with its aim of achieving inflation rates below, but close to, 2% over the medium term.
	Third, we decided to **reinvest the principal payments** on the securities purchased under the APP as they mature, for as long as necessary. This will contribute both to favourable liquidity conditions and to an appropriate monetary policy stance. The technical details will be communicated in due ti
	Fourth, we decided to include, in the public sector purchase programme, **euro-denominated marketable debt instruments issued by regional and local governments located in the euro area** in the list of assets that are eligible for regular purchases by the respective national central banks.
	Fifth, we decided to continue conducting the main refinancing operations and three-month longer-term refinancing operations as **fixed rate tender procedures with full allotment** for as long as necessary, and at least until the end of the last reserve maintenance period of 2017.

Source: the ECB (Continued)

(Table 1-1) says that the ECB decided in June 2014 that their policy rate set to -0.1%, lowering main refinancing operations as EONIA: Negative Interest Rate Policy. And the same time, they decided to conduct a series of Targeted Longer-Term Refinancing Operations(TLTROs), statistically included in APP.

In January 2015, the ECB decided to launch an expanded asset purchase programme, encompassing the existing purchase programmes for asset-backed securities and covered bonds. Under this expanded programme, the combined monthly purchases of public and private sector securities would amount to €60 billion.

Table 1-2 the ECB Monetary Policy Decisions from June 2014 to June 2019 (Continued)

Date	the ECB Monetary Policy Decisions
10, March 2016	First, as regards the key ECB interest rates, we decided to lower the interest rate on the main refinancing operations of the Eurosystem by 5 basis p 0.00% and the rate on the marginal lending facility by 5 basis points to 0.25%. The rate on the deposit facility was lowered by 10 basis points to -0
	Second, we decided to expand the monthly purchases under our asset purchase programme from €60 billion at present to €80 billion. They are inte run until the end of March 2017, or beyond, if necessary, and in any case until the Governing Council sees a sustained adjustment in the path of inf consistent with its aim of achieving inflation rates below, but close to, 2% over the medium term. To ensure the continued smooth implementation asset purchases, we also decided to increase the issuer and issue share limits for the purchases of securities issued by eligible international organis and multilateral development banks from 33% to 50%.
	Third, we decided to include investment-grade euro-denominated bonds issued by non-bank corporations established in the euro area in the list of a that are eligible for regular purchases under a new corporate sector purchase programme. This will further strengthen the pass-through of our asse purchases to the financing conditions of the real economy. Purchases under the new programme will start towards the end of the second quarter of year.
	Fourth, we decided to launch a new series of four targeted longer-term refinancing operations (TLTRO II), starting in June 2016, each with a maturi years. These new operations will reinforce the ECB's accommodative monetary policy stance and will strengthen the transmission of monetary policy further incentivising bank lending to the real economy. Counterparties will be entitled to borrow up to 30% of the stock of eligible loans as at 31 Jar 2016. The interest rate under TLTRO II will be fixed over the life of each operation, at the rate on the Eurosystem's main refinancing operations pre the time of take-up. For banks whose net lending exceeds a benchmark, the rate applied to the TLTRO II will be lower, and can be as low as the int rate on the deposit facility prevailing at the time of take-up. There will be no requirement for mandatory early repayments under TLTRO II, and swi from TLTRO I will be allowed.
	Finally, looking ahead, taking into account the current outlook for price stability, the Governing Council expects the key ECB interest rates to remai present or lower levels for an extended period of time, and well past the horizon of our net asset purchases.
8, December 2016	As regards **non-standard monetary policy measures**, we will continue to make purchases under the asset purchase programme (APP) at the current monthly pace of €80 billion until the end of March 2017. From April 2017, our net asset purchases are intended to continue at a monthly pace of €6 until the end of December 2017, or beyond, if necessary, and in any case until the Governing Council sees a sustained adjustment in the path of inf consistent with its inflation aim. If, in the meantime, the outlook becomes less favourable, or if financial conditions become inconsistent with further towards a sustained adjustment of the path of inflation, the Governing Council intends to increase the programme in terms of size and/or duration. purchases will be made alongside reinvestments of the principal payments from maturing securities purchased under the APP.
19, January 2017	Regarding **non-standard monetary policy measures**, we confirm that we will continue to make purchases under the asset purchase programme (APP) a current monthly pace of €80 billion until the end of March 2017 and that, from April 2017, our net asset purchases are intended to continue at a mo pace of €60 billion until the end of December 2017, or beyond, if necessary, and in any case until the Governing Council sees a sustained adjustme the path of inflation consistent with its inflation aim. The net purchases will be made alongside reinvestments of the principal payments from maturi securities purchased under the APP.
27, April 2017	Regarding **non-standard monetary policy measures**, we confirm that our net asset purchases, at the new monthly pace of €60 billion, are intended to r until the end of December 2017, or beyond, if necessary, and in any case until the Governing Council sees a sustained adjustment in the path of inf consistent with its inflation aim. The net purchases will be made alongside reinvestments of the principal payments from maturing securities purcha under the asset purchase programme.
26, October 2017	First, the **key ECB interest rates** were kept unchanged and we continue to expect them to remain at their present levels for an extended period of tim well past the horizon of our net asset purchases.
	Second, as regards **non-standard monetary policy measures**, we will continue to make purchases under the asset purchase programme (APP) at the current monthly pace of €60 billion until the end of December 2017. From January 2018 our net asset purchases are intended to continue at a mont pace of €30 billion until the end of September 2018, or beyond, if necessary, and in any case until the Governing Council sees a sustained adjustme the path of inflation consistent with its inflation aim. If the outlook becomes less favourable, or if financial conditions become inconsistent with furth progress towards a sustained adjustment in the path of inflation, we stand ready to increase the APP in terms of size and/or duration.
	Third, the Eurosystem will reinvest the principal payments from maturing securities purchased under the APP for an extended period of time after th its net asset purchases, and in any case for as long as necessary. This will contribute both to favourable liquidity conditions and to an appropriate m policy stance.
	And fourth, we also decided to continue to conduct the main refinancing operations and three-month longer-term refinancing operations as fixed rat procedures with full allotment for as long as necessary, and at least until the end of the last reserve maintenance period of 2019.
14, December, 2017	Regarding **non-standard monetary policy measures**, we confirm that from January 2018 we intend to continue to make net asset purchases under the purchase programme (APP), at a monthly pace of €30 billion, until the end of September 2018, or beyond, if necessary, and in any case until the Governing Council sees a sustained adjustment in the path of inflation consistent with its inflation aim.
25, January, 2018	Regarding **non-standard monetary policy measures**, we confirm that our net asset purchases, at the new monthly pace of €30 billion, are intended to r until the end of September 2018, or beyond, if necessary, and in any case until the Governing Council sees a sustained adjustment in the path of in consistent with its inflation aim.
14, June, 2018	First, as regards **non-standard monetary policy measures**, we will continue to make net purchases under the APP at the current monthly pace of €30 bi until the end of September 2018. We anticipate that, after September 2018, subject to incoming data confirming our medium-term inflation outlook reduce the monthly pace of the net asset purchases to €15 billion until the end of December 2018 and then end net purchases.
	Second, we intend to maintain our policy of reinvesting the principal payments from maturing securities purchased under the APP for an extended p time after the end of our net asset purchases, and in any case for as long as necessary to maintain favourable liquidity conditions and an ample deg monetary accommodation.
	Third, we decided to keep the **key ECB interest rates** unchanged and we expect them to remain at their present levels at least through the summer of and in any case for as long as necessary to ensure that the evolution of inflation remains aligned with our current expectations of a sustained adjus path.

Source: the ECB (Continued)

(Table 1-2) says that in March 2016, the ECB lowered EONIA to -0.4% as Negative Interest Rate Policy deepening. Secondly, the ECB also decided to expand the monthly purchases under the ECB's asset purchase programme from €60 billion at the time to €80 billion. They were intended to run until the end of March 2017, or beyond. Thirdly, the ECB decided to include investment-grade euro-denominated bonds issued by non-bank corporations established in the euro area in the list of assets that are eligible for regular purchases under a new

corporate sector purchase programme(as CSPP). Finally, the ECB decided to launch a new series of four targeted longer-term refinancing operations (TLTRO II), starting in June 2016, each with a maturity of four years.

Table 1-3 the ECB Monetary Policy Decisions from June 2014 to June 2019 (Continued)

Date	the ECB Monetary Policy Decisions
26, July, 2018	Regarding **non-standard monetary policy measures**, we will continue to make net purchases under the asset purchase programme (APP) at the curre monthly pace of €30 billion until the end of September 2018. We anticipate that, after September 2018, subject to incoming data confirming our n term inflation outlook, we will reduce the monthly pace of the net asset purchases to €15 billion until the end of December 2018 and then end net purchases. We intend to reinvest the principal payments from maturing securities purchased under the APP for an extended period of time after th our net asset purchases, and in any case for as long as necessary to maintain favourable liquidity conditions and an ample degree of monetary accommodation.
13, September, 2018	Regarding **non-standard monetary policy measures**, we will continue to make net purchases under the asset purchase programme (APP) at the curre monthly pace of €30 billion until the end of this month. After September 2018, we will reduce the monthly pace of the net asset purchases to €15 until the end of December 2018 and we anticipate that, subject to incoming data confirming our medium-term inflation outlook, we will then end n purchases. We intend to reinvest the principal payments from maturing securities purchased under the APP for an extended period of time after th our net asset purchases, and in any case for as long as necessary to maintain favourable liquidity conditions and an ample degree of monetary accommodation.
25, October, 2018	Regarding **non-standard monetary policy measures**, we will continue to make net purchases under the asset purchase programme (APP) at the new monthly pace of €15 billion until the end of December 2018. We anticipate that, subject to incoming data confirming our medium-term inflation ou will then end net purchases. We intend to reinvest the principal payments from maturing securities purchased under the APP for an extended peric time after the end of our net asset purchases, and in any case for as long as necessary to maintain favourable liquidity conditions and an ample de monetary accommodation.
13, December 2018	Based on our regular economic and monetary analyses, we decided to keep **the ECB interest rates** unchanged. We continue to expect them to rema at their present levels at least through the summer of 2019, and in any case for as long as necessary to ensure the continued sustained converger inflation to levels that are below, but close to, 2% over the medium term.
	Regarding **non-standard monetary policy measures**, our net purchases under the asset purchase programme (APP) will end in December 2018. At the same time, we are enhancing our forward guidance on reinvestment. Accordingly, we intend to continue reinvesting, in full, the principal payments maturing securities purchased under the APP for an extended period of time past the date when we start raising the key ECB interest rates, and in case for as long as necessary to maintain favourable liquidity conditions and an ample degree of monetary accommodation.
24, January 2019	Based on our regular economic and monetary analyses, we decided to keep **the ECB interest rates** unchanged. We continue to expect them to rema at their present levels at least through the summer of 2019, and in any case for as long as necessary to ensure the continued sustained converger inflation to levels that are below, but close to, 2% over the medium term.
	Regarding **non-standard monetary policy measures**, we intend to continue reinvesting, in full, the principal payments from maturing securities purcha under the asset purchase programme for an extended period of time past the date when we start raising the key ECB interest rates, and in any ca long as necessary to maintain favourable liquidity conditions and an ample degree of monetary accommodation.
7, March, 2019	First, we decided to keep the **key ECB interest rates** unchanged. We now expect them to remain at their present levels at least through the end of 20 and in any case for as long as necessary to ensure the continued sustained convergence of inflation to levels that are below, but close to, 2% over medium term.
	Second, we intend to continue reinvesting, in full, the principal payments from maturing securities purchased under the asset purchase programm extended period of time past the date when we start raising the key ECB interest rates, and in any case for as long as necessary to maintain favou liquidity conditions and an ample degree of monetary accommodation.
	Third, we decided to launch a new series of quarterly targeted longer-term refinancing operations (TLTRO-III), starting in September 2019 and en March 2021, each with a maturity of two years. These new operations will help to preserve favourable bank lending conditions and the smooth transmission of monetary policy. Under TLTRO-III, counterparties will be entitled to borrow up to 30% of the stock of eligible loans as at 28 Februa at a rate indexed to the interest rate on the main refinancing operations over the life of each operation. Like the outstanding TLTRO programme, TLTRO-III will feature built-in incentives for credit conditions to remain favourable. Further details on the precise terms of TLTRO-III will be comm in due course.
	Fourth, we will continue conducting our lending operations as fixed rate tender procedures with full allotment for as long as necessary, and at leas the end of the reserve maintenance period starting in March 2021.
6, June, 2019	First, we decided to keep the **key ECB interest rates** unchanged. We now expect them to remain at their present levels at least through the first half 2020, and in any case for as long as necessary to ensure the continued sustained convergence of inflation to levels that are below, but close to, 2 the medium term.
	Second, we intend to continue reinvesting, in full, the principal payments from maturing securities purchased under the asset purchase programm extended period of time past the date when we start raising the key ECB interest rates, and in any case for as long as necessary to maintain favou liquidity conditions and an ample degree of monetary accommodation.
	Third, regarding the modalities of the new series of quarterly targeted longer-term refinancing operations (TLTRO III), we decided that the interes each operation will be set at a level that is 10 basis points above the average rate applied in the Eurosystem's main refinancing operations over th the respective TLTRO. For banks whose eligible net lending exceeds a benchmark, the rate applied in TLTRO III will be lower, and can be as low as average interest rate on the deposit facility prevailing over the life of the operation plus 10 basis points.

Source: the ECB

(Table 1-3) says that in July 2018, the ECB said that they would reduce the monthly pace of the net asset purchases to €15 billion until the end of December 2018 and then end net purchases. The ECB intended to reinvest the principal payments from maturing securities purchased under the APP for an extended period of time after the end of the ECB's net asset purchases. In January 2019, the ECB decided to keep the key ECB interest rates unchanged, at least through the Summer of 2019.

2.3 Additional CSPP Implementation Criteria by the ECB

CSPP debt instruments are eligible for purchase, provided they fulfill all of the following criteria (from Nordine Abidi, Ixart Miquel-Flores (2018)):

"1.they are eligible as collateral for Eurosystem credit operations, based on the requirements defined in the Guideline on the implementation of the Eurosystem monetary policy framework (ECB/2014/60). 2. they are denominated in euro. 3. they have a minimum first-best credit assessment of at least credit quality step (rating of BBB- or equivalent) obtained from an external credit assessment institution (ECAIs) according to Guideline ECB/2014/60. The four credit rating agencies considered by the ECB are Standard & Poor's, Moody's, FitchRatings and DBRS. 4. they have a minimum remaining maturity of six months and a maximum remaining maturity of 30 years at the time of purchase. 5. they have a yield to maturity above the deposit facility rate (DFR) at the time of purchase.

6. the issuer:

• is a corporation established in the euro area, defined as the location of incorporation of the issuer,

• is not a credit institution,

• does not have any parent undertaking (as defined in Article 4(15) of the Capital Requirements Regulation) which is a credit institution (as defined in Article 2 (14) of Guideline ECB/2014/60),

• is not an asset management vehicle (as defined in the Bank Recovery and Resolution Directive and Single Resolution Mechanism Regulation) or a national asset management and divestment fund established to support financial sector restructuring and/or resolution." (from Nordine Abidi, Ixart Miquel-Flores (2018))

"Conditional on being eligible for the CSPP, the Eurosystem also applies the additional restrictions: 1.An issue share limit of 70% per international securities identification number (ISIN) on the basis of the outstanding amount. 2.A limit at issuer group level." (from Nordine Abidi, Ixart Miquel-Flores (2018))

"Following the European Sovereign Debt Crisis 2009-12 and the weak macroeconomic dynamics, the CSPP has been created in addition to other existing asset purchase programmes with the aim to address the risks of a too prolonged

period of inflation. The CSPP is the last component of the expanded asset purchase programme (APP)."(from Nordine Abidi, Ixart Miquel-Flores (2018))

2.4 Effects of Unconventional Monetary Policies in the Euro Area

Table 2-1 Unconventional Monetary Policy Effects in the Euro Area (An Augmented Survey)

Study	notes	Government bonds yields	Real GDP	Prices	Other
Darracq-Paries and De Santis(2015)	3-year LTRO effects using a VAR model		[+0.8%]	[+0.3%]	[+3%] credit, [-0.2%]lending spreac
Cahn, Matheron, and Sahuc(2014)	Effects of an LTRO of 2% of GDP. DSGE model with financ frictions.		[+1%]		
De Pooter, Maritin, and Pruitt(2015)	Effects of the SMP on peripheral bonds liquidity prer	[-32] to [-40] bps on impact, [-13] to [-1 bps are lasting			
Ghysels, Idier, Mangnelli, and Vergote(2016)	Effects of SMP with VAR mod with high frequency data.	[-320] bps(Italy 2y), [-180] bps (Spain 2y [-230] bps (Italy and Spain 10y), Similar results for Ireland and Portugal, not significant for Greece			
Eser and Schwab(2016)	Cumulative SMP effects of purchases looking at high-frequency data	[-10] bps (5y), [-170] bps (Portugal 5y), 190] bps (Spain 5y), [-210] bps (Italy 5y) 330] bps (Greece 5y)			
Ferrando, Popov, and Udell(2015)	OMT effects of SME access to credit in euro area distressed countries				Probability of being credit constrained was reduced by [6.4%]
Altavilla, Giannone, and Lenz(2014)	Effects of OMT announcemen using event studies and VAR models	[-199] bps (Italy 2y), [-234] bps (Spain 2 no effects in Germany and France	[+1.5%] (Italy), [+2%] (Spain)	[+1.2%] (Italy), [+0.74%] (Spain)	[+3.6%] (credit, Italy [+2.3%] (credit, Spain)
Fratszcher, Lo Duca, and Straub(2016)	Effects of LTRO, SMP, and OMT announcements using high-frequency data	[-25] bps to [-121] bps (Italy and Spain 10y)			[+4.1%] to [+8.7%] (equity prices)
Krishnamurthy, Nagel, an Vissing-Jogenson(2018)	Effects of OMT, SMP, and LTROs	[-200] bps (Italy and Spain 2y), [-500] bp (Portugal and Ireland 2y), [-1,000] bps (Greece 2y)			[+4%] to [+13%] (stock prices)
Koijen, Koulischer, Nguye and Yogo(2016)	Effects of APP on portfolio holdings by institutional investors	Average [-13] bps. Range [-2] to [-60] b (higher in disressed countries)			
Andrade, Breckenfelder, [Fiore, Karadi, and Tristani(2016)	Effects of APP using time series and DSGE models	[-45] bps	[+1.1%]	[+0.4%] (actual), [+0.45%] (expectations)	
Mouabbi and Sahuc(2016)	Effects of APP and TLTRO using a DSGE model with an esitimated shadow rate		[+0.56%] (average of 2014-2016)	[+0.25%] (average c 2014-2016)	[-400] bps (shadow rate)
Cova, Pagano, and Pisani(2015)	Effects of APP in DSGE model		[+1.4%]	[+0.8%]	
Hutchinson and Smets(2017)	Effects of NIRP, TLTRO, and APP	[-155] bps (average euro area 10y bond)	[+1.7%] (accum 2016-2019)	[+0.5%] (accum. 2016-2019)	[-70] bps (lending rate), [13%] euro depreciation

Source: Auther, Dell'Ariccia, Rabanal, and Sandri (2018), Lenza and Slacalek(2018) Continued

(Table 2-1) and **(Table 2-2)** generally says that **Non-Standard Measures and Unconventional Monetary Policies** so far are effective for decreasing Government Bonds Yields, raising real GDP, and raising Prices. Furthermore, they also increase the volumes of supplied credits to private economies, raise stock prices,

depreciate the Euro and so on.

Table 2-2 Unconventional Monetary Policy Effects in the Euro Area (An Augmented Survey) Continued

Study	notes	Government bonds yields	Real GDP	Prices	Other
Altavilla et al.(2016)	Effects of OMT using VAR	[+0.2%] to [+1%] (DE, ES, F IT)	[+0.34%] to [+2.01%]	[+0.28%] to [+1.21%]	
Altavilla et al.(2015)	Effects of APP	[+0.3%] to [+0.5%] (EA, DE, FR, IT)			
Joyce and Tong(2012)	Effects of APF1	[+1%] (UK)			
Christensen and Rudebusch(2012)	Effects of APF1	[+0.43%] to [+0.89%] (UK)			
Baumeister and Benati(2013)	Effects of LSAP using TVP VAR		GDP grwth rate: trough of [-10%] to [-12%](UK)	trough of [-1%] to [-4%](UK)	unemployment rate peak [+10.6%](UK)
Kapetanios et al.(2012)	Effects of BoE LSAP using TVP VAR		peak effect of [+1.42%](UK)		
Weale and Wiedadek(2016)	Effects of LSAP using Bayesian VAR		[+0.25%] to [+0.58%] (UK)	[+0.32%] to [+0.62%] (UK)	
Gambacorta et al. (2014)	Various Effects using Pane VAR		[-0.25%] to [+0.25%] (EA, non-EA countries)	[-0.12%] to [+0.10%] (I non-EA countries)	
Babecka Kucharcukovaet al.(2016)	Efffects of ECB QE using VAR			[-0.1%] to [+0.06%] (E. non-EA countries)	
Bluwstein and Canova(2016)	Effects of ECB QE using Bayesian SVAR			[0%] to [0.5%] (EA, EU countries)	
Hachula et al.(2016)	Effects of LTRO using SVAR s		[+0.1%] to [+0.65%] (EA, EU countries)	[0%] to [0.45%] (EA, EU countries)	unemployment rate [-0.21%] to [0.07%] (EA, I countries)
Behrendt (2017)	Effects of ECB QE using SVAR			[-0.0006%] to [0.0005% (EA)	
Boeckx et al. (2017)	Effects of 3y LTRO, CBPP1 using SVAR		[-0.35%] to [0.6%] (E EU countries)	[-0.1%] to [0.3%] (EA, I countries)	
Abidi and Miquel-Flores(2018)	Effects of CSPP by using Regression Disciontinuity Design Approach				bond yield spread [-0.15%]

Source: Author, Dell'Ariccia, Rabanal, and Sandri (2018), Lenza and Slacalek(2018)

2.5 Effects of CSPP in the Euro Area

CSPP was implemented by the ECB's purchases of investment-grade-guaranteed eligible corporate bonds by the ECB's criteria "above BB+ grade"(showed in **(Figure 3)**) from private secondary markets. As to how many quantities and ratios the ECB considers eligible for the purchases by CSPP, see **(Figure 4)**.

Nordine Abidi, Ixart Miquel-Flores (2018) shows "the decline in the cost of borrowing after the announcement of the CSPP**(Figure 5)**. The effects are more pronounced for the bonds that are located within the rating wedge and extend beyond the ECB's eligibility criteria (i.e. towards riskier assets)."

Second, Nordine Abidi, Ixart Miquel-Flores (2018) shows that "liquidity effects are ambiguous at the announcement of the corporate QE (i.e. March 10, 2016). Nevertheless, the dynamics of bid-ask spreads (despite its measurement limits) reveal that eligible corporate bonds seem to have suffered from a deterioration of liquidity until the ECB's effective purchase date (i.e. June 8, 2016). As the ECB is expected to reduce the stock of "investment grade" bonds on the secondary market, the corporate QE seems to have altered the bargaining power of sellers towards buyers in the market for CSPP-eligible securities. A careful examination highlights however that bid-ask spreads were compressed in the segment of "high-yield" corporate bonds."**(Figure 6)**

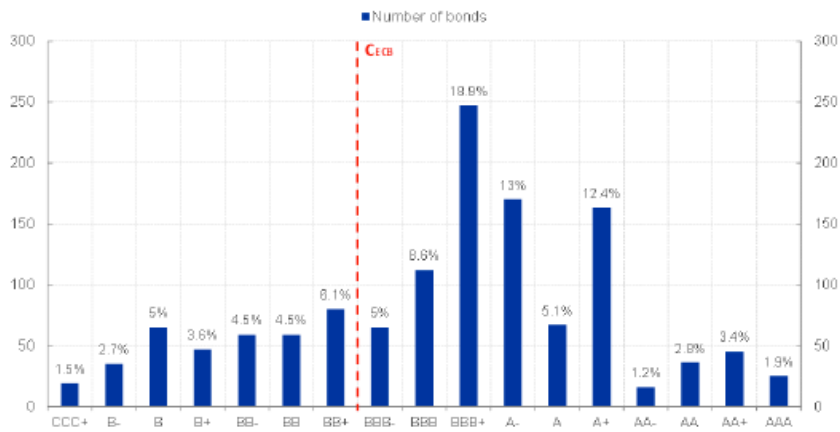
Figure 3 Harmonized Rating Scale

Notes: This table maps the ratings of S&P, Moodys, Fitch and DBRS into seventeen numerical values, with 10 corresponding to the highest rating (AAA/Prime High Grade) and -6 to the lowest (CCC+/substantial risks). The horizontal dashed-line separate assets from "High Yield" to "Investment Grade".

DBRS	Moody's	S&P	Fitch	Rating Description	Ranking
AAAu	Aaa	AAA	AAA	Prime	10
AAH	Aa1	AA+	AA+	High grade	9
AA	Aa2	AA	AA		8
AAL	Aa3	AA-	AA-		7
AH	A1	A+	A+	Upper medium grade	6
A	A2	A	A		5
AL	A3	A-	A-		4
BBBH	Baa1	BBB+	BBB+	Lower medium grade	3
BBB	Baa2	BBB	BBB		2
BBBL	Baa3	BBB-	BBB-		1
BBH	Ba1	BB+	BB+	Non-investment grade	0
BB	Ba2	BB	BB	speculative	-1
BBL	Ba3	BB-	BB-		-2
CCCH	B1	B+	B+	Highly speculative	-3
CCC	B2	B	B		-4
CCCL	B3	B-	B-		-5
CCH	Caa1	CCC+	CCC+	Substantial risks	-6

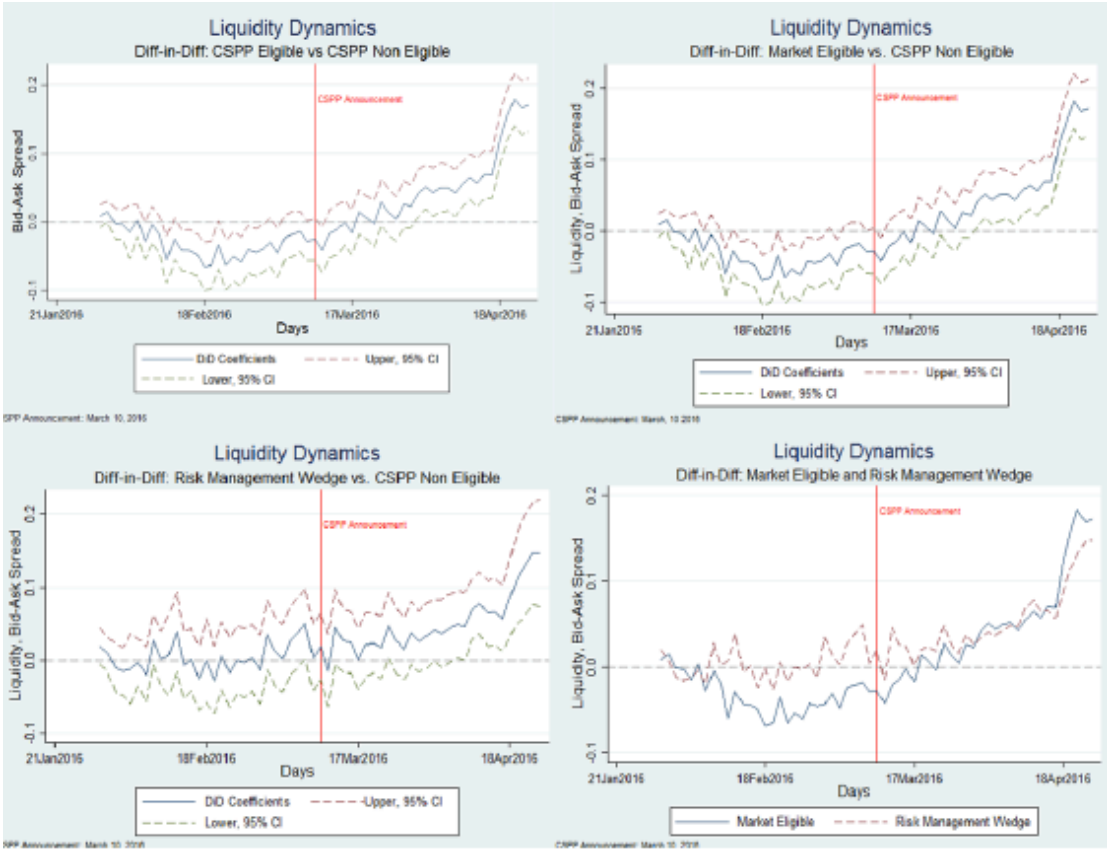
Source: Nordine Abidi, Ixart Miquel-Flores (2018)

Figure 4 Histogram of Corporate Bond by First Best Ratings



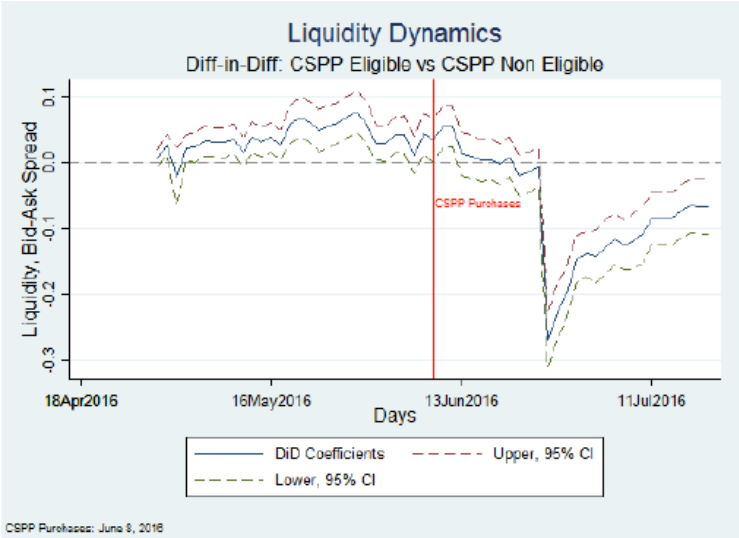
Source: Bloomberg and Nordine Abidi, Ixart Miquel-Flores (2018)

Figure 5 Liquidity Dynamics: At the Announcement (March 10, 2016)



Source: Nordine Abidi, Ixart Miquel-Flores (2018)

Figure 6 Liquidity Dynamics: Effective Purchases (June 8, 2016)



Source: Nordine Abidi, Ixart Miquel-Flores (2018)

3. Hypotheses to Verify

We are interested in whether the ECB's Unconventional Monetary Policies are working or not. So, we verify the outcomes below in terms of the ECB's Unconventional Monetary Policy transmission channels.

There are 2 types of transmission mechanisms: Direct channel and Indirect channel. Transmission channels are decomposed into:

$$V_t' = \theta_t \frac{\partial V_t}{\partial D_t} + \kappa_t \frac{\partial V_t}{\partial I_t}\frac{\partial I_t}{\partial D_t}, (\theta_t: Direct\ Effect, \kappa_t: Indirect\ Effect\ )\ \ (\ gradient\ D = Direct\ channel, gradient\ I = Indirect\ channel)$$

We have several Hypotheses of these 2 types transmission channels. We discuss those below.

Hypothesis 0: (Direct Channel) Whether A Trend of Inflation Affected by Unconventional Monetary Policies is around 2% Rise or Not

Whether 2% rise of HICP is accomplished is empirically evaluated by the trend of HICP growth rate whether it is anchored around 2 % rise trend of HICP.

However, empirically, the HICP growth rate of Euro area economy may and may not have a trend. In addition, although it has a trend, its trend may be in positive or negative value. If the trend of HICP growth rate in euro area has 2%, or below but close to 2%, the ECB's monetary policy accomplishes the inflation target. Even if it is without 2%-rise-trend, it is still accomplishable by other ways. Then in this case, the ECB utilizes unconventional monetary policies described and assessed below to lift the trend inflation or utilize monetary policy transmission channels to raise GDP and HICP growth rates.

Hypothesis 1: (Direct Channel) Interest Arbitrage Channel (FF rate to HICP)

If capital mobility is totally free and domestic and foreign assets are perfectly substitute, FF rate and Eonia interest rate differential determines the change rate of exchange, which affects international trade of goods and services between the U.S. and Euro Area. International trades affected by FF rate changes Euro area exports and imports, which raises or lowers growth rate of GDP and HICP in the

Euro area.

(Indirect Channel): Hypothesis 1.1 FF rate to Eonia (Exchange Channel)

If a change of FF rate affects Eonia by way of an exchange channel between them, there exists a transmission channel of FF rate changing Euro area GDP and HICP.

Hypothesis 2(Direct Channel) Negative Interest Rate Channel (Eonia to HICP)

Negative interest rate policy lowers yield curve. The ECB's aim to carry out Negative interest rate policy is increasing lending of private banks to private economy by portfolio rebalancing.

This channel is that negative interest rate raises investment of firms, and consumption of household by lowering real interest rate, which raises GDP and HICP in the Euro area.

(Indirect channel): Hypothesis 2.1 Eonia to Lending to Firms (Portfolio Rebalancing Channel)

If the aim of negative interest rate policy is not fully understood by financial markets, short term negative interest rate would only be burden on private banks in that private banks lowered deposit rate only and didn't increase lending to firms and households. Conversely, the aim of negative interest rate policy is fully applicable to private banks, negative interest rate policy brings them to increase lending which raises GDP successfully and, not to lower deposit rate which curtails private bank net profits.

(Indirect Channel): Hypothesis 2.2 Eonia to Lending to Households (Counter Balance Sheet Recession Channel)(Wealth Effects)

Lowering the ECB's policy rate to negative domains let private banks willing to lend and supply more liquidity to households with lower interest rates. In addition, with lower interest rates, households may be willing to borrow more liquidity from private banks to have housing loans to possess their own houses. Negative interest rate softens borrowing constraints for households and that invigorates the euro

area economy, which raises GDP and HICP in the Euro area.

Hypothesis 3: (Direct Channel) Quantity Channel (PSPP to HICP)

An assumed transmission channel of the QE by Benjamin M Friedman (2014) which establishes the theory of the QE is that increasing credit demand by QE shifts credit demand curve to the right, which causes interest rates to decline and GDP to rise. This GDP increase raises inflation afterward.

QE aims to lower expected real interest rates and raise real GDP and HICP. A success of the transmission channel requires complements such as forward guidance, CSPP, negative interest rate policy and so on, which lowers interest rates and raise GDP.

(Indirect Channel): Lowering Yield Curve

Lowering yield curve is a necessary condition to raise GDP and HICP with shifting credit demand curve to the right. The combination of forward guidance, negative interest rate policy, QE and so on is a powerful and effective tool for lowering real interest rates and raising GDP and HICP. (For empirical facts, see **Table 2-1, Table 2-2**)

(Indirect Channel): Hypothesis 3.1 PSPP to Lending to Firms (Portfolio Rebalancing Channel)

Portfolio rebalancing channel is defined as that due to the deficiency of safe assets, investors are influenced to shift their investments away from safe assets towards investment of assets with higher expected returns, including lending to households and firms. This risk taking may bring about higher profits or further consumption, which raises GDP and HICP.

(Indirect Channel): Hypothesis 3.2 PSPP to Lending to Households (Wealth Effects)

QE implementation prompts further asset purchases, which raises asset prices and gives rise to asset bubbles on occasions. Those who possess liquidity or these assets or bonds priced higher by QE, may feel rich and consume more, which is

called wealth effect. This transmission is also an assumed effect by the APP.

Hypothesis 4: (Direct Channel) Liquidity Channel (CSPP to HICP)

(Abidi and Miquel-Flores (2018)) CSPP: Public Sector Bank (the ECB's Direct) Lending Channel: Assumed transmission channels of CSPP as:

(1) Credit Easing Channel (declining in the cost of borrowing) (Bid-ask spreads made eligible corporate bonds liquidity deteriorated at the announcement of CSPP and they were compressed in the high-yield corporate bonds),

(2) Liquidity channel (After the ECB's large asset purchases of investment grade bonds on secondary market, potential bond buyers are oriented to buy CSPP eligible securities.)

(3) Portfolio rebalancing channel: See Hypothesis 4.1 below.

(Indirect Channel): Hypothesis 4.1 CSPP to Lending to Firms (Portfolio Rebalancing Channel)

By CSPP, the ECB purchases eligible private bonds or assets to stimulate whole the Euro area economy and injects liquidity to firms. Being sellers of those bonds and assets, private corporations which sold eligible corporate bonds to the ECB can get some degree of additional liquidity from the ECB. Then, by injecting those liquidity, they can invest on riskier assets or bonds seeking for higher profits. For example, if those additionally injected liquidity goes to the ECB's direct lending to firms, firms-level investment, production or other economic activities get invigorated, which raises GDP. That outcome is an intent of the ECB's CSPP.

(Indirect Channel) Hypothesis 4.2 CSPP to Lending to Households (Wealth Effects)

CSPP implementation prompts further asset purchases possessed by private corporations, which raises asset prices and gives rise to asset bubbles on occasions. Those who possess assets or bonds priced higher by CSPP may feel rich, borrow more liquidity and then consume more, which is called wealth effect. This transmission is an assumed effect by the APP.

Hypothesis 5: (Direct Channel) Bank Lending Channel (Lending to Firms to HICP): Firms-Level Counter Balance Sheet Recession Channel (Production, Investment Channel)

This traditional channel is restrained or limited by liquidity trap or balance sheet recession advocated by Richard Koo. In this situation, monetary policy effect is limited.

If this channel had some effects on production and investment by corporations, the Euro area economy got out of balance sheet recession or liquidity trap. If firms have positive effects, they are willing to produce and invest more, making effective demands more than ever after the financial crisis since 2008.

Hypothesis 6: (Direct Channel) Bank Lending Channel (Lending to Households to HICP): Households-Level Counter Balance Sheet Recession Channel (Consumption Channel)

This traditional channel is restrained or limited by liquidity trap or balance sheet recession advocated by Richard Koo. In this situation, monetary policy effect is limited.

If this channel had some effects on consumption by households, the Euro area economy got out of balance sheet recession or liquidity trap. If this channel is effective, households consume fully to raise HICP in the Euro area.

4.Research Methods

4.1 Evaluation Model (Vector Error Correction Model: VECM)

We employ VECM with 3 constants and 3 trends as described below. Terms in first parentheses are error corrected cointegrating equations with a constant and a trend. Terms in second parentheses are estimated impulse response functions with a constant and a trend. Terms in third parentheses are the parts of Phillipes-Perron unit-root test with a constant and a trend.

1st constant and trend are from Error Correction Terms. 2nd constant and trend are from impulse response functions. 3rd constant and trend are from original variables which are tested by Phillipes-Perron unit-root test, which are discussed below.

$$\Delta \boldsymbol{y_t} = \boldsymbol{\alpha}(\boldsymbol{\beta}' \boldsymbol{y_{t-1}} + \boldsymbol{\mu} + \boldsymbol{\rho t}) + \left(\sum_{i=1}^{p-1} \boldsymbol{\Gamma_i} \Delta \boldsymbol{y_{t-i}} + \boldsymbol{\gamma} + \boldsymbol{\tau t} \right) + (\boldsymbol{\psi} + \boldsymbol{\delta t}) + \boldsymbol{\epsilon_t}$$

$z = \beta' y_{t-1} + \mu + \rho t$: cointegrating equations with a constant and a trend

μ: a constant in cointegrating equations

ρt: a trend in cointegrating equations

γ: a constant in irf of Δy_t

τt: a trend in irf in Δy_t

ψ: a constant in Phillipes-Perron unit-root test

τt: a trend in Phillipes-Perron unit-root test

4.1.1 Unit Root Test and Cointegration Ranks

By Phillipes-Perron unit-root test, we have all the nonstationary variables with apparently positive rising trends by APP. So, we convert them taking natural logarithm and taking differences of them to get stationary variables, which have the coefficients of the variables defined as growth rates of them suitable for assessing the degree of the accomplishment of the 2% inflation target policy by the trend and the ECB's unconventional monetary policies transmissions.

Fortunately, by doing that, we can get all the stationary variables by taking first differences of natural logarithm of the variables below, although only taking natural logarithm of the variables without differences let them nonstationary except for (ln PSPP) below.

Therefore, we can assess the effects by VECM successfully in this paper.

By AIC, we can get appropriate lags 4. Also, By AIC of Johansen cointegration test, we can get appropriate cointegration ranks of 6.

4.2 Variables and Order Selection Criteria

The variables to evaluate the ECB's unconventional monetary policies in this paper are described below.

(1) Effective Federal Funds Rate, Percent, Monthly, Not Seasonally Adjusted (from FRED)

(2) negative Eonia rate (represented in positive values multiplied by (-1))-

Historical close, average of observations through period - Euro, provided by the ECB(from the ECB Statistical Data Warehouse)
(3) ln Public sector purchase programme Stock euro millions(from the ECB)
(4) ln Corporate Sector purchase programme Stock euro millions(from the ECB)
(5) ln total loans to euro area non-financial corporations adjusted for loan sales, securitisation and notional cash pooling (million EUR) stock(from the Euro Area Statistics)
(6) ln total loans to euro area households adjusted for loan sales, securitisation and notional cash pooling (millionEUR) Stock(from the Euro Area Statistics)
(7) ln HICP - All-items excluding energy and food, Monthly Index [2015 = 100] Average of observations through period (A)(from the ECB Statistical Data Warehouse)

Data ranges of Eonia of this paper is all in negative values. However, we set all in negative values multiplied by (-1) and converted them to be in positive values. Another notation has (ln) which means taking natural logarithm of the variables.

In this paper, Cholesky decomposition order of the VECM is defined by a sequence of reasons below. First, we assume for the ECB, the Fed has international influences on euro area interest rates. So, FF rate is defined as the most exogenous factor.

Then, as euro area level unconventional monetary policy variables, we assume their exogeneity by their chronological earliness which is applied. That is Negative Interest Rate Policy(Eonia)(from June 2014 on), followed by PSPP(from March 2015 to December 2018), CSPP(from June 2016 to December 2018) as APP. Then we assume exogeneity of private activity Private banks lending to firms followed by Private banks lending to households. Finally, we assume HICP is the most endogenous of all, which is just one of the target variable affected by the implementation of the ECB's unconventional monetary policies.

4.3 Data, Phillipes-Perron (PP) Unit Root Test and Its Trend Term

Phillipes-Perron unit-root test:

$$\boldsymbol{y_t = \psi + \rho y_{t-1} + \delta t + u_t}$$

We utilize Phillipes-Perron unit-root test with a constant and a trend, because

of a concern about nonstationarity of variables, say, PSPP, CSPP and so on.

Data frequency is monthly. And data range is from March 2015 to December 2018, which coincides with the start of QE implementation and coincides with the end of QE purchase programme. The results of PP test are shown in (Table 3).

Table 3 Phillipes-Perron unit-root test

	PP test statistic	p-value	trend	(t-value)	constant	(t-value)
EffectiveFederalFundsRatePe	-1.298	0.8885	0.0051942	2.08**	-0.0144462	-0.66
D.EffectiveFederalFundsRatePe	-6.547	0.0000***	0.0019818	2.59**	0.0052338	0.29
plusEoniarateHistoricalcl	-1.551	0.811	-0.0001904	-0.66	0.0282333	3.98***
D.plusEoniarateHistoricalcl	-5.116	0.0001***	-0.000417	[-2.18**]	0.0143993	2.7***
lnPublicsectorpurchaseprogr	-8.807	0.0000***	0.0055395	5.42***	2.644399	14.62***
D.lnPublicsectorpurchaseprogr	-26.343	0.0000***	-0.0013372	[-7.35***]	0.0522863	9.36***
lnCorporateSectorpurchasepro	-1.494	0.8312	0.0249218	0.82	0.4218163	1.06
D.lnCorporateSectorpurchasepro	-6.156	0.0000***	-0.0108827	-0.68	0.5084911	1.22
lntotalloanstoeuroareanon	-1.648	0.7732	0.0002305	2.54**	2.481559	1.95*
D.lntotalloanstoeuroareanon	-8.932	0.0000***	0.0000805	2.07**	-0.0004527	-0.47
lntotalloanstoeuroareahous	-1.206	0.9093	0.0001697	1.38	1.310188	1.19
D.lntotalloanstoeuroareahous	-5.645	0.0000***	0.0000211	1.25	0.0011479	2.51**
lnHICPAllitemsexcludinge	-3.011	0.129	0.0002877	3.06***	1.660227	3.06***
D.lnHICPAllitemsexcludinge	-9.318	0.0000***	5.09E-07	0.07	0.0010214	4.66***

Source: Author *** significant at 1% level, **significant at 5% level, *significant at 10% level

5. Empirical Results

We estimate the VECM by STATA 16. The significance level of the empirical

results of the paper is at 5% significant level.

5.1 Estimation Results of 3 Constants, 3 Trends and Cointegrating Equations in the VECM

Then, we get estimation results below. The constant and the trend in the cointegrating equation, and those in the Impulse Response Functions (IRFs) **(Figure 7)** and the trend in the Phillipes-Perron unit-root test are all zeros. However, we obtain a constant of HICP growth rate in the Phillipes-Perron unit-root test of first differences of those as nonzero(0.0010214%) in the VECM specification.

So, we get the results of the HICP growth rate in the Euro area as "**trend stationary" with positive growth rate of (1.22568%) in a year**, because (0.0010214) is a constant in a month effect represented by range of (from 0 to 1), which is modified (0.10214%) in a month multiplied by 100, and (1.22568%) in a year by multiplied by 12 to get a yearly effect.

$$\Delta \boldsymbol{y_t} = \boldsymbol{\alpha}(\boldsymbol{\beta}'\boldsymbol{y_{t-1}} + \boldsymbol{\mu} + \boldsymbol{\rho t}) + \left(\sum_{\boldsymbol{i=1}}^{\boldsymbol{11}} \boldsymbol{\Gamma_i} \Delta \boldsymbol{y_{t-i}} + \boldsymbol{\gamma} + \boldsymbol{\tau t}\right) + (\boldsymbol{\psi} + \boldsymbol{\delta t}) + \boldsymbol{\epsilon_t}$$

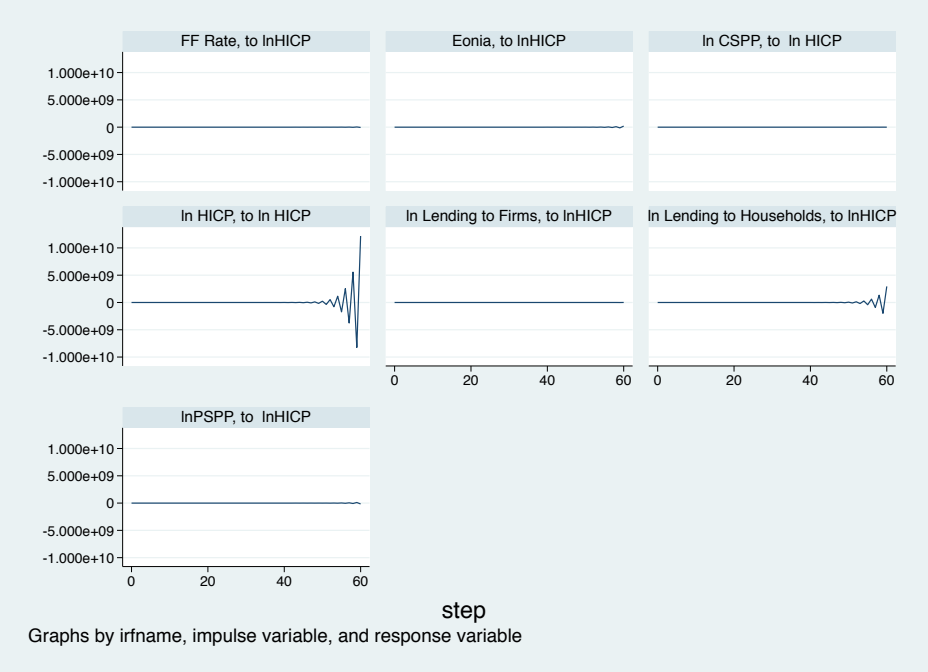
$$\boldsymbol{\mu = 0}, \quad \boldsymbol{\rho = 0}, \quad \boldsymbol{\gamma = 0}, \quad \boldsymbol{\tau t = 0}, \quad \boldsymbol{\psi = 0.0010214}, \quad \boldsymbol{\delta t = 0}$$

One of the most influential Cointegrating Equations estimating HICP changes: $0 + 0t + (3.04\mathrm{e}-18)\mathrm{FF\ rate}_{t-1} + (1.39\mathrm{e}-17)\mathrm{Eonia}_{t-1} + (0)\ln \mathrm{PSPP}_{t-1} + (2.71\mathrm{e}-20)\ln \mathrm{CSPP}_{t-1} + (-5.55\mathrm{e}-17)\ln \mathrm{Lending\ to\ Firms}_{t-1} + (1)\ln \mathrm{Lending\ to\ Households}_{t-1} + (0)\ln \mathrm{HICP}_{t-1}$

The existence of cointegrating relationships among unconventional monetary policies shows that the scale of unconventional monetary policies is determined by considering correlated other unconventional monetary policy tools implementation. We show a predicted cointegrating equation, the most significant one to assess the VECM, as a graph in **(Figure 8)**. Cointegrating equations are error terms which adjust the errors over or under equilibrium ones towards equilibrium values. The value of the cointegrating equation in the graph and also in the VECM of the paper is in positive value and increasing with time going, which means that the Euro area economies' temporary economic fundamentals or

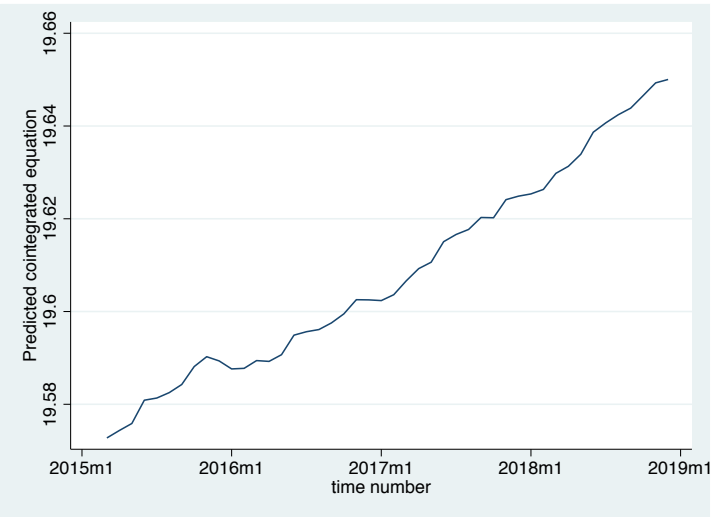
its present trends are above equilibrium about HICP growth rate from March 2015 to December 2018.

Figure 7 Impulse Response Functions(IRFs) of the Direct Transmission Channels



Source: Author

Figure 8 An Estimated Cointegrating Equation of the VECM



Source: Author

5.2 Estimation Results of Impulse Response Functions(IRFs) of the "Direct" Transmission Channels

$$\Gamma_i = coirf(in\ 12\ months) to\ \Delta\ln \text{HICP}_t (Direct\ Channel)$$

$$= \begin{pmatrix} -.005084 \\ .002907 \\ -.002167 \\ .003602 \\ -.004817 \\ .000768 \\ .023903 \end{pmatrix} \begin{pmatrix} \Delta\text{FF rate}_{t-i} \\ \Delta\text{Eonia}_{t-i} \\ \Delta\ln \text{PSPP}_{t-i} \\ \Delta\ln \text{CSPP}_{t-i} \\ \Delta\ln \text{Lending to Firms}_{t-i} \\ \Delta\ln \text{Lending to Households}_{t-i} \\ \Delta\ln \text{HICP}_{t-i} \end{pmatrix}$$

Γ_i means that 1% increase of FF rate raises HICP inflation rate in 12 months by (-0.5084%) **(Hypothesis 1: (Direct Channel) Interest Arbitrage Channel (FF rate to HICP))**.

One percent increase of Eonia (such as from -0.4 % to -1.4%) raises HICP inflation rate in 12 months by (0.2917 %) **(Hypothesis 2(Direct Channel) Negative Interest Rate Channel (Eonia to HICP))**.

One percent increase of PSPP raises HICP inflation rate in 12 months by (-0.2167 %) **(Hypothesis 3: (Direct Channel) Quantity Channel (PSPP to HICP))**.

One percent increase of CSPP raises HICP inflation rate in 12 months by (0.3602 %) **(Hypothesis 4: (Direct Channel) Liquidity Channel (CSPP to HICP))**.

One percent increase of Lending to Firms raises HICP inflation rate in 12 months by (-0.4817 %)**(Hypothesis 5: (Direct Channel) Bank Lending Channel (Lending to Firms to HICP) Firms-Level Counter Balance Sheet Recession Channel (Production, Investment Channel))**.

One percent increase of Lending to Households raises HICP inflation rate in 12 months by (0.0768 %) **(Hypothesis 6: (Direct Channel) Bank Lending Channel (Lending to Household to HICP) Households-Level Counter Balance Sheet Recession Channel (Consumption Channel))**.

As to autocovariance of HICP growth rate, one percent increase of HICP raises HICP inflation rate in 12 months by (2.3903 %), which means that exogenous 1% increase of HICP suffices to accomplish 2% inflation target.

HICP growth rate in the Euro area is **"trend stationary".** The effect of Γ_i is **"temporary"** in 12 months and is **"not permanent"**, because of the ECB's emergent purchases of assets and bonds by, say, PSPP, CSPP and so on continuing for relatively short-term or medium-term, whose effects may be changing overtime

especially during the time of transition from short-term adjustment phase to long-term equilibrium phase exactly in the future.

$$\Delta \ln \mathrm{HICP}_t = \begin{pmatrix} 0 \\ -.027349 \\ 0 \\ 6.48\mathrm{e}-06 \\ 0 \\ -.3134541 \\ \mathbf{-1.551215} \end{pmatrix} \begin{pmatrix} \text{FF rate}_{t-1} \\ \text{Eonia}_{t-1} \\ \ln \text{PSPP}_{t-1} \\ \ln \text{CSPP}_{t-1} \\ \ln \text{Lending to Firms}_{t-1} \\ \ln \text{Lending to Households}_{t-1} \\ \ln \text{HICP}_{t-1} \end{pmatrix}$$

$$+ \begin{pmatrix} -.005084 \\ .002907 \\ -.002167 \\ .003602 \\ -.004817 \\ .000768 \\ \mathbf{.023903} \end{pmatrix} \begin{pmatrix} \Delta\text{FF rate}_{t-i} \\ \Delta\text{Eonia}_{t-i} \\ \Delta\ln \text{PSPP}_{t-i} \\ \Delta\ln \text{CSPP}_{t-i} \\ \Delta\ln \text{Lending to Firms}_{t-i} \\ \Delta\ln \text{Lending to Households}_{t-i} \\ \Delta\ln \text{HICP}_{t-i} \end{pmatrix} + \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ \mathbf{.0010214} \end{pmatrix}$$

$$+ \epsilon_t$$

The values of cointegrating equation are in positive ones, which means growth rate of HICP is above its equilibrium with a constant HICP growth rate of 0.10214% increase in a month, summing them over 12 months to 1.22568% increase in a year. So, the ECB must raise net HICP growth rate exogenously only by about 1% or so, unless there are HICP growth rate declining factors. With them, the ECB must instead raise HICP growth rate at least more than 1% indispensably and also exogenously only by their own (unconventional) monetary policy tools.

The results are also explained by unconventional monetary policies' **"direct"** and **"indirect"** transmission channels(represented as cumulated orthogonalized impulse response functions: COIRF)

Firstly, Γ_i says that policy tools of using Eonia, Lending to Households to raise HICP have overused (due to negative adjustment parameter "α") to raise HICP and those effects on HICP growth are over steady state level and are accordingly in positive values.

Secondly, the relatively new policy tool of CSPP to raise HICP is underutilized and below its equilibrium values. So, there are some rooms for CSPP to raise

HICP growth rate (because of positive adjustment parameter " α ") toward upper steady state equilibrium values.

Thirdly, the effects of FF rate, PSPP, Lending to Firms on HICP growth rate are just in equilibrium values (because adjustment parameter " α " of those are not significantly different from all zeros, which means there are all in equilibrium values) in terms of their equilibrium growth rates.

5.3 Phillipes-Perron Unit-Root Test Results of All the Variables with A Constant and A Trend Terms

From Phillipes-Perron unit-root test, some differenced variables representing percent (%) changes have some trends and some constants described below from March 2015 to December 2018.

$$\begin{pmatrix} \Delta\text{FF rate}_t \\ \Delta\text{Eonia}_t \\ \Delta\ln \text{PSPP}_t \\ \Delta\ln \text{CSPP}_t \\ \Delta\ln \text{Lending to Firms}_t \\ \Delta\ln \text{Lending to Households}_t \\ \Delta\ln \text{HICP}_t \end{pmatrix} = \begin{pmatrix} 0 \\ .0143993 \\ .0522863 \\ 0 \\ 0 \\ .0011479 \\ .0010214 \end{pmatrix} + \begin{pmatrix} .0019818 \\ -.000417 \\ -.0013372 \\ 0 \\ .0000805 \\ 0 \\ 0 \end{pmatrix} t + u_t$$

$\Delta\ln \text{HICP}_t = .0010214$ means growth rate of HICP in a month is (0.10214%). So, HICP rises by (1.22568%) in a year in the euro area during the sample periods.

$\Delta\ln \text{Lending to Households}_t = .0011479$ means Lending to Households in a month rises by (0.11479 %), which rises to (1.37748%) in 12 months.

$\Delta\ln \text{Lending to Firms} = .0000805\text{t}$ means that Lending to Firms rises by (0.00805%) in a month starting at 0. In a year, Lending to Firms rises to (0.0966%), adding the same by (0.0966%) each year.

$\Delta\ln \text{PSPP} = .0522863 - .0013372\text{t}$ means that PSPP rises by (5.2%) each year. However, the growth rate (5.2%) each year will also be decreased additionally by (0.13372%) each year.

$\Delta\text{Eonia} = .0143993 - .000417\text{t}$ means that because Eonia are indeed in all negative values during the sample periods, Eonia has a constant negative interest rate increase by (-0.0143993 %) each year. However, Eonia has a little upward interest rate trend increase of (0.000417%) every 12 months.

ΔFF rate = .0019818t means that FF rate has a positive trend of (0.001918%) increase each year.

5.4 Estimation Results of Impulse Response Functions of "Indirect" Transmission Channels

$$\Gamma_i = coirf(in\ 12\ months) to\ \Delta\text{Eonia}_t (Indirect\ Channel)$$

$$= \begin{pmatrix} .002308 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \begin{pmatrix} \Delta\text{FF rate}_{t-i} \\ \Delta\text{Eonia}_{t-i} \\ \Delta\text{ln PSPP}_{t-i} \\ \Delta\text{ln CSPP}_{t-i} \\ \Delta\text{ln Lending to Firms}_{t-i} \\ \Delta\text{ln Lending to Households}_{t-i} \\ \Delta\text{ln HICP}_{t-i} \end{pmatrix}$$

Γ_i means that 1% increase of FF rate raises Eonia in 12 months by (0.2308%) as a positive value representation of Eonis **(Hypothesis 1.1(Indirect Channel): (FF rate to Eonia))**.

$$\Gamma_i = coirf(in\ 12\ months) to\ \Delta\text{ln Lending to Firms}_t (Indirect\ Channel)$$

$$= \begin{pmatrix} 0 \\ .003559 \\ .003836 \\ .000173 \\ 0 \\ 0 \\ 0 \end{pmatrix} \begin{pmatrix} \Delta\text{FF rate}_{t-i} \\ \Delta\text{Eonia}_{t-i} \\ \Delta\text{ln PSPP}_{t-i} \\ \Delta\text{ln CSPP}_{t-i} \\ \Delta\text{ln Lending to Firms}_{t-i} \\ \Delta\text{ln Lending to Households}_{t-i} \\ \Delta\text{ln HICP}_{t-i} \end{pmatrix}$$

Γ_i means that 1% increase of Eonia (as in negative values) (such as -0.4 % to -1.4%) raises Lending to Firms in 12 months by (0.3559%)**(Indirect channel): Hypothesis 2.1 Eonia to Lending to Firms (Portfolio Rebalancing Channel)**.

One percent increase of PSPP raises Lending to Firms in 12 months by (0.3836 %) **(Indirect Channel): Hypothesis 3.1 PSPP to Lending to Firms (Portfolio Rebalancing Channel)**.

One percent increase of CSPP raises Lending to Firms in 12 months by (0.0173 %) **(Indirect Channel): Hypothesis 4.1 CSPP to Lending to Firms (Portfolio Rebalancing Channel)**.

$$\Gamma_i = coirf(in\ 12\ months) to\ \Delta\text{Lending to Households}_t (Indirect\ Channel)$$

$$= \begin{pmatrix} 0 \\ .000291 \\ -.000759 \\ .002249 \\ 0 \\ 0 \\ 0 \end{pmatrix} \begin{pmatrix} \Delta\text{FF rate}_{t-i} \\ \Delta\text{Eonia}_{t-i} \\ \Delta\ln \text{PSPP}_{t-i} \\ \Delta\ln \text{CSPP}_{t-i} \\ \Delta\ln \text{Lending to Firms}_{t-i} \\ \Delta\ln \text{Lending to Households}_{t-i} \\ \Delta\ln \text{HICP}_{t-i} \end{pmatrix}$$

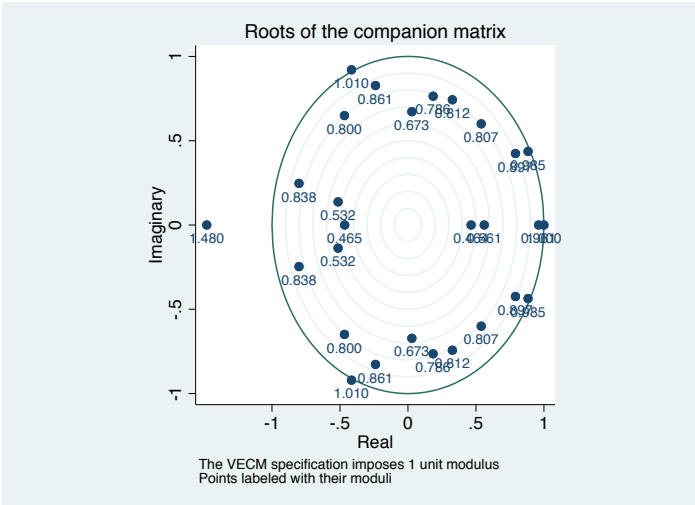
Γ_i means that 1% increase of Eonia (as negative values) (such as -0.4 % to -1.4%) raises Lending to Households in a year by (0.0291%) **(Indirect Channel): Hypothesis 2.2 Eonia to Lending to Households (Counter Balance Sheet Recession Channel).**

One percent increase of PSPP raises Lending to Households in a year by (-0.0759%) **(Hypothesis 3.2 (Indirect Channel) PSPP to Lending to Households (Wealth Effects)).**

One percent increase of CSPP raises Lending to Households in a year by (0.2249%) **(Indirect Channel): Hypothesis 4.2 CSPP to Lending to Households(Wealth Effects).**

5.5 Stability Analysis of the VECM Estimation

Figure 9 Stability Conditions of the VECM Estimation



Source: Author

Because the VECM specification in this paper has cointegrating equations, and

also because of the application of Granger's representation theorem to this case, we have successfully the error term ϵ_t guaranteed to be a white noise with its mean 0, its variance σ^2 and its autocovariance 0, which means that there are no other important factors related to the error term ϵ_t left in the VECM of the paper.

However, only one outstanding irregular variable for its eigenvalues' stability analysis to estimate is lagged variables of HICP growth rate **(Figure 9)**. Adjustment parameter(α) of its eigen value is less than (-1), which means its nonstationarity. Although the cointegrating equation itself is nonstationary, however, ln HICP in the cointegrating equation **($\boldsymbol{\beta' y_{t-1}}$) multiplied nonstationary adjustment parameter ($\boldsymbol{\alpha : -1.551215}$) becomes "a stationary error correction term($\boldsymbol{\alpha\beta' y_{t-1}}$)" in the VECM,** which means that HICP growth rate is indeed **"upwards trend stationary" one as a longer-term trend.**

6.Discussion: Verification of Hypothesis 0: Whether A Trend of Inflation Affected by Unconventional Monetary Policies is around 2% Rise or Not

HICP rises by (1.22568%) a year by itself. So, the success of 2 % inflation target requires raising another growth of exogenously additional 1% HICP growth rate increase by (Unconventional) Monetary Policies at the start. As a whole, increasing Lending to Firms decreases HICP growth rates, while increasing Lending to Households increases HICP growth rates. This shows that Lending to Firms is important to increase production and investment, and then raise GDP. However, increasing Lending to Firms decreases Lending to Households to consume more and then raise HICP growth.

6.1 HICP Growth Rate Increasing Factors

Firstly, as to the positive side for increasing HICP growth, Lending to Households rises by (1.37748%) in 12 months. So, the transmission effects of Lending to Households on HICP growth rate is (0.0768 %) multiplied (1.37748%), which equals (0.105790464%).

In addition, and in a direct channel, as a trend, Eonia decrease by about (0.0143993%) in 12 months at the start point with additionally decreasing by about (0.020016%) in 4 years from the start of PSPP, which sums to (-

0.0056167%) decreases in 4 years. This (0.0143993%) decrease in a year of Eonia transmits to HICP growth rate by (0.2917 %) multiplied by (0.0143993%) in 12 months, which equals (0.00420027581 %) increase of HICP growth rate in 12 months.

In indirect channels of Lending to Households, 1% increase of Eonia (as in negative values) (such as -0.4 % to -1.4%) raises Lending to Households in a year by (0.0291%), which is transmitted to the HICP growth rate by (0.0291 %) multiplied (0.0768 %), which equals (0.00223488 %) increase in a year.

One percent increase of PSPP raises Lending to Households in a year by (-0.0759%), which is transmitted to the HICP growth rate by (-0.0759%) multiplied (0.0768 %), which equals (-0.00582912 %) increase in a year.

One percent increase of CSPP raises Lending to Households in a year by (0.2249%), which is transmitted to HICP growth rate by (0.2249%) multiplied (0.0768 %), which equals (0.01727232 %) in a year. The 1% change effects of EONIA and PSPP on HICP growth rate are relatively tiny (the scale of its change is at 0.001% level in a year) compared to that of CSPP on HICP growth rate (the scale of its change is at 0.01% level in a year).

Fortunately, "trend" CSPP growth rate from June 2016 to December 2018 was almost zero and there is much room to increase its growth rate and the transmission effects to HICP growth rate in the future.

For example, if the ECB makes CSPP growth be 1% increase from the start, its direct effects on HICP growth is (0.3602 %) in a year, and its indirect effects through Lending to Households on HICP growth rate is (0.01727232 %) in a year, summing to (0.37747232 %) increase in a year. So, if the ECB makes the CSPP growth rate as 2 %, its direct effect on HICP growth rate is (0.7204 %) and its indirect effect is (0.03454464 %), summing to (0.75494464 %) increase in a year. Likewise, with 3% CSPP growth rate, its direct effect is (1.0806 %) and its indirect effect is (0.05181696 %), summing to (1.13241696 %) increase in 12 months.

With accomplishing increase of HICP growth rate by 1% exogenously by utilizing (Unconventional) Monetary policies, that is enough for raising HICP growth rate to 2% unless there are HICP growth rate decreasing factors, because

of euro area GDP increasing-driven upwards HICP trend.

So, we calculate below HICP growth decreasing factors, Lending to Firms and PSPP, and so on.

6.2 HICP Growth Rate Decreasing Factors

Secondly, as a direct channel, as to the negative side for decreasing HICP growth rate, one percent increase of Lending to Firms raises HICP inflation rate in 12 months by (-0.4817 %).

In addition, and in a direct channel, as a trend, PSPP growth rate is (5.22863%) each year with additionally decreasing by (0.13372%) each year, which sums to (5.09491 %) in a year and to (4.69375 %) increase in 4 years. That (5.09491 %) increase of PSPP in 12 months transmits to HICP growth rate calculating that (5.09491 %) multiplied by (-0.2167 %), which equals (-1.104066997%) in a year.

In indirect channels of Lending to Firms, 1% increase of Eonia (as in negative values) (such as -0.4 % to -1.4%) raises Lending to Firms in 12 months by (0.3559%), which is transmitted to the HICP growth rate by (0.3559%) multiplied by (-0.4817 %), which equals (-0.17143703 %) increase in a year.

One percent increase of PSPP raises Lending to Firms in 12 months by (0.3836%), which is transmitted to the HICP growth rate by (0.3836%) multiplied by (-0.4817 %), which equals (-0.18478012 %) increase in 12 months.

One percent increase of CSPP raises Lending to Firms in 12 months by (0.0173 %), which is transmitted to the HICP growth rate change by (0.0173 %) multiplied by (-0.4817 %), which equals (-0.00833341 %) increase in a year.

Although the negative transmission effect of Lending to Firms growth rate increase on HICP growth rate is relatively large (e.g. (-0.4817 %) increase in 12 months), other indirect channels negative transmission effects provided less than 1% increase of the variables, are relatively small (e.g. at most, they are from -0.1 % to -0.2 % levels).

As PSPP growth rate is (5.22863%) each year with additionally decreasing by (0.13372%) each year, which sums to (5.09491 %) in a year and to (4.69375 %) increase in 4 years, the sum of direct and indirect effects of PSPP growth of (5.09491 %) increase in a year are direct (-1.104066997 %)+ indirect (-

0.18478012 %), which equals (-1.288847117 %) in a year.

Because sums of those negative transmission effects on HICP growth rate with 1% change of each variable (Eonia, PSPP, CSPP) are at most (-1.468617577%) levels in a year (due to PSPP Direct(-1.104066997%)+PSPP Indirect(-0.18478012%)+Eonia Indirect(-0.17143703%)+CSPP Indirect(-0.00833341%)), those negative effects on HICP growth rate can be offset by increasing CSPP growth rate.

For Example, increasing CSPP growth rate by 1% causes (0.37747232 %) HICP increase in a year through increasing Lending to Households, and (-0.00833341 %) increase in a year through increasing Lending to Firms, summing to net HICP growth rate increase of (0.36913891 %) in 12 months. Likewise, if the ECB sets CSPP growth rate more than 6.5398638422% in a year, (due to ((negative sum1.468617577%+exgogenous1%)/(inflation rate by CSPP 0.3777232%)), which is indeed realistically much less than the realized value: it's average 110% growth of CSPP in 3 years from the implementation, net increase of HICP growth rate will be (1%) in a year, which is amply effective for the ECB to accomplish inflation target of 2 % with its **"annual trend of 2 % onwards"**.

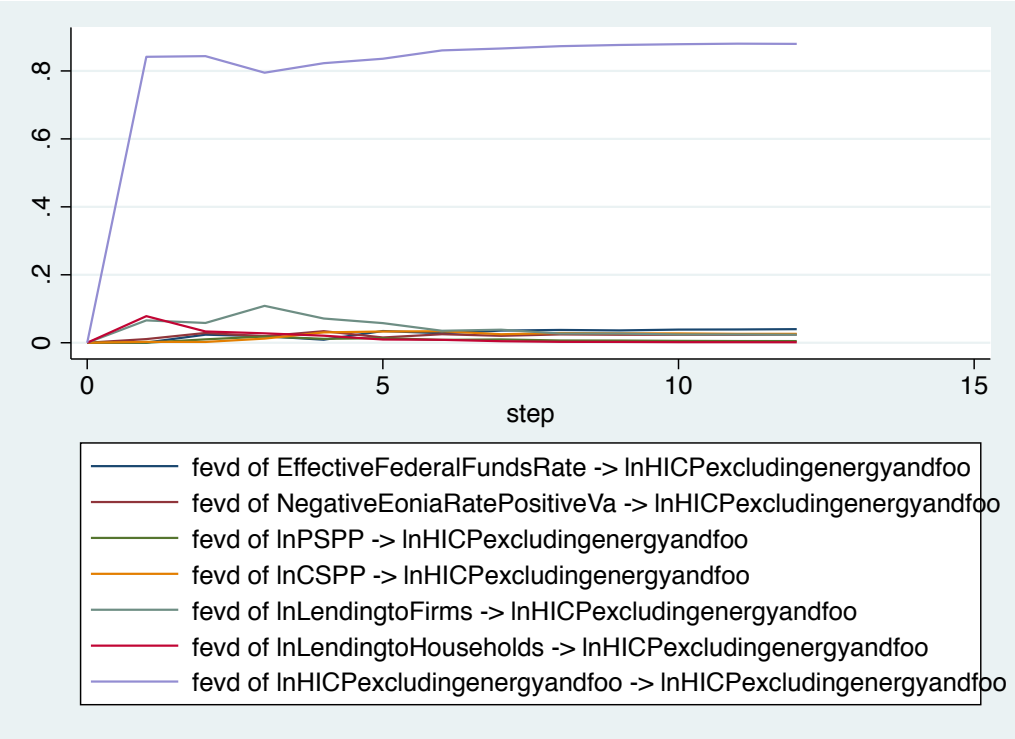
6.3 FEVD (Forecast Error Variance Decomposition) of HICP Growth Rate in A Year COIRF

Finally, we have the FEVD with no constant and no trend explaining HICP FEVD(**Figure 10**). The coirf coefficient in 12 months of FF rate change rate is 0.040037. The coirf coefficient in 12 months of Negative Eonia change rate is 0.024038. The coirf coefficient in 12 months of PSPP change rate is 0.004943. The coirf coefficient in 12 months of CSPP change rate is 0.026165. The coirf coefficient in 12 months of Lending to Firms change rate is 0.023689. The coirf coefficient in 12 months of Lending to Households change rate is 0.001483. The coirf coefficient in 12 months of HICP change rate is 0.879645.

FEVD of HICP growth rate is decomposed into 7 variables in the paper. HICP growth rate consists of 88% of its lags, followed by FF rate of its 4%, CSPP of its 2.6%, Negative Eonia of its 2.4%, Lending to Firms of its 2.3%, PSPP of its 0.49% and Lending to Households of its 0.14%.

Mostly, HICP growth rate is determined by its lagged growth (: (88 %) of those). However, other variables can and must affect HICP growth rate, such as CSPP, Eonia, PSPP, and so on, to raise indispensably and exogenously given 1% HICP increase required to lift depressed HICP growth rate up towards its 2% trend, which is just the outcome aimed by the ECB's unconventional monetary policies.

Figure 10 Variance Decomposition of VECM



Source: Author

7.Conclusion

In conclusion, as we verified whether the ECB's 2% inflation target accomplished or not by the ECB's Unconventional Monetary Policies, the ECB indeed accomplished the 2% inflation trend growth in a year onwards.

As a result, the ECB's Unconventional Monetary Policies raises HICP growth rate exogenously by 1 %, which makes a **"trend"** of 2 % HICP growth in a year.

The most effective transmission channels are especially CSPP growth on HICP. Furthermore, any monetary policies to increase Lending to Households channels, which relates to wealth effects stimulated by the ECB's Unconventional Policies,

are especially effective for raising consumption, and then HICP growth, compared to increasing Lending to Firms channels stimulating production, investment and then GDP in the Euro Area, affecting the economic fundamentals, which is caused by portfolio rebalancing effect.

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