Monetary Policy in the Face of the Eurocrisis How does the European Central Bank Absorb Excess Liquidity?

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The objective of this paper is to demonstrate the mechanism by which the European Central Bank (ECB) has been successfully absorbing excess liquidity – albeit to a small extent. These Fine Tuning Operation (FTO) were introduced to neutralize the liquidity effects of the Securities Markets Programme initiated in May 2010. Even for students in Monetary Economics it is usually difficult to understand, how such operations work in reality. With a hands-on classroom experiment, we let students simulate investment decisions in the name of financial institutions which needed to park excess liquidity with the ECB through an auction process that replicates the actual Fine Tuning Operations in place. The auctions showed to be very competitive, thereby enhancing the students understanding of the real word behaviour of major European financial institutions. A thorough analysis of the bidding results and the various determinants of total profits is presented. A link to the final credit points of the course – thus the grade - of the participants can be made. Though, first we start by describing as well as analyzing the evolution of the ECBs' monetary policy instruments. The adjustments in policy as well as in the instrumental catalogue of the ECB in the aftermath of the Great Recession are focused on. Finally, a brief outlook on the future of European monetary policy is given.

Financial crisis, monetary policy instruments, auction design, experimental economics.

Introduction

The financial crisis of 2007 started out in the US subprime market (real estate finance) - a market segment of relative limited scope. As US housing prices started to come down, several subprime originators failed. When Lehman Brothers had to file for Chapter 11 bankruptcy protection on 15 September 2008, the previous market turmoil escalated into a full-fledged global crisis. As a growing

number of major financial institutions were facing the risk of default, a crisis of confidence resulted - quickly spreading across markets and countries.[1] The run on money market mutual funds triggered "shareholders redemptions that resembled a bank run" (BIS 2009 p. 26). The crisis of confidence hit most of the financial intermediaries and quickly spread via the credit channel to the real sector of the economy (corporates and private households). Only when six major central banks engaged in unprecedented interventions and coordinated joint reductions in their policy rates did the financial markets stabilize at a much more fragile level. Though, concerns about solvency as well as liquidity of counterparties remained significant.

The worst global crisis since the Great Depression led world output drop for the first time since the late 1940ies – as real GDP contracted by 0.6 % (2009). At the same time, the breakdown of international trade was even more pronounced – trade in goods and services contracted by almost 11 % in 2009. Therefore, open and trade-oriented countries were hit hard by the contraction of international import and export flows. Some of them, like Germany and Japan, experienced sharp drops in output compared to the United States (-3.1 %). Their real GDP contracted by 5.1 % and 5.5%, respectively – even though their financial sector remained relatively sound.[2] Crisis countries with fragile banking systems, large current account deficits and subsequent rising public debt ratios had to go through a much more pronounced – while longer - recession. For some of them, the end of their plight is still not in sight; e.g. Greece, Portugal or Spain.

The major advanced countries quickly coordinated their fiscal stimuli packages.[3] They undertook measures to stabilize the financial sector through recapitalization, liability guarantees and asset purchases. Importantly, they did <u>not</u> resort to damaging protective policy measures as during the Great Depression. The major central bank's coordination was even more extensive – they sharply reduced interest rates and provide extensive liquidity support.[4] In addition, Asian emerging markets - especially China and India - were not only able to shield themselves of the recessionary impact – taking just a small dip in their high rates of growth in 2009. In 2010, their economies bounced back onto their pre-crisis growth path. Rapid growth in Asia as well as in other developing country regions led to a sharp revival of world trade (+12.5 %) in 2010. Combined with domestic expansionary fiscal and monetary measures, real GDP growth for most advanced crisis countries

1 For an overview, Gorton; Metrick (2012), Lo (2012) and Mishkin (2011) make a good read. In Table 1 of Gorton; Metrick (2012), a financial crisis major events timeline is presented. Another one is to be found in BIS (2009 Table II.1).

2 Small open economies were hit even harder – e.g. Hungary (-6.7 %), Finland (-8.5%) or Estonia (-14.1 %) (IMF 2013 Table A2 and A4).

3 Though, fiscal stimuli seemed to be of less importance than the stabilization of the financial sector (Mishkin 2009 p. 576; Mishkin 2011 p. 64).

4 See IMF (2009) in Gorton; Metrick (2012 Table 2) for a summary of supportive measures by government and central banks.

jumped forward again. Within the Euro Area, Germany's rebound was the strongest, while advanced countries as a group experienced a growth rate of 3.0 % (2010). Due to the short economic contraction in world output,[5] the financial crisis 2007-2013 is often also labeled as the Great Recession (2008-2009).[6]

The quick recovery of the real sector in 2010-11 was in no way paralleled in the financial sector, and it did not cover all countries. In Europe, a major sovereign debt crisis in the countries of the periphery emerged in late 2009. The debt levels of Greece, Portugal and Ireland had become unsustainable.[7] In May 2010 Greece was the first country in need of an international financial aid package (three year lending facility, $110 bn). The crisis management of the Euro Area countries was in the hands of a Troika - European Commission, ECB and International Monetary Fund (IMF). Especially the German government had been very keen on for an active role of the IMF. Besides participating with its own share of $30 bn, the IMF was seen as more experienced and independent. Due to the threat of contagion, further stabilization measures were adopted. The EU finance ministers established the European Financial Stability Mechanism (EFSM €60 bn) and the Euro Area states agreed on the European Financial Stability Facility (EFSF €440 bn). On a case-by-case basis, the IMF could top-up the financial aid coming from the two European funds by 50 %.[8] These decisions were made end of May 2010, in hope to calm down the turmoil on international financial markets. Ireland was the first country to slip under this new "European financial umbrella"[9] in November 2011 (€67.5 bn). Portugal, Greece, Cyprus and Spain were to follow by mid 2013. As it became apparent that temporary measures were not successful enough, the European Council decided to establish a permanent crisis management mechanism. The European Stability Mechanism (ESM €700 bn) enter into force on July 1 2013, thereby replacing the measures mentioned before.[10]

After the US subprime crisis (2007) and the bankruptcy of Lehman Brothers (2008), the European sovereign debt crisis (2010) emerged as the main challenge for policy makers in Europe – governments as well as the European Central Bank. The paper starts to look in depth into the monetary policy reaction of the European

5 Germany's real GDP expanded 4.0 % in 2010 and 3.1 % in 2011 and was mainly export and investment driven. For advanced countries, GDP contracted by 3.5 % in 2009, whereas real world output bounced back to +5.2 % in 2010 (IMF 2013 Table A2).

6 See Schularick; Taylor (2012) p. 1042.

7 Lane (2012 p. 51f.) provides a comprehensive overview on the accumulation of European countries sovereign debt and its link to financial as well as external imbalances.

8 More specifics to these measures can be found in Bundesbank (2011a) p. 90 and in ECB (2011b) p. 75.

9 In German: Europäischer Rettungsschirm.

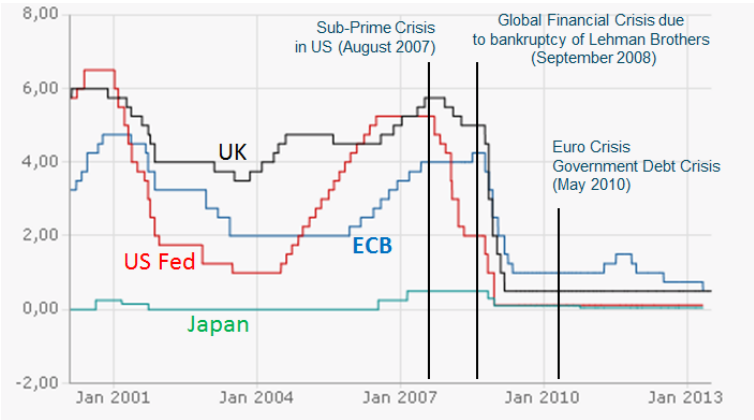
10 To limit the potential liability of the Euro Area states until the EFSF has run out, total consolidated ESM and EFSF lending may not exceed €500 bn (ECB 2011b p. 74).

Central Bank (ch. 1), followed by a discussion on the economic effects of various policy instruments (ch. 2). In chapter 3, the monetary policy experiment is presented. It includes the set-up as well as the analysis of the findings. Finally, the learning outcomes of the classroom experiments as well as broad implications on the effectiveness of monetary policy instruments are discussed. A brief outlook on future monetary policy developments is given.

1. Financial Crisis and ECB's Monetary Policy Reactions

Based on the experience of the Great Depression, John M. Keynes recommended for central banks to initiate anti-cyclical policy actions by providing liquidity to the economy in order to dampen the detrimental effects of an imminent recession in the real sector. In the economic aftermath of the bust of the dot.com bubble (2000), the US Federal Open Market Committee (FOMC) cut the federal funds rate aggressively in 2001 to cushion the fall in demand and employment. After the 9/11 terror attack, all major central banks accommodated the rise in uncertainty by providing liquidity to the financial system in a coordinated move. In retro-perspective, the sharp expansionary policy stance, supported the real economy successfully and prevented a worldwide recession to emerge. As inflationary expectations were well anchored, there was no significant hike in inflation.[11]

Fig. 1: Leading Interest Rates of Major Central Banks (2000-2013)



U.S. federal funds target rate 0-0.25 %; Bank of Japan 0-0.1 %; UK base rate 0.5 %; ECB main refinancing rate 0.5 %. www.finanzen.net (05. August 2013)

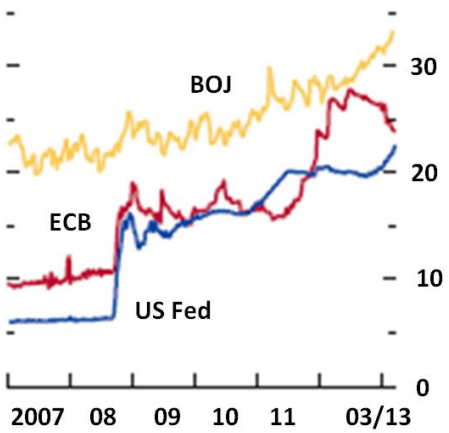
Figure 1 presents the development of the leading interest rates of major central banks: the US Federal Reserve, Bank of England, Bank of Japan and the European Central Bank. During the last 15 years the variation in interest rates has been a

[11] Inflation in this sense equates to a rise in consumer prices (CPI) and not of asset-prices (Goodfriend 2007 p. 55).

very close one. Only the degree of variation in national rates differs significantly. Traditionally, decisions of the US FOMC set the pace for the other central banks to follow. One exception was the temporary rise of the ECBs' main refinancing rate in 2011, just before a sharpening of the European debt crisis led to a reconsideration of its interest rate policy. Essentially, central banks aim to determine short-term market interest rates – money market rates - by influencing the cost of interbank lending. Through various channels of transmission, they want to target real economic activity, and eventually consumer price inflation.[12]

Following the bankruptcy of Lehman Brothers and the subsequent crisis of confidence all major central banks cut down their leading interest rates fast and substantially – until they reached the zero-bound. They started off in a concerted action, when six central banks reduced their rates by 50 basis points on October 8 2008.[13] These standard monetary policy actions are often asymmetric in nature – slowly raising interest rates, when the economy is in danger of overheating, and rapidly reducing the rates, when the economy is over the cliff (*Figure 1*). This is called the "mop-up" approach in monetary policy.[14]

Fig. 2: Total Assets of Major Central Banks in percent of GDP (2007-2013)



IMF (2013) p. 5

Growing uncertainty about the financial health of major commercial banks (loss of confidence) led to a collapse of the money-market and other financial markets.

12 A stylised illustration of the transmission mechanism from interest rates to prices is presented in ECB (2011c p. 59).

13 Canada, European Central Bank, Sweden, Switzerland, United Kingdom, United States (ECB 2010b p. 65).

14 See Blinder (2010) for a thorough discussion of how the "mop-up approach" evolved, and when it should be implemented.

Interbank lending virtually came to a halt. Central banks quickly provided massive liquidity and introduced various kinds of non-standard measures to reduce systemic risks as well as to stabilize financial markets. In addition, the channels through which interest rate decisions were normally transmitted to the economy came under severe strain.[15] As the key interest rates reached the zero lower bound, the monetary authorities' ability to further reduce real interest rates is rather limited since a reduction in nominal rates is not possible anymore.[16] Due to the above reasons, the central banks had to undertake other, more innovative measures.

The vast size of the non-standard measures undertaken by the monetary authorities is reflected in the "explosion" of central bank balance sheets (*Figure 2*). In percent of GDP, the balance sheet of the ECB almost tripled over the course of the global financial crisis, peaking at 27 % of GDP in 2012. The increase in liquidity provision to a country's economy falls under the term *Quantitative Easing*. At the same time, the balance sheet underwent significant structural changes (*Qualitative Easing*). Parts of the structural changes were the considerable extension of maturities (refinancing operations) as well as the reduction in quality standards for collateral the central banks would accept. While changes in the minimum reserve requirements and the purchase of government bonds led to an additional expansion of balance sheets.

Tab. 1: Non-standard Measures of the ECB (2008-2013)

	Money Market-Based	**Securities** Market-Based
Fixed-rate full allotment in		
- main refinancing operations	2008	
- longer-term refinancing operations	2008	
Special maintenance-period operations	2008	
Supplementary LTROs	2007	
6 / 12 / 36-month LTROs	2008 / 2011	
USD / SFR providing operations	2007 / 2008	
Covered Bond Purchase Programme (CBPP)		2009
Securities Markets Programme (SMP)		2010-2012
Reduction of Reserve Requirements (to 1%)	2012	
List of eligible collateral extended	2008	
Outright Monetary Transactions (announced)		2012

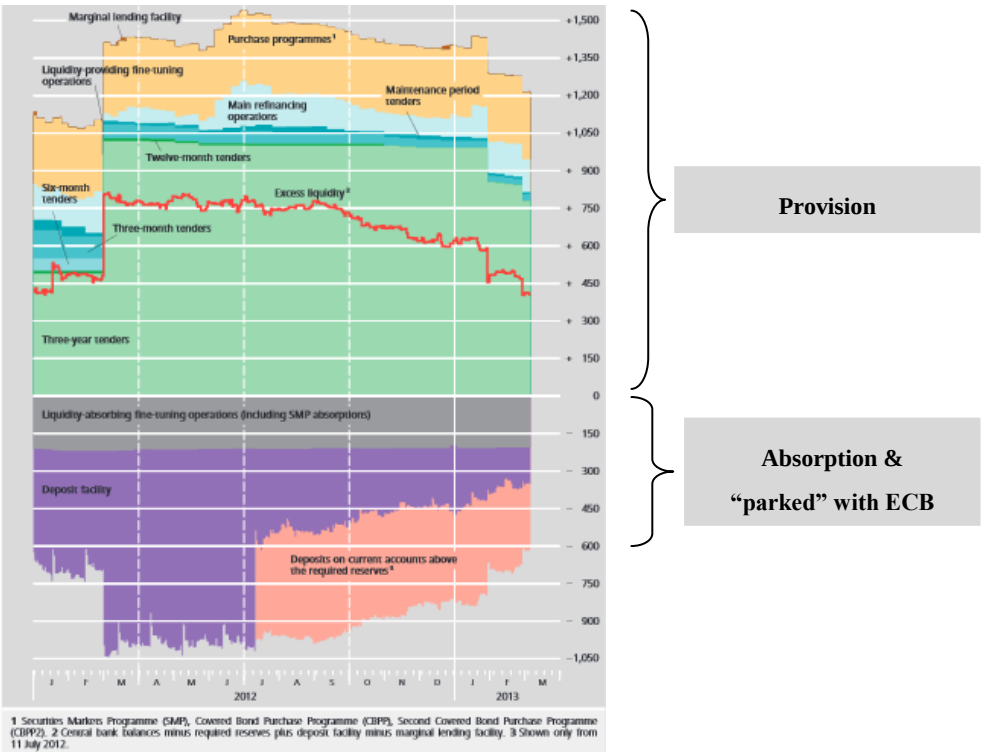
LTROs = Longer-Term Refinancing Operations (year of introduction – or phase-out); based on ECB (2011a) p. 57 and Deutsche Bundesbank (2013) p. 47-48

15 The financial crisis impaired the pass-through from official to short- and long-term market rates, banks found it hard to access funding, bank's borrowers experienced a fall in assets, and finally creditworthiness as well as risk perceptions changed (ECB 2011a p. 55; Woodford 2010 p. 37 and Figure 5).

16 In such an instance, the public prefers to hold cash, instead of lending funds or holding deposits at a negative rate (ECB 2011a p. 57).

Table 1 presents the various non-standard measures implemented by the ECB during the course of the financial crisis. They either fall into money market-based measures – with a focus on general liquidity provision - or securities market-based measures – focusing on providing liquidity to specific, dysfunctional market segments. ECB studies found the (money market-based) non-standard measures to be quite successful in dampening the recession as bank lending rates to households and non-financial corporations declined with short delay, and the level of lending contracted only moderately (ECB 2011a p. 61). Though, the differences in development between periphery and core countries remained substantial. Due to the continued crisis of interbank confidence (counterparty risk), many financial institutions asked the ECB for much more liquidity than they actually worked with.[17] Excess liquidity ballooned, when the two 36-month refinancing operations took place (12/2011 and 03/2012). The banks reduced their excess liquidity especially when the overnight deposit rate at the ECB dropped to zero and (unlimited) outright monetary transactions were announced (*Figure 3*).[18]

Fig. 3: Liquidity Management of the Eurosystem (2012-2013)



1 Securities Markets Programme (SMP), Covered Bond Purchase Programme (CBPP), Second Covered Bond Purchase Programme (CBPP2). 2 Central bank balances minus required reserves plus deposit facility minus marginal lending facility. 3 Shown only from 11 July 2012.

Deutsche Bundesbank (2013a) p. 46

[17] See SVR (2009) p. 92 and following.

[18] Deposit facility: 0 % (11.07.2012); Governing Council decided on OMTs (06.09.2012).

As the global financial crisis calmed down in early 2010, the Governing Council of the ECB planned to return to normal ("standard times") by reducing the scale of longer-term refinancing operations as well as changing the auction design of the refinancing operations to variable rates and limited allotment (pre-crisis design). But in May 2010 the European sovereign debt crisis hit, unsettling international financial markets further. So, the ECB prolonged the non-standard measures and expanded them in scope as well as in scale by fall 2012 (*Table 1*).

To support dysfunctional financial markets within the Euro Area the Governing Council decided on May 10 2010 to implement the Securities Markets Programme (SMP). It targeted illiquid public and private debt securities markets – mainly government bond markets of countries on the European periphery like Portugal, Italy, Ireland, Greece and Spain. The Eurosystem purchases are strictly limited to secondary markets[19] – therefore being "kind of" in line with no direct financing of fiscal deficits. The SMP was heavily disputed in the German public as well as within the Governing Council – especially by its two German members. The friction on this fundamental policy issue led to major personal consequences and the election of Mario Draghi as the current president of the ECB.[20]

Direct purchases of securities do not provide additional liquidity to the Euro Area. They have to be fully sterilized by conducting liquidity-absorbing operations.[21] In *Figure 3*, the purchase programmes show up on the top of the liquidity provision as well as on the bottom with liquidity-absorbing fine-tuning operations.

2. How do ECB's Open Market Operations work?

Open market operations are central in implementing the monetary policy of the Eurosystem. They are used to target interest rates and the liquidity of Euro Area's financial markets. In addition, these operations provide crucial information to market participants on future monetary policy actions of the ECB. Their function of signalling medium-term policy developments has become much more important lately.[22] Up to fall 2007 its main refinancing operations – with a maturity of one

19 See ECB (2010b) p. 74

20 Mario Draghi was the unanimous candidate for the ECB only, after Axel Weber dropped out as the prefered candidate unexpectably in the spring of 2011. Weber stepped down as president of the Bundesbank due to the monetary policy decisions the ECB had taken. In September 2011, the chief economist and German board member of the ECB, Jürgen Stark, announced to end his career with the ECB before his term of service was over.

21 ECB (2010b) S. 74.

22 The former member of the Board of Governors of the Federal Reserve, F.S. Mishkin (2011 p. 62), stresses the importance of monetary policy to focus on the management of market participants' expectations. In his July 4 2013 statement to the press, the

week – had been dominating the liquidity management. Between 60-75 % of all liquidity provided to the economy were short-term in nature. After the outbreak of the global financial crisis in October 2008, the focus shifted towards longer-term refinancing operations. Herewith, reducing the uncertainty of financial intermediaries in tapping liquidity they needed. Instead of using interbank lending, the Central Banks provided them with direct access to liquidity over a longer term.

Since the start of the Eurosystem in January 1999 up until the outbreak of the global financial crisis, the ECB had already undertaken several important changes in implementing its main refinancing operations. *Table 2* gives an overview of the various structural changes for liquidity providing operations within the whole period of 1999-2013.

Tab. 2: Tender Procedures for Main Refinancing Operations (1999-2013)

Start of Period	**Fixed Rate** Tender (ltd Allotment)	**Fixed Rate** Tender (Full Allotment)	**Variable Rate** Tender (American Auction)	Maturity (# of days)
07.01.1999	X*			14 **
28.06.2000			X	14 **
10.03.2004			X	7
15.10.2008		X		7

ltd – limited; * with extremely small allotment ratios; ** overlapping – with each week a new tender
Deutsche Bundesbank (2011c); ECB (2011c).

The main refinancing operations are liquidity-providing reverse operations that are executed regularly by the Eurosystems National Central Banks (NCBs) through standard tenders.[23] In the case of *fixed rate (volume) tenders*, the central bank specifies the interest rate (i_{fix}) in advance and the participating counterparties (e.g. commercial banks) bid the amount of money they want to transact at the specified rate. During the period 1999-2000 the bid of the counterparties usually exceeded the volume of money the ECB provided the banking sector with. Therefore, the submitted bids were satisfied pro rata – according to each bids share of the aggregate amount. The allotment ratio reflects the amount to be allotted to the aggregate amount bid. The competition between the counterparties led to totally unrealistic and therefore non-informative bids ("moon bids"). On June 7 2000,

president of the ECB (M. Draghi), for the first time, gave explicit *forward guidance* towards the interest rate policy of the Governing Council: "Looking ahead, our monetary policy stance will remain accommodative for as long as necessary. The Governing Council expects the key ECB interest rates to remain at present or lower levels for an extended period of time." (Draghi 2013).

23 A detailed presentation of the different forms of monetary policy instruments and procedures can be found in ECB (2011d).

counterparties bid for €8,491.2 bn while the ECB allotted only €75 bn - the allotment ratio being a meagre 0.9 %.[24]

Due to continued overbidding the Governing Council decided to switch to a more market-oriented procedure by the end of June 2000: *variable rate (interest) tenders*. The ECB specifies (usually) a minimum interest rate (i_{min}). With this rate in mind, the counterparties bid the amounts of money and the interest rates at which they want to enter into transaction with the Eurosystems NCBs. Counterparties are not limited to submit only a single bid. They can submit up to ten bids that differ in the amount of money and the interest rate.[25] The ECB ranks all incoming bids in descending order (liquidity-providing operations) based on the offered interest rate. In general, the bids with higher interest rates offered are satisfied first and to full extent. Bids with successively lower rates are accepted until the total liquidity to be allotted is exhausted. If the aggregate amount of bids at the lowest acceptable rate – marginal interest rate ($i_{marginal}$) – exceeds the amount of liquidity still to be allotted, this remaining amount is allocated pro rata.[26] All bids with interest rates below the marginal interest rate do not receive any allotment. As these variable rate tenders proceed with an *American auction* design, the bidding counterparties have to pay their individually interest rates offered. By switching the procedure in June 2000, overbidding was sharply reduced. The allotment ratio rose substantially, whereby the information content of the bids for the ECB also increased significantly.[27]

A graphical depiction of the two recent tender operations is presented in *Figure 4*. On the left hand side, the market-oriented *variable rate (interest) tender* is shown. Most of the time, demand of the counterparties (banks) exceeded the supply of liquidity provided by the ECB. On October 15 2008, the European Central Bank switched back to *fixed rate (volume) tender*, though this time all of the counterparties bids are fully allotted.[28] It covers the main refinancing operations as well as the longer-term refinancing operations. As the financial institutions knew that they would receive any amount they were bidding for, the problem of extreme overbidding did not arise. There are still two reasons that account for the excess liquidity we observed in *Figure 3*: firstly, the liquidity management of each individual counterparty wants to be on the safe side – therefore, they will bid for

24 Deutsche Bundesbank (2011c). The maximum allotment ratio is 100 %. Frenkel et al. (2003) analyze the process of overbidding in more depth.

25 The interest rates bid must be expressed as multiples of 0.01 percentage point and the minimum bid amount is €1 mn (ECB 2011d L331/23).

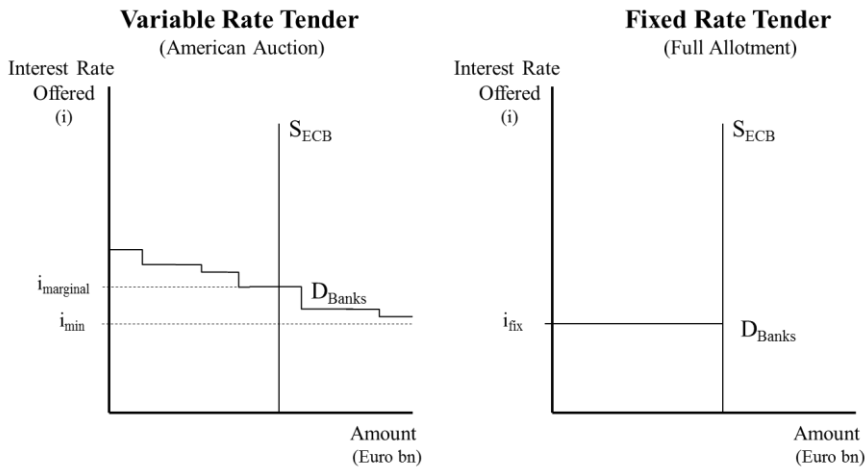
26 Additional information can be found with ECB (2011d L331/24).

27 The various tender procedures – including the variable (interest) rate tender with Dutch auction design – are discussed in Frenkel et al. (2003 p. 112f) and Gischer et al. (2004 p. 187f). Numerical examples are given in ECB (2011d) Appendix 1.

28 A graphical depiction of the fixed rate tender during the period 1999-2000 would show that the ECB's liquidity supply is far to left of the aggregate amount bid for all counterparties combined; see right hand side of *Figure 4*.

larger amounts than necessary. Secondly, due to the crisis in confidence the banks reduced their usage of interbank lending, which increased their demand for ECB's liquidity provision. Since liquidity was provided for a longer-term (up to 3 years), excess liquidity should prevail, even if the confidence crisis subsides and interbank lending picked up.

Fig. 4: Liquidity-providing Tenders



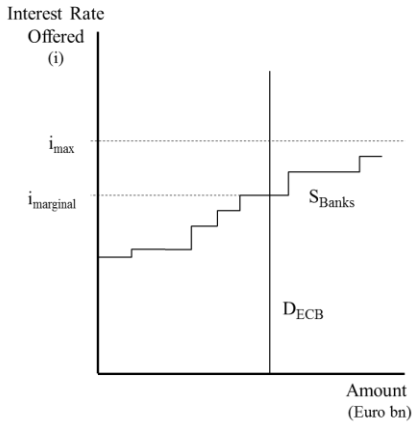
Piazolo (2011) Figure 4

Direct purchase of securities by the ECB through the Covered Bond Purchase Programmes, the Securities Markets Programme and the Outright Monetary Transactions should under no circumstances provide additional central bank liquidity to the financial system. Therefore, special Fine Tuning Operations (FTOs) were initiated to absorb the provided liquidity by exactly the same amount – the purchase programmes were fully sterilized. Practically, this was (still is) done through a variable rate tender with an American auction.

In *Figure 5* such a procedure is presented graphically. The ECB announces a tender operation and specifies a maximum interest rate. Then, the counterparties offer excess liquidity to the ECB; e.g. the latter collects fixed-term deposits for one week. As the interest rates offered represent costs for the ECB, the central bank tries to minimize these costs by accepting the bids with the lowest interest rates first. Subsequently, bids with higher interest rates are accepted until the total liquidity to be absorbed is exhausted. At the highest interest rate just being accepted, (marginal interest rate) an allotment pro rata takes place, if the aggregate amount of bids exceeds the remaining amount to still be allotted.[29] In August 2013 the ECB absorbed €190.5 bn at an average interest rate of 0.11 % (p.a.).

[29] For more details see ECB (2011d L331/25).

Fig. 5: Liquidity-absorbing Tenders



Collection of Fixed Deposits

Tender-ID: 20130188	
Quick Tender (variable rate tender, American auction)	
Submission date for bids:	27.08.2013 at 12:05
Maturity:	7 days
Maximum interest rate bid:	0.50 %
Minimum amount being allotted:	-
Minimum amount of bid:	€1.00 mn
Targeted allotment amount:	-
Aggregate amount bid:	€287.539 bn
Number of counterparties:	123
Total amount of allotment:	€190.500 bn
Marginal interest rate:	0.13 %
Ratio of allotment at marignal interest rate:	64.47 %
Average interest rate:	0.11 %
Bids spread:	0.00 % - 0.50 %

Piazolo (2011) Figure 5; www.bundesbank.de / FTO 2013-08-27 (in German)

3. Monetary Classroom Experiment on Tender Procedures

3.1 Setup of the Classroom Experiment

To enhance the students understanding of the bidding behaviour of major financial institutions – as reflected by the results of the fine tuning operation in the right hand column of *Figure 5*, we asked them to participate as investment officers in two different kinds of liquidity-absorbing operations. The banks, they are working for, are in excess of €4 mn of liquidity. The participants are supposed to engage with €2 mn each in both investment opportunities – thereby maximizing their own profits.

The first kind of investment is a Fine Tuning Operation, which almost exactly resembles the liquidity-absorbing *collection of fixed-term deposits* through the ECB presented above. Though, the following adjustments are made for reasons of simplification:

- Maturity is lengthened to one year; therefore, the interest rate is easily captured as per annum.
- €2 mn is to be invested in two tranches of €1 mn each, or alternatively in one tranche only. Instead of being able to submit bids with up to 10 different interest rate levels,[30] we restrict them to a maximum of two different bids.

30 See for comparison ECB (2011d L331/23).

- As the aggregate amount of bids is unknown to us in advance, we announce that only 2/3 of this aggregate will be allotted by the central bank. Therefore, all participants know that they are part of a competitive auction process.
- An alternative investment vehicle is introduced: German Federal Treasury Notes ("Bundesschatzbriefe") with comparatively low interest rates. They essentially serve as a lower bound of an interest rate corridor for the bidding process.

The tender procedure is a *variable rate tender*, whereas the participating counterparties will have to submit bids stating the interest rate(s) offered as well as the amount of liquidity to be deposited. In *Table 3*, we mimicked an official ECB announcement for a tender operation. It was presented to the students via email and the university's learning management system (Blackboard and VCRP[31]). The announcement was made 8-10 days in advance of the submission date.

Tab. 3: ECB Announcement of Fine Tuning Operation (June 13 2013)

Liquidity-Absorbing Collection of Fixed-Term Deposits	
Standard Tender (variable rate tender, American auction)	
Submission date for bids:	21.06.2013 at 12:00
Allotment date:	21.06.2013
Maturity:	360 days
Maximum interest rate:	0.50 %
Minimum amount being allotted:	---
Minimum amount of bid:	€1 mn
Maximum amount of bid:	€2 mn
Targeted allotment amount:	2/3 of aggregate amount of bids

This announcement was part of general information material on the various auction designs for tenders in ECBs main refinancing operations. In the participation sheet the students had to submit (*appendix 1*), they were made aware that the amount (excess liquidity) of the unsuccessful bids would automatically be invested in an alternative government security. In the 2013 experiment, these German Federal Treasury Notes carried an interest rate of 0.25 % (p.a.).

In the second part of the experiment, we made use of the fact that the National Central Bank of Germany – Deutsche Bundesbank – acts, besides being an integral part of the Eurosystem, also as fiscal agent for the German government.[32] Deutsche Bundesbank is given the mandate to offer Federal bonds, Federal Treasury notes and Treasury discount paper for sale by auction, and it also is in

[31] Virtueller Campus Rheinland-Pfalz

[32] Deutsche Bundesbank acts for the account of the Federal Government, the German Finance Agency or "Finanzagentur GmbH" (Deutsche Bundesbank 2012 p. 1).

charge for providing liquidity to the market by directly engaging for the account of the Federal Government in trading securities if necessary.

Technically, the bids are to be transmitted electronically through the Bund Bidding System run by Deutsche Bundesbank. Even though there are no restrictions on the range of potential buyers, only members of the "Bund Issues Auction Group" can directly participate in the auctions. In August 2013, 37 major international financial institutions – mainly commercial banks – were members of the auction group.[33] In 2012, 70 auctions took place - with a total allotment of €214 bn. In 2008, fewer auctions were conducted with less securities being allotted to (37 auctions and €170 bn respectively). Though, the peak of allotment had been reached in 2010 with a total volume of €273 bn - due to the additional financing needs of the Federal Government to stabilize financial markets. For 2013, a volume of €250 bn is scheduled – almost 70 % of which are capital market securities, while 30 % are money market securities like Treasury discount papers.[34] The latter are so called *Bubills* with maturities varying between 3-12 months.

We mimic an auction for Treasury discount papers (*Bubills*) with a maturity of 12 months. For discount papers, the interest or effective rate of return for the investor results from the difference between the nominal value (100.00) and the purchase price.[35] The design is a *variable rate tender* run as an American auction. The minimum amount to bid for is €1 mn. Several bids can be submitted – varying in price and volume.[36] Though, in our out of classroom experiment only two bids can be made, and price bids must be expressed as 0.01 percentage points.

As the issuer aims to keep interest rate payments as low as possible, higher price offers are served first and fully. So, bids which are above the lowest price accepted (marginal price) will be allotted to full extent. Bids below the marginal price will not be considered. So, Deutsche Bundesbank ranks all incoming bids in descending order based on the prices offered. The marginal price is manifested when the total volume of *Bubills* to be allotted is exhausted. If the aggregate amount of bids at the marginal price exceeds the amount of *Bubills* still to be allotted, this remaining amount is allocated pro rata.[37]

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33 Financial institutions have to fullfill specific criteria to become and remain a member; e.g. submitting a minimum amount of successful bids (Deutsche Bundesbank 2012 p. 1 and 2013).

34 For more detailled information see Finanzagentur (2012 p. 1). Small amounts of inflation-indexed bonds as well as foreign currency bonds are also auctioned off.

35 Federal Ministry of Finance (2012 p. 2).

36 The price bids for Treasury discount paper must be expressed as full 0.00005 percentage points (Deutsche Bundesbank 2012 p. 2).

37 Graphically, this is exactly depicted in *Figure 4* (left hand side). In the case of *Bubills*, one just has to switch the y-axis to Prices Offered.

It is also possible to submit non-competitive bids. These bids are allotted at the weighted average price of the competitive bids accepted.[38] The introduction of non-competitive bids adds a third investment option for our participants – besides competitive bids and German Federal Treasury Notes. The participants represent a member institution of the Bund Issues Auction Group. Therefore, they are eligible to participate in the Bund Bidding System.

In the name of the Federal Government, Deutsche Bundesbank announced the following (fictional) terms and conditions to an invitation for bids of *Bubills* offered for sale by auction.[39]

Tab. 4: Announcement on Auction of Treasury Discount Papers (June 13 2013)

German Treasury Discount Papers (*Bubills*)	
Standard Tender (variable rate tender, American auction)	
Submission date for bids:	21.06.2013 at 12:00
Allotment date:	21.06.2013
Maturity:	12 months
Minimum Price for competitive bids:	99.50 %
Minimum amount being allotted:	---
Minimum amount of bid:	€1 mn
Maximum amount of bid:	€2 mn
Targeted allotment amount:	2/3 of aggregate amount of competitive bids
Note: Non-competitive bids can also be submitted	

In the participation sheet the students had to submit (*appendix 1*), they were made aware that the amount (excess liquidity) of the unsuccessful bids would automatically be invested in German Federal Treasury Notes. Just as for placing fixed-term deposits with the ECB, these carried an interest rate of 0.25 % (p.a.).

The experiment was offered in 2010-2013 to students of Financial Services (B.A.) at the University of Applied Sciences Kaiserslautern (Germany). We presented the invitation to participate in their second year compulsory course in *Monetary Economics (Theory & Policy)*. The experiment took place in the latter part of the course weeks after the topics on main refinancing operations with different kinds of tender procedures had been discussed in class. In 2010, we also invited MBA students at an international seminar in Budapest, Hungary, to participate in that years' experiment.[40] The coursework consisted of one final exam – two hours, written and open answers. With 120 points on the exam, one was rewarded with grade "A" - the German equivalent of "1.0". To pass the course, a minimum of 60

38 Deutsche Bundesbank (2012 p. 2).

39 This second part of the classroom experiment resembles the auction experiment of T-bills by Saros (2009).

40 ECB's monetary policy - including its instruments and procedures - were part of the course work of the International Seminar at Obudá University. The students had to submit a poster presentation, on which their grade was based on.

points was required. During the semester we offered minor assignments to the students on a voluntary basis: participating in two knowledge surveys and one or two classroom experiments as well as giving a ten-minute presentation on a current topic in monetary policy. The maximum aggregate bonus points by the assignments to be earned were ten percent of total points. For our monetary tender experiment 2 to 5 bonus points were at stake: 2 for participation only, and an additional 2-3 points when reaching the top 20% of all students profit-wise. Between 31% and 76% of each cohort of students participated in the experiment. The bonus points served as incentive for participation as well as for submitting competitive bids.

3.2 Analysis of bidding behaviour

In total, 126 students participated over the course of four years. The largest number of participants was reached in 2013 (44). In 2010, we started with the smallest group – in absolute terms (26) as well as in relation to all signups to the course (31 %). For each cohort we ran a separate experiment. As monetary conditions changed over time – e.g. the leading interest rate for the Euro Area varied, the experiments were adjusted accordingly. The analysis consists of two parts: First, we present the summary results for the largest cohort (2013) in a descriptive manner. It is similar to the feedback the participants were provided with. Thereafter, we analyze the aggregate bidding behaviour of all four years.

3.2.1 Descriptive Analysis of the Class of 2013

The benchmark of profits for the 44 participating students, when investing €4 mn in excess liquidity, depends on the interest rate for the alternative investment opportunity: German Federal Treasury Notes. As their rate was set at 0.25 % (p.a.), participants should at the least end up with €10,000 in profits. This represents a return on a fully risk free investment.[41] It serves as the lower bound for profits to all rational decision makers. This is also true for students, whose bids were not successful in the auction process.[42] The upper bound for profits is twice the amount (€20,000), as the ECB and the German Government are willing to accept a maximum interest rate of 0.50 %. In *Figure 6*, total interest rate earnings are shown for all participants. Two main findings can be generalized; they hold for the previous cohorts as well.

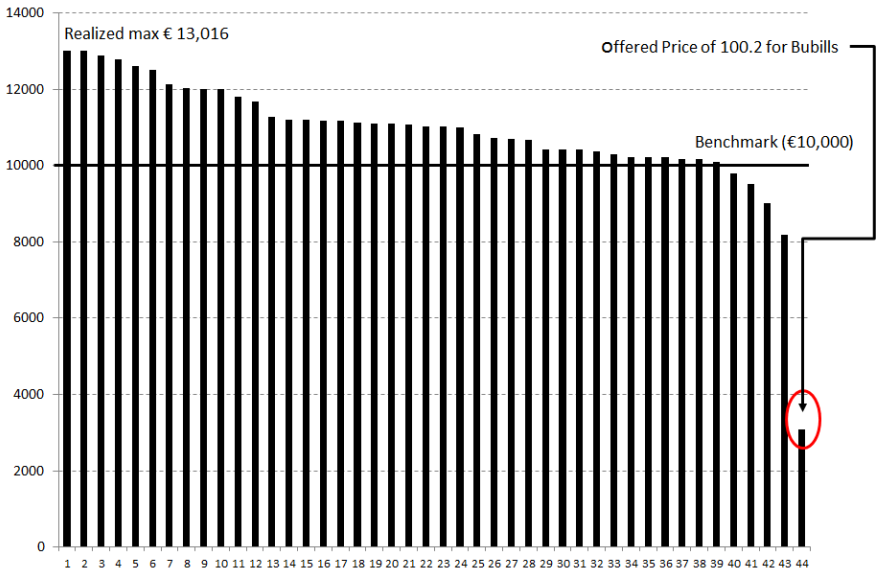
- None of the participants gets close to the upper limit of possible profits. The opposite is true, average profits remain pretty close to the lower bound. In 2013, average profits are €10,848 (median at €11,014) with the coefficient of variation standing at 14.5 % only.

41 "Risk free" in the sense of not being dependent on the other participant's bids.

42 As noted in the participation (decision) sheet, bids that did not receive an allotment were automatically shifted to be invested in German Federal Treasury Notes (*appendix 1*).

- There are always a few participants, who do not behave rational in a sense that they do not even reach the risk free rate of return (€10,000).

Fig. 6: Total Interest Rate Profits 2013 (Excess Liquidity of €4 mn)



These findings seem to reflect a tense competition among the participants. The drive for competitiveness led a significant number of students (11 %) to be carried away during their bidding process by dropping beneath the risk-free benchmark. Either the relative small incentive for bonus points works well, or the drive for "winning" against their peers dominates. In *Table 5* we present the results of the bids of the two tender procedures.

Tab. 5: Tender Procedures - Summary of Bids (2013)

Collection of Fixed-Term Deposits		***Bubills* - Federal Treasury Discount Paper**	
Bids (amount)	€ 88 mn	Competitive Bids (amount)	€ 68 mn
Offered Interest Rates	0.10 % - 0.50 %	Offered Prices	97.60 - 100.20
Allotment (amount)	€ 58.7 mn	Allotment (amount)	€ 45.3 mn
Marginal Interest Rate	0.39 %	Marginal Price	99.65
	€ 11 mn p.r.		€ 5 mn p.r.
		Non-competitive Bids (amount)	€ 20 mn
		Average Price of Competitive Bids (Weighted)	99.74
Alternative Investment - Federal Treasury Notes (0.25 %)			
Amount	€ -- mn	Amount	€ -- mn

p.r. = pro rata; n = 44 participants.

Overall, none of the participants opted for the alternative investment. As the Federal Treasury Notes represent their fallback option, this is a fully rational approach.[43] For the collection of fixed-term deposits, five bids were submitted at 0.25 % or less the interest rate of the Federal Treasury Notes. In addition, eleven competitive bids for *Bubills* were set at prices of 99.75 and above. These 16 bids - 9 % of the total - were not rational as they contained prices and interest rates that were the "below" the ones for Federal Treasury Notes.

For the *Bubills* auction, almost a quarter of bids were non-competitive in nature. In reality, financial institutions often submit an even higher share of non-competitive bids.[44] The non-competitive bids were allotted to full extent at the weighted average price offered of 99.74 % - just marginally above the interest rate of Federal Treasury Notes. The tight concentration of bids in interest rates as well as in prices offered is reflected in the amount of bids (€11 mn & €5 mn) being allotted pro rata at the marginal rate & price respectively. Overall, the strong competition between participants led to relative minor profits - quite similar to the real world (e.g. right hand side of *Figure 5*). Though, one would not expect professional investment agents to overbid.

3.2.2 Analysis of Aggregate Tender Procedures in 2010-2013

Of the 126 students participating, we could only use of 111 sheets for our statistical analysis - due to missing information on several of the participation sheets submitted.[45] The monetary conditions were varied according to the ECB framework in each year. *Figure 7* reflects these developments in the change of the main refinancing rate as well as in the interest rate of the Federal Treasury Notes. The main refinancing rate varied from 0.50 % (2013) to 1.00 % (2010, 2012) and to 1.25 % (2011). While the interest rate of the alternative investment - representing the lower bound - remained at 0.25 % except for 2011 (0.50 %). The benchmarks of the risk-free investment alternative were €10,000 and €20,000 respectively. On the opposite side, maximum profits for the €4 mn investment of excess liquidity could have reached €20,000 (2013), €40,000 (2010, 2012) and €50,000 (2011). *Figure 7* shows that the actual realization of total interest rate profits remained far below these maximum rates. One observation seems to be obvious: In 2011, as the interest rate for Federal Treasury Notes doubled profits rose accordingly. Though, the higher profit level could also be driven by the rise of the main refinancing rate (upper bound). Additional comparative statistics are presented in *appendix 2*. Total profits (mean) differ significantly between 2011

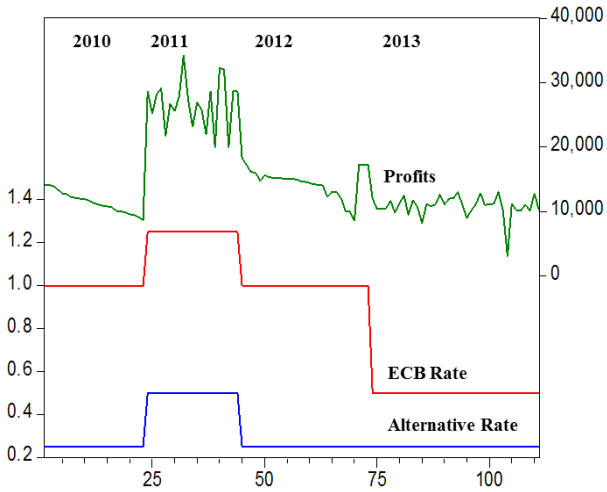
43 In 2010-2012 each, a few participants chose to invest in the risk-free alternative.

44 For example, the Bundesbank's tender for 12 month *Bubills* on August 26 2013 resulted in 43 % of the total amount bid being non-competitive (Deutsche Bundesbank 2013c).

45 In 2013, data for 38 students out of a total of 44 students participating in the experiment was applied to the econometric analysis. An important selection criteria was the students participation in the final exam of the course.

and the other years, but the relative variation in profits remains small. Age-wise, 2010 is the cohort with the oldest participants. The difference in age is solely explained by the participating post-graduate MBA students - this group of nine students was 39 years old (mean) whereas the remaining second-year B.A. students of 2010 were in line with their mates of the other cohorts (23.5 years). Of the 102 bachelor students that enrolled in the course *Monetary Economics*, exactly half of them had been placed in *Group A* and *B*. To provide a better learning environment it is departmental policy to split a course into two parallel groups if total enrollment exceeds 40 students. The assignment to *Group A* or *B* is not random. For *Group B*, students with higher final marks in their High School Diploma ("Abitur") are selected. Total profits of *Group A* students are on average €14,798, whereas the mean of total profits of *Group B* stands at €15,868.

Fig. 7: ECB Conditions and Total Interest Rate Profits in 2010-2013



Alternative Rate: Federal Treasury Notes; ECB Rate: Main Refinancing Rate in percent p.a. (left y-axis); Total Profits in € (right y-axis).

Our next step is to sort out, which factors determine *total profits*. Based on the above descriptive statistics, we can formulate the following hypotheses:

- The rates of return are expected to influence total profits positively. As Federal Treasury Notes rates (lower bound) and ECBs main refinancing rate (upper bound) go up, profits on average are expected to increase. (*Hypothesis # 1a, 1b*) Whereby the lower bound should have a greater impact on profits, as competition drove down the mean rates of profits closer to this boundary.
- The number of participants might influence the depth of the competition process - more students (e.g. in 2013) increase the competition and therefore drive down total profits (*Hypothesis # 2*).

- The age of students does not differ too much, but minor age difference (25 vs. 22) could reflect that the student took the more demanding *Monetary Economics* course at a later stage of his/her study programme. This is especially the case, when he/she had to struggle to pass the basic courses of the first year already. As struggling students would be older age-wise, we can expect age to exert a negative influence on profits (*Hypothesis # 3*).
- MBA students - many of them with a Bachelor's degree in Engineering - have less of an academic background in economics. Therefore, we expect them to do not as well in the auction process (*Hypothesis # 4*).
- Due to the selection process for the two groups of *Monetary Economics* students, we expect the better students - based on their secondary education - to understand the auction design more thoroughly. *Group B* students should be rewarded with higher total profits (*Hypothesis # 5*).
- Only a quarter to a third of the participants is female (*appendix 2*). Women are underrepresented since their share in *Monetary Economics* is on average 45 %. Due to the competitive nature of the experiment, it seems to attract more of the male students. This self-selection bias might result in an outperformance of male vs. female students (*Hypothesis # 6*).

Tab. 6: Determinants of Total Interest Rates Profits (2010-2013)

Total Profits [1)] n = 111	**Model I**	**Model II**	**Model III**	**Model IV**	**Model V**
Constant	-2,484.1 (978.7)***	5,482.8 (4,129.5)	2,456.7 (4,102.2)	-1,971,336 (652,377)***	-19,334.5 (5,403.0)***
Alternative Rate	58,555.7 (3,466.0)***	48,887.9 (3,969.8)***	46,146.4 (3,882.9)***	43,386.8 (3,942.2)***	45,708.8 (3,910.2)***
ECB Rate [2)]		5,026.3 (903.0)***	6,251.3 (950.0)***	9,578.1 (1,484.4)***	12,829.7 (2,671.5)***
log(Age)		-2,975.8 (1,328.1)**	-2,362.9 (1,305.2)*		
Monetary Economics Group B			1,776.0 (501.4)***	1,201.2 (542.7)**	1,400.8 (545.2)**
Year of Experiment				949.7 (323.9)***	
MBA Course				-1,449.1 (634.4)**	-1,554.5 (625.9)**
Male					780.8 (496.2)°
# of Participants					285.1 (111.1)**
R^2	*0,812*	*0.844*	*0.861*	*0.875*	*0.878*
Adj.R^2	*0,810*	*0.840*	*0.856*	*0.869*	*0.871*
Prob.(F-Statistic)	*0.000****	*0.000****	*0.000****	*0.000****	*0.000****

[1)] Method: OLS white heteroskedasticity-consistent standard errors & covariance (with *EViews*). Significance level: ° 15%, * 10%, ** 5%, *** 1%. [2)] ECB's main refinancing rate.

Both - the interest rate of Federal Treasury Notes as well as the ECB's main refinancing rate - have a major and significant impact on total profits. The rate of the alternative investment in itself explains 81 % of the variation in overall profits. But, profit levels still increase as the ECB's leading interest rate (upper bound) rises (*hypothesis # 1a, 1b* √). As participants get older their profits decrease. One reason being that less inclined students tackle *Monetary Economics* at a later stage than proposed by the official study programme (in their 3rd or even 4th year). Secondly, *MBA* students, who are on average 16 years older than the B.A. students, do less well. The moment we include *MBA* as an independent variable, *age* drops out - so, the *MBA* criteria seems to override *age* (*hypothesis # 4* √). Pre-selected students of *Group B* in *Monetary Economics* do significantly better by €1,201 up to €1,776 (*hypothesis # 5* √). *Male* students improve profits compared to their female counterparts. Though, the support for *hypothesis # 6* is weak and its effect relatively meager - being only half in size compared to the pre-selection effect of *Group B*.

When comparing model IV with model V, the *year of the experiment* is significant in the former, while the *number of participants* is in the latter. Model V is the one we consider to be our best fit. A possible transfer of know-how filtering through the cohorts could explain the positive impact of the year the experiment took place. Though, the moment the number of participants is included, years drops out. The correlation between the two independent variables is strong as the number of participants increase over time (*appendix 2*), but the variation in participants seems to dominate time. On the contrary to *hypothesis # 2*, more participants are driving up profits significantly. This is a stable[46] as well as an intriguing result. In 2013, some cooperative behaviour between the participants combined with better knowledge on the bidding process might have enhanced profit levels.

Except for the MBA students, all of the participants had to write a final exam at the end of the semester determining the grade they got. In the second part of our econometric analysis, we would like to determine, which factors drive the total amount of points the individual students acquired during the course (*Table 7*). On aggregate, participants ended up with 72.1 points on average, which is a German grade 3.3 - equivalent to an ECTS grade C^-. Almost a quarter of our participants failed the course *Monetary Economics* - while all of the MBA students finished their seminar successfully. By participating in minor voluntary assignments, students could acquire up to twelve bonus points in advance. In 2013, 60 % of all participants did a ten minute presentation pushing up the average bonus level to almost nine points. In the previous three years, only three out of ten students presented topics in class - reducing average bonuses substantially (*appendix 2*).

[46] *Number of participants* exert a significant positive effect on profits in all our other models tested (six different variations).

We are especially interested in the answers to the following question: Does the bidding behaviour of students in the experiment affect the total amount of points, and therefore their final grade - besides the obvious impact that bonus points have in ratcheting up total points on a 1:1 base? We expect that *Total Profit* exerts a positive impact on total points (*Hypothesis # 7*), since the understanding of tender procedures might serve as a proxy to a students' general knowledge in monetary theory and policy. As *male* students grasped the experimental design better than female participants (model V in *Table 6*), they should also outperform on overall points (*Hypothesis # 8*). The postgraduate *MBA* programme requires applicants to have grade B or above in their Bachelors' degree, therefore a positive influence on total points can be expected (*Hypothesis # 9*). Due to the selection process for getting into *Group B* of *Monetary Economics*, this group of students should do better than the others (*Hypothesis # 10*). In 2012 & 2013, the failure rates have been substantially higher than for the previous cohorts (*appendix 2*). At the same time the absolute *number of participants* as well as the relative participation rate to our experiments increased. This could mean that less self-selection has taking place. Now that the less engaged and academically inclined students were drawn into participating, a negative impact on average total points could result (*Hypothesis # 11*).

Tab. 7: Determinants of Total Points in *Monetary Economics* (2010-2013)

Total Points[1)] n = 111	**Model I**	**Model II**	**Model III**	**Model IV**	**Model V**	**Model VI**	**Model VII**
Constant	64.74 (3.26)***	26.47 (8.80)***	52.99 (13.30)***	40.82 (5.19)***	99.38 (27.33)***	120.26 (28.15)***	97.22 (26.73)***
Bonus Points	1.27 (0.40)***	1.70 (0.35)***	2.01 (0.36)***	2.18 (0.35)***	2.23 (0.36)***	2.32 (0.35)***	2.29 (0.36)***
Age		1.17 (0.32)***	-0.10 (0.57)		-3.85 (1.68)**	-3.65 (1.74)**	-4.08 (1.70)**
Age^2					0.056 (0.023)**	0.055 (0.024)**	0.060 (0.023)**
Male		9.38 (3.40)***	9.79 (3.09)***	9.87 (2.94)***	9.34 (2.97)***	9.81 (3.07)***	9.75 (2.91)***
MBA Course			30.93 (8.66)***	33.12 (6.29)***	36.10 (7.96)***	28.27 (8.00)***	35.72 (8.12)***
Total Profit				0.00056 (0.00022)**	0.00058 (0.00023)**		
# of Participants						-0.57 (0.21)***	
Alternative Rate							45.33 (14.17)***
R^2	*0.092*	*0.242*	*0.299*	*0.331*	*0.354*	*0.356*	*0.371*
Adj.R^2	*0.084*	*0.221*	*0.273*	*0.306*	*0.317*	*0.319*	*0.335*
Prob.(F-Statistic)	*0.001****	*0.000****	*0.000****	*0.000****	*0.000****	*0.000****	*0.000****

[1)] Method: OLS white heteroskedasticity-consistent standard errors & covariance (with *EViews*).
Significance level: ° 15%, * 10%, ** 5%, *** 1%. Total points possible (range: 0-120).
Bonus points (range: 0-16); nine MBA students (poster presentation).

Starting with the obvious, *bonus points* exert the positive effect we expected. But there seems to be more to it: in our best-fit models V-VII for each bonus point total points actually increase by 2.3 points! This is 1.3 points more than one could have expected. Again, self-selection of the more engaged and academically inclined might offer an explanation. Being a *male* participant seems to be worth ten points (*Hypothesis # 8* √), which is substantial. Though, the effect of being a postgraduate *MBA* student is more than three times the size (*Hypothesis # 9* √). Just to the opposite of our analysis on total profits, *MBA* students and *Age* have contrary effects on total points. As participants get older, their course results diminish - but this effect tapers off with rising *Age*. Especially, older undergraduate students do worse, since they are often the academically weaker ones (*Hypothesis # 3* √).

Surprisingly, it doesn't seem to pay off to be a member of *Group B* in *Monetary Economics*. They just got a single point more on average, which is not enough to exert a significant positive impact.[47] Whereas *Total profits* as well as the *Alternative Rate* for Federal Treasury Notes raise total points significantly. Due to multi-correlation, they exert their influence in separate models only (*Hypothesis # 7* √).[48] The *Number of Participants* has a negative effect on total points - supporting the argument of less self-selection of the academically more inclined students taking place over time (*Hypothesis # 11* √).

In general, the explanatory power of our best-fit model on the courses' total points is substantially lower than for total profits (37% versus 88 %). Considering the possibility of us falling under the fallacy of the missing variable bias, one could think of additional independent variables exerting an influence on total points: e.g. substituting the dummy variable *Group B* for each individuals grade of the High School Diploma as well as integrating variables like the number of tests taken during the same exam period or the individual grades for the introductory course in Economics. Unfortunately, due to the lack of data, we were constrained to the analysis above.

4. Insights Gained and Outlook on Monetary Policy Implementation

The depth as well as the build-up of the different phases of the global financial crisis setting in during the summer of 2007, led major central banks to react aggressively first, by using standard monetary policy instruments. After the bankruptcy of Lehman Brothers, they applied innovative and non-standard measures to tackle the crisis of confidence within the financial sector as well as to

[47] Average total points for *Group B* are 71.2, while for Group A „only" 70.2.

[48] The strong correlation between *Total Profits* and *Alternative Rate* is reflected in model I of *Table 6*.

revive the real economy through the credit channel. In addition, the European Central Bank still has to cope with the crisis of debt ridden countries in the periphery of the Euro Area. Early on, Deutsche Bundesbank as well as the leading economic research institutes in Germany had been very critical of the course the ECB had taken. Especially when it implemented the different programmes of direct securities markets interventions.[49] The strict separation of fiscal versus monetary policy seemed to dissolve as central banks increased their balance sheet risks when taking in 2nd or 3rd rated (non-investment grade) government and corporate bonds. At least concerning the liquidity effect of such purchases and its long-term inflation risk, the ECB made use of Fine Tuning Operations to sterilize the liquidity enhancing purchases.

For the better understanding of ECBs main refinancing operations, we invited students to take part in an out of classroom experiment. As financial institutions in the Euro Area have soaked up long-term central bank liquidity in excessive amounts (see *Figure 3*), they have been bidding to invest their excess liquidity with the ECB in the short-term. To make use of the competition between the banks, the ECB chose to implement a variable rate tender procedure (American auction) - effectively reducing its interest rate costs. This is the framework in which our experiments settled in. Of their excess liquidity, the participants submitted competitive bids in the amount of €2 mn for *Fixed-Term Deposits* with the ECB (interest rates), as well as an additional €2 mn to the Bundesbank acting as fiscal agent of the German government for *Bubills* (prices). The auction design for *Bubills* had the additional twist that non-competitive bids were also possible to submit. The experiment ran with four different cohorts of students with varying conditions on ECB's main refinancing rate (upper bound) as well as on the interest rate of the alternative investment vehicle - German Federal Treasury Notes (lower bound). The main insights based on descriptive statistics as well as on the econometric analysis of the participants' behaviour can be summarized as follows:

- very tense *competition* drove down profits - closely reflecting real world behaviour of financial institutions. Though, some participants were carried away by submitting irrational bids.
- unsurprisingly, *Total Profits* were driven by financial market conditions - whereas the *Alternative Rate* exerted a greater influence than the *ECB Rate*. *Male* students and academically more inclined *Group B* students outperformed, while older participants (*Age*) and *MBA* students did less well. The former, because they delayed enrolling in the demanding course of *Monetary Economics*, the latter, because their academic background had been in engineering mainly (*MBA*).

[49] See Deutsche Bundesbank (2011b p. 70) and GD (2011 p. 55f). In June 2013, Deutsche Bundesbank and ECB met on behalf of Outright Monetary Transactions and the European Stability Mechanism on opposed sides infront of Germany's Federal Constitutional Court.

- surprisingly, *Total Points* in the course (the grade) were significantly affected by the bidding behaviour of our participants. *Age* had the above negative effect, while post-graduate students (*MBA*) as well as *Males* performed better in general. In addition to *Bonus Points* acquired in advance to the final exam, *Total Profits* and the *Alternative Rate* had a significant positive influence on their own.

Overall, the experiment deepened the students' understanding of the behaviour of financial sector market agents when participating in competitive tender procedures. Based on personal feedback to the lecturer, the students seemed to have enjoyed this interactive teaching approach thoroughly. For monetary economics, the experiment gave additional empirical support for central banks - like the ECB - to return to variable rate tenders (American auctions) for their main refinancing operations when providing liquidity to the economy. It is the most market-oriented tender procedure. Unfortunately due to the enduring problems and challenges of the international financial system, the return to - monetary speaking - standard times is still somewhere in the far future (2015).

Appendix 1 – Participation (Decision) Sheet of Individual Institution

Name _____ Age _____ Sex male / female

I. ECB Fine Tuning Operation: Liquidity-Absorbing Collection of Fixed-Term Deposits

In the name of your employer (financial institution), you invest €2 mn of excess liquidity.
Standard Tender (variable rate, American auction)
Offered interest rates must be expressed as multiples of 0.01 percentage points;
the maximum rate is 0.50 %. Two bids can be submitted.
2/3 of aggregate amount of bids will be allotted by ECB.

Bid 1: amount ___ (€ mn); interest rate offered _____ (% p.a.)
Bid 2: amount ___ (€ mn); interest rate offered _____ (% p.a.)
Investment alternative – Federal Treasury Notes at 0.25% p.a. Amount ____ (€ mn)

II. Bundesbank Tender: German Treasury Discount Papers (*Bubills*)

In the name of your employer (financial institution), you invest €2 mn of excess liquidity.
Standard Tender (variable rate, American auction)
Offered prices must be expressed as muliples of 0.01 percentage points; the minimum price is 99.50 %. Two competitive bids can be submitted. 2/3 of aggregate amount of bids will be allotted by ECB. Non-competitve bids are fully allotted at the (weighted) average price of the competitive bids being successful.

Bid 1: amount ___ (€ mn); price offered _____ (%)
Bid 2: amount ___ (€ mn); price offered _____ (%)
Bid 3: amount ___ (€ mn); non-competitive bid
Investment alternative – Federal Treasury Notes at 0.25% p.a. Amount ____ (€ mn)

Unsuccessful competitive bids are automatically invested in Federal Treasury Notes.
Date of submission: June 21 2013 at 12:00 (electronically).
General aim: maximize total profits by investing €4 mn of excess liquidity.

Appendix 2 - Comparative Summary Statistics for 2010-2013

n = 111	2010	2011	2012	2013
Total profits (TP) - mean	€11,422	€26,814**	€14,514	€10,845
Total profits (TP) - median	€11,300	€27,467	€15,000	€11,087
TP - Standard deviation	€1,583	€3,750	€2,239	€1,676
TP - Coefficient of variation	14.0 %	13.7 %	14.9 %	15.1 %
Possible Range of Total Profits*	€10,'-40,000	€20,'-50,000	€10,'-40,000	€10,'-20,000
# of participants	23	21	29	38
Age of participants - mean	29.2	23.6	23.1	23.4
Age of participants - CV	31.6 %	9.6 %	9.0 %	9.0 %
Female Participants	30.4 %	33.3 %	24.1 %	26.3 %
Final points - mean	79.0	75.2	63.6	72.6
Failure rate of participants	8.7 %	14.3 %	41.4 %	23.7 %
Bonus points - mean	4.0	5.0	5.9	8.6

(*) Possible Range of Total Profits: Profits of Federal Treasury Notes to ECB main refinancing rate.
CV - Coefficient of Variation. In 2013, the data differs slightly compared to the quotes in the text as the number of participants analyzed dropped from 44 to 38.
(**) Total Profits in 2013 differ at the 1 % level significantly with the ones in 2010, 2011 and 2012 (Difference in Means Test).

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