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Ο ΡΟΛΟΣ ΤΟΥ ΚΕΝΤΡΙΚΟΥ ΤΡΑΠΕΖΙΤΗ ΚΑΙ ΤΟΥ ΣΤΑΔΙΟΥ ΤΗΣ ΟΙΚΟΝΟΜΙΑΣ ΣΕ ΕΝΑΝ ΝΟΜΙΣΜΑΤΙΚΟ ΚΑΝΟΝΑ.

ΜΕΛΕΤΗ ΠΕΡΙΠΤΩΣΗΣ: Η ΠΕΡΙΠΤΩΣΗ ΤΗΣ ΕΥΡΟΠΑΙΚΗΣ ΚΕΝΤΡΙΚΗΣ ΤΡΑΠΕΖΑΣ.

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Abstract

The purpose of this paper is to model ECB's behaviour, from day one until the present day. To do that, I initially follow Klose's (2011; 2016) approach, in order to estimate an asymmetric Taylor response function, where asymmetries rest on the state of the economy, in a Taylor- like rule framework. Next, I enhance the existing model, by introducing a new heavyside reaction function to account for asymmetric conduct with respect to different governing periods. Furthermore, following again the example of Klose (2011), I too admit a volatility term of inflation and the production gap in the estimation equation for each state, to capture possible nonlinearities within each regime. Following this line, I introduce a new "optimal" Yardstick to compare against the result from the previous method and also, to observe in which states of the Economy these volatility terms actually improve the linear specification. All estimations carried out in the paper, are done by using data for the euro area, since ECB has set an explicit inflation objective.

Keywords: ECB, Taylor Rule, Asymmetries, Non- linearities, Linear Programming, GMM.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Περίληψη

Στόχος της παρούσας εργασίας, αποτελεί η μοντελοποίηση της συμπεριφοράς της Ευρωπαϊκής Κεντρικής Τράπεζας (ΕΚΤ), από την ίδρυσή της μέχρι και σήμερα.

Ακολουθώντας την προσέγγιση των Klose (2011; 2016), εκτιμώ μια συνάρτηση αντίδρασης, όπου ασυμμετρίες(μη- γραμμικές συμπεριφορές) αποδίδονται στην κατάσταση που βρίσκεται η οικονομία, όπως αυτή ορίζεται από τους υπάρχοντες στόχους της ΕΚΤ. Η εκτίμηση αυτού του νομισματικού κανόνα γίνεται στο πλαίσιο ενός Κανόνα τύπου Taylor.

Αρχικά, επεκτείνω το υπάρχον μοντέλο, των Klose (2011; 2016), εισάγοντας μια καινούργια (πολύπλευρη) συνάρτηση αντίδρασης όπου οι ασύμμετρες συμπεριφορές αποδίδονται στον εκάστοτε Πρόεδρο (και διοικητικό συμβούλιο) της ΕΚΤ. Στη συνέχεια, σε μια προσπάθεια να «συλλάβω» αυτή τη μη- γραμμική συμπεριφορά, που παρατηρείται σε κάθε στάδιο της οικονομίας, και ακολουθώντας πάντοτε το παράδειγμα των Klose (2011), ενισχύω το υπάρχον μοντέλο, προσθέτοντας μεταβλητές που μετρούν τη μεταβλητότητα τόσο του πληθωρισμού όσο και του παραγωγικού κενό.

Στο πλαίσιο αυτό, εισάγω έναν «βέλτιστο» δείκτη (Benchmark) ως μέτρο σύγκρισης των εμπειρικών αποτελεσμάτων που έλαβα. Παράλληλα, ο δείκτης αυτός χρησιμεύει στο να δείξω το βαθμό, που το αρχικό μου μοντέλο βελτιώνεται, με την ενσωμάτωση αυτών των όρων (που αντιπροσωπεύουν τη μεταβλητότητα).

Αξιοσημείωτο είναι το γεγονός ότι δείκτης αυτός υπολογίζεται με τη χρήση μη- γραμμικού προγραμματισμού αντί να προέχεται από την οικονομετρική εκτίμηση.

Τέλος, όλες οι εκτιμήσεις που έχουν λάβει χώρα στην παρούσα εργασία, έχουν γίνει με τη μέθοδο GMM και τη χρήση δεδομένων πραγματικού χρόνου, προερχόμενα από την αντίστοιχη βάση δεδομένων της Ευρωπαϊκής Κεντρικής Τράπεζας.

Λέξεις Κλειδιά: Κανόνας Taylor, ΕΚΤ, Ασυμμετρίες, Γραμμικός Προγραμματισμός, ΓΜΡ.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Υπεύθυνη δήλωση

Βεβαιώνω ότι είμαι συγγραφέας αυτής της διπλωματικής εργασίας και ότι κάθε βοήθεια την οποία είχα για την προετοιμασία της, είναι πλήρως αναγνωρισμένη και αναφέρεται στη διπλωματική εργασία. Επίσης έχω αναφέρει τις όποιες πηγές από τις οποίες έκανα χρήση δεδομένων, ιδεών ή λέξεων, είτε αυτές αναφέρονται ακριβώς είτε παραφρασμένες. Επίσης βεβαιώνω ότι αυτή η πτυχιακή εργασία προετοιμάστηκε από εμένα προσωπικά ειδικά για τις απαιτήσεις του προγράμματος μεταπτυχιακών σπουδών στην Εφαρμοσμένη Οικονομική του Τμήματος Οικονομικών Επιστημών του Πανεπιστημίου Θεσσαλίας. Βόλος, Δεκέμβριος 2017.

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Ευχαριστίες

Ευχαριστώ Θερμά,

Τον καθηγητή μου Δρ. Παπαδάμου Στέφανο , τόσο για την εμπιστοσύνη που μου έδειξε όσο και για την καθοδήγησή του στην εκπόνηση της διπλωματικής εργασίας.α Όπως επίσης, και όλους τους καθηγητές του ΠΜΣ Εφαρμοσμένη Οικονομική στην Τραπεζική και Χρηματοοικονομική, για τις γνώσεις που μας μετέδωσαν.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Table of Contents

Section 1

1.1 Introduction…………………………………………………………………………7

1.2 The two interpretations of the Taylor rule..……………………………………………9

1.2.1 A narrow clarification regarding the Traditional Taylor rule…………………………9

1.2.2 Initial Critique..……………………………………………………………………10

1.2.3 A broad interpretation……..………..………………………………………………12

1.3 Background and Justification…………………………...…………………………… 14

Section 2

2.1 Derivation of the model………………………………………………………………. 21

Section 3

3.1 Data Construction and Classification………………………………………………… 29

3.2 Nature of the data used…………………………………...…………………........ 31

3.3 Variables ….……………………………………………………………………………33

Section 4

4.1 Empirical Results………………………………………………………………………39

4.2 Robustness Tests……………………………………………………………………….48

4.2.1 Bounds approach………………………………………………………………….48

4.2.2 The Central Banker Approach ………………………………………………………52

4. The Asymmetries of Taylor Rule framework within each regime …………………….56

4.3.1 Taking this approach a step further…………………………………………………6

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Section 5

5.1 Conclusions……………………………………………………………………………69

Section 6

6.1 Bibliography…………………………………………………………………………71

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Section 1

1.1 Introduction

Contemporary monetary policy, can be expressed through the use of explicit reaction functions. Perhaps, the most famous amongst them, is the so- called Taylor rule. According to this rule, "Central banks set their official policy rate, responding to deviations of the inflation rate from its (either explicit or implicit) target and the output from its potential." (see Taylor (1993)).

Still, linear specifications, cannot account for the potential existence of asymmetries or non-linearities that may exist within the estimators. However, there is undeniable evidence, coming from an ever- growing literature that nearly all monetary authorities respond asymmetrically to developments and/or contractions of the inflation and the production gap (see for example Gerlach (2000), Bec, Collard, and Salem (2002), Ruge-Murcia (2003), Nobay and Peel (2003), Surico (2003), Martin and Milas (2004), Kim, Osborn, and Sensier (2005), Dolado, Maria-Dolores, and Naveira (2005), Altavilla and Landolfo (2005), Surico (2007a, 2007b), Castro (2008), Cukierman and Muscatelli (2008), Bunzel and Enders (2010), Hayat and Mishra (2010), Klose (2011), Belke and Klose (2013) and Klose(2016)).

There are many motives for these asymmetric reactions, most of them originate from either the asymmetric inclinations of the central bank or the existence of non-linearities in the underlying models.

Most of the findings do not only account for asymmetric conduct at times of heightened or decreased production/inflation or in other words, during different states of the Economy. Nor, for the existence of potential non- linear responses to aberrations from their respective optimums, i.e. milder responses to slighter deviations.

Klose (2011) first contributed to this debate by taking a quite straight forward approach to account for possible asymmetries, while identifying the four so- called states of the economy. And as a matter of fact, his results were in line with the "Taylor rule" agenda. Also, Brueggemann and Riedel (2011), illustrated that asymmetric responses, lead to non-linear Taylor rules, which capture the evolution of official policy rates, more effectivtively.

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By following Klose's (2011) approach, it enables us to estimate, in the empirical part of our analysis, whether monetary institutions respond in a non-linear way, in every regime, with respect to production deviations from its potential and the explicit inflation objective.

For the purposes of my dissertation, I have only relied on real- time data, of the euro area, since ECB has explicitly defined an explicit inflation objective (close but still less than two percent, in the medium term), so that I will not have to account for potential time- varying inconsistencies of this variable.

Additionally, my approach takes me a step further from Klose's (2011; 2016) analyses, allowing to make some contributions to the related literature. My contribution, comes from the investigation of potential asymmetries with respect to the different governing periods and finally, the introduction of a Yardstick for each state, calculated rather than estimated, to compare against the results from the linear specification and the one containing inflation and output gap volatility terms.

Consequently, this paper is organized as follows: First, in section 1, I am going to provide you with an Interpretation of the rule and also, the Background and Justification for my approach. In the following section, I am going to deliver a method which accounts for potential asymmetries in the response equations, first by depending on the state of the economy and then by relying on the "presidency" period. And finally, I am going to deliver a new Yardstick approach. The third section gives an overview of the data used and some definitions regarding the variables. furthermore, my estimations are reported through Section 4. And finally, Section 5 contains the conclusions.

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1.2The two interpretations of the Taylor rule:

According to Orphanides (2003), In his initial description of a rule-based framework for monetary policy analysis, Taylor presented two interpretations regarding monetary policy heavily relying on rules. The primary interpretation, focused on a case given in a specific algebraic formulation. The second stressed the broad features of policy rules, identifying that, as is the case of any regulation, execution specifics are better left to policymakers. Even though, initially, all attention was focused on the particulars of the (mathematical) formula, Orphanides' analysis presented evidence that the broader (second) interpretation is of the same importance, particularly from a historical perspective.

1.2.1. *A narrow clarification regarding the Traditional Taylor rule:*

The explicit example that fascinated the public so much, was offered by Taylor as a "hypothetical but representative policy rule" (Taylor, 1993, p. 214). In essence, this particular illustration was nothing more than a specific parameterization of a monetary rule, which had previously been studied in depth by members of the "Brookings project on policy regime" estimation was presented in Bryant et al. (1993), and also studied in another involvement to the Carnegie-Rochester (1992) presented by Henderson and McKibbin (1993).1 The Brookings analysis studied rules setting deviations of the nominal policy rate (short- term), i, from a target path, i*, corresponding to deviations of a target variable z, from its target, z*.

$$(1) \quad i_t - i_t^* = \theta (z - z^*)$$

Amongst the alternate target variables studied, the joint discoveries in the Brookings analysis named two as more probable to positively effect economic performance.

The first suggestion had been targeting the sum of the price levels, p, and real production q. Since, those constitute nominal revenue, p+ q ("nominal income targeting regime"). The other proposed targeting the sum of inflation, π= Δp, and real output ("real-production-plus-inflation targeting regime"):

$$(2) \quad i_t - i_t^* = \theta \{(\pi + q) - (\pi^* + q^*)\}$$

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Variations of this construction with differential reactions to price growth and production:

$$(3)\ i_t - i_t^* = \theta\ \{(\pi - \pi^*) + (q - q^*)\}$$

were also part in some of the evidence form the initial the Brookings study. In his specification, Taylor adopted the "real-production-plus-inflation" modification and set the Yardstick nominal rate to equal the sum of the equilibrium policy interest rate, r*, and inflation, π. He used the gap in production measure, also known as "output gap", as attained from a smooth trend {HP- filter}, y=q− q*, and used the year-to-year rate of change of the GDP deflator to measure inflation. Setting the inflation target and equilibrium real rate equal to two and the reaction coefficient, θ to one half, he arrived at what is now known as the classic Taylor rule formulation:

$$(4)\ i_t = 2 + \pi + ½*(\pi - 2) + ½*(q - q^*)$$

Taylor noted that this specification seemed to fit Fed's behaviour well over the previous years and detected: "If the policy rule comes so close to describing actual Federal Reserve behaviour in recent years and if FOMC members believe that such performance was good and should be replicated in the future even under a different set of circumstances, then a policy rule could provide some guidance to future decisions." (See p. 208.)

1.2.2 *Initial Critique*

In the following paragraphs, is presented the "initial limitations" of the Taylor rule, from a time when it was still considered to be a "Panachia", when regarding the modelling the behaviour of a monetary institution. This, was part of Orphanides (2003) analysis, regarding a historical approach to Taylor rule.

As McCallum (1993) stated, Taylor's specification was not "operational." It required information which were not available to monetary authorities, when taking the interest rate decisions. Significantly, this representation requires policymakers to take a stand on and design policy on the basis of implicit expectations concerning concepts such as the natural interest rate and potential production (the required level of production, such that unemployment is at the natural level), which are recognised to be infamously unreliable as policy signals. To quote Orphanides (2003) "Not all academic observers and policy

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practitioners believe such concepts are either necessary or helpful for formulating policy. Policymakers, in particular, might prefer to avoid the dogmatic reliance on natural-rate-gap-based policy rules, such as Taylor's classic formulation.”

Greenspan (1997), stressed that these complications should help us recognise that this kind of a policy rule, should only be considered as a, approach that could only be implemented with a considerable element of discretion.

As Taylor himself recognized, these types of specifications can only be viewed as “guide-posts” to aid monetary authorities, not inflexible rules, set in stone, which eliminate choice. One reason is that their specification relies on the values of certain key variables.

In reality, these variables, have been found by witnessing the past behaviour of macroeconomic indicators—either through informal review of the data, or more formally as implanted in models. In that way, like all rules, as discussed above, they symbolise an estimate that the past will repeat itself. Regrettably, though, “history is not an infallible guide to the future, and the levels of these two variables are currently under active debate”, as stated by Orphanides (2003).

Additionally, the traditional Taylor framework lacks an explicit role for predictions and related rulings about prospective economic advances. As stated by Meyer (2002):

Granting that the Taylor rule had been a useful Yardstick for policymakers, for many years, even before the financial crisis, there existed considerations that are not explicit in the Taylor rule have played an important role in policy deliberations. For example, forecasts had always played an important role in shaping the reactions of monetary policy in a way not reflected in the simple Taylor rule.

Indeed, forecasts of the economic outlook, have always assisted the monetary policy decision making process, especially in the case of the Federal Reserve, with rather similar reasonings being provided for this practice over the decades.

As Orphanides (2003) presented, the following comments made by Chairman Greenspan from 1999 and the remarks by Chairman Martin in 1965, both presented during periods when monetary policy was in a contractionary phase and inflation appeared to be the predominant threat.

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For monetary policy to accommodate sustainable economic growth, it is useful to anticipate forces of disparity before they threaten economic stability. But this is not always the case. Even, the near future at times can be too "cloudy" to predict. So, according to Orphanides suggestion, at times when monetary institutions can be pro-active, they should be, since modest pro-active actions can prevent more drastic actions at a later time, which could undermine the economy. (See Greenspan, 1999.)

As stated by Martin (1965), "To me, the effective time to act against inflationary pressures is when they are in the development stage—before they have become full-blown and the damage has been done. Precautionary measures are more likely to be effective than remedial action: the old proverb that an ounce of prevention is worth a pound of cure applies to monetary policy as well as to anything else."

In general, anticipation measures seemed to be a guiding belief of the Federal Reserve as early as the founding of the Federal System. As the executive board explained in its First Annual Report of 1914, which was published in January 1915: "[A reserve bank's] duty is not to await emergencies but by anticipation, to do what it can to prevent them."

As is the case of most major Monetary institutions, both the Fed and ECB, seem to have a forward- looking perspective. As suggested by Taylor (1993), policymakers should observe the forecast path of the federal funds rate, obtained by projecting rule (3) and relying on estimates of inflation and production. In an effort to incorporate an explicit role for predictions in a monetary policy framework, however, must be seen in the context of a broader interpretation of policy rules than the one embedded in Taylor's classic rule example.

1.2.3. *A broad interpretation*

The extensive explanation of a Taylor's rule framework, delivers a degree of flexibility that addresses some of the apparent drawbacks of the initial approach. In describing this broad interpretation Taylor emphasized that "a policy rule need not be a mechanical formula" (1993, p. 198). Rather, assuming a position closer to the past explanations of policy rules as described in Samuelson (1951, 1967) and Tobin (1983). Taylor stressed the more extensive description of a rule as a methodical policy sequence focused on the achievement of the vital policy objectives. Broadly speaking, Taylor defined the key structures of the policy, that he

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was recommending by quoting a useful summary report from the 1990 Economic Report of the President (which, as a member of the Council that year, he had co-authored):

“The Federal Reserve generally increases interest rates when inflationary pressures appear to be rising and lowers interest rates when inflationary pressures are abating and recession appears to be more of a threat.” (See Council of Economic Advisers, 1990, p. 85.)

As was the case with the traditional, “narrow interpretation”, the main target of monetary actions is to diminish business cycle fluctuations and maintain price stability. But unlike the narrow interpretation, policymakers are equipped with more flexibility in taking actions to achieve the desired result. This allows the use of sound ruling outside the scope of any fixed method in formulating policy and without confining authorities to an explicit analytical framework.

Of course, this broad interpretation has the drawback of reduced precision. However, on the other hand, this broad interpretation provides some considerable rewards as a descriptive device. It maintains a role for pre-emptive actions and also, the use of estimates in setting policy, and it adopts the revealed preferences of the governing council for accommodating explicitly forward-looking policy guidelines. Nevertheless, Taylor's broad interpretation, is of Equally importance, since it does not require authorities to accept natural-rate-gap-based policy as their guiding principle. By being more encompassing, the broad interpretation of the Taylor rule arguably better captures the actual policy process over time.

This broad interpretation of Taylor's rule, contrasted with the initial Taylor framework, also narrates more closely to the inflation targeting approach to policy, discussed in Bernanke and Mishkin (1997), and Bernanke et al. (1998). Without a doubt, both Bernanke and Mishkin stress, inflation targeting is a framework of “constrained discretion.”

1. 3 *Background and Justification*

At the down of the worst financial crisis, of modern times, both the theoretical and applied fundamentals of contemporary monetary policy, seemed secure and their application appeared robust. The main objective of monetary policy was to attain a low and stable annual price growth rate, hence the policy framework was geared towards inflation targeting, with the short-term policy rate being the primary device. Through that, monetary authorities provided funds to financial institutions and the interbank lending market. With the effect of this official policy rate, on both market rates and the wider economy, being adequately modelled. (See Joyce et.al (2012))

Within this approach, interest rate setting was mainly accomplished by using an extensive assortment of macroeconomic indicators, and in a consistent way regarding the Taylor Rule suggestions. Thus, according to this rule, interest rates responded more than one- for- one regarding changes in inflation and secondarily, they also replied to variations in the output gap.

This successfully summarises what constituted conventional monetary policy amongst the mature economies. Its operation led to an effective and predictable use of monetary policy and a quite effective pursuit of low inflation (see Woodford, 2003).

This period of the financial crisis and its aftermath, brings a number of challenges for both monetary policy and authorities, alike. While the so- called "conventional" monetary tools achieved a low and stable inflation, they proved ineffective to prevent the beak down of the asset market or to deal with the consequences, afterwards.

While, for the Pre-crisis period, there exists a vast literature, examining the role of monetary policy in containing asset market bubbles. A significant school of thought, proposed that the main objective of monetary authorities should not be to contain inflation, through what later became known as "Conventional" policies. But, instead, it may prove more effective to use monetary policy to clean up the repercussion of a bursted bubble. As expected, this opinion has been widely challenged, in recent times.

Nowadays, Monetary institutions, exert a much greater focus on financial stability. One can even claim, that these days, inflation targeting has become a secondary objective.

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However, by Tinbergen's Law, if an authority has N policy targets it needs at least N policy instruments, so, in the aftermath of the crises, monetary institutions have heavily expanded their arsenal of policy instruments, with the inclusion of macroprudential instruments and the consolidation of capital requirements and liquidity directions, via the newly introduced and stricter, Basel III. [1]

1 See Joyce, M., Miles, D., Scott, A. and Vayanos, D. (2012).

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To quote Joyce et.al (2012) “The aim of these policies is to achieve financial stability and prevent or at least moderate asset market bubbles.”.

The other key challenge to this pre- crisis accord, has been the capability of “conventional” monetary policies to clean up the aftermath of a financial calamity and also, to bring the economy back to positive growth rates.

Nonetheless, there exists a wide assortment of problems, that one may considered here. The first issue, is that of the zero-lower bound, on nominal policy rates. As the depression deepened, that inevitably meant that Taylor rule would have recommended nominal interest rates take negative values, in most countries.

In practice, however, market interest rates are effectively bounded to zero, since agents will always prefer to hold on “cash”, instead. With the interest rates being set to or nearly at zero, other monetary “tools”, had to be considered. The second problem arose from the severance of the financial system. Given the magnitude of losses sustained in the aftermath of the bubble bursting, the solvency of many banks was called into question.

Hence, conventional monetary policy proved insufficient. And policy rates could not be changed in accordance with the Taylor rule. These aberrations of official policy rates, from the levels suggested by the Taylor rule, have been persistent, since the turn of the century and they have only increased since.

As a result, compared to the Yardstick provided by the Taylor rule, official interest rates were frequently found below the recommended levels.[2]

2 See Beckmann, J., Belke, A. and Dreger, C. (2017)

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According to Beckmann et.al (2017), there are mainly two reasons driving this result. First, is the existence of international spillovers (e.g. international dependencies in the interest rate setting of monetary authorities). And so, there have been quite a few explanations, why international linkages have become such an important factor.
Belke and Gros (2005), provide evidence that the ECB followed the Fed's interest rate decisions, whilst, Taylor (2013) argues that a further transmission channel for international spillovers emanates from the fact that monetary institutions no longer set policy rates autonomously.
Next, comes the presence of non- linear response outlines, that provide us with a more realistic specification of the traditional Taylor rule. Consequently, official interest rates fell below the recommended levels, almost, in close synchronization across countries.

However, Hubert and Labondance (2016), showed that ECB's "forward guidance announcements reduce the majority of the term structure of private short- term interest rate prospects", with this result being robust for a variety of different specifications. This effect, is more robust on longer maturities and more enduring, as well. Hence, proving "Taylor's Rule" relevance, even in the crisis period.

So, after the ECB, set the main refinancing rate in the direction of its effective lower bound, in 2010, "forward guidance" has become the only existing mean of delivering monetary accommodation and assistance for market participants' expectation of a continued period of depressed interest rates (see Eggertson and Woodford (2003)), combined with liquidity requirements and balance sheet expansion.
"ECB's Governing Council assumes, that the primary interest rate, is going to persist at current or perhaps even lower levels, for a prolonged period of time." This announcement was made on the 4th of July 2013, after a meeting of the Board of Governors, by the President, Mario Draghi, to assume this new communication policy.
Later, on the 9th of January 2014, Draghi augmented the use of this communication strategy with the following statement, "we firmly reiterate our forward guidance that we continue to expect the key ECB interest rates to remain at present or lower levels for an extended period of time".
In this vein, another part of the literature, i.e. Belke and Klose (2013), also provided us with evidence that Taylor rule can still produce reliable suggestions, if we simply

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substitute the nominal interest rates with the real rates instead, since the zero- lower bound does not apply to them.
All in all, although nowadays, it is not realistic to claim that ECB solely relies solely on a "Taylor Rule", to implement monetary policy across the euro- area, as it did in the pre-Crisis era. And, despite the new number of arrows (policy channels) in its quiver, "Taylor Rule" still has its merits, since it can influence the future expectations of market participants. Thus, even in these unconventional times, Taylor rule, remains an invaluable policy instrument.

In the following table, I am presenting you, with a concise summary of relevant literature, which adopted Taylor- like specification to address similar issues, regarding the behaviour of major Monetary institutions. This table, is meant to justify both the empirical methodology and the frequency of data, used in my paper, since my choices are consistent with the majority of the literature.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Year	*Author(s)*	*Countries/Central Banks*	*Publication*	*Frequency*	*Methodology*	*Main Objective*
1998	**R. Clarida et al.**	**Germany, Japan, US, UK, France, Italy**	**European Economic Review**	**monthly**	**GMM**	**To investigate a monetary rule, in practice.**
1999	M. Ball	Canada, Australia, New Zeland	University of Chicago Press.		An Extension of Svensson's (1997) and Ball's (1997) model.	To capture the conventional philosophy regarding the main consequences of monetary policy, in a siplistic way.
2003	Batini, Harrison, Millard	UK	Journal of Economic Dynamics and Control		Taylor Rule in a close Economy, following Ball's(1999) inflation projections	To investigate both the appication and the effectiveness of different specifiacations of monetary policy rules, based on the initial Taylor framework.
2004	Chadha, et.al.	USA, UK, Japan	IMF Staff Papers	monthly	GMM	To investigate the role of asset prices and exchange rates values, within an interest rate rule, in an effort to assess the degree that Fed, Boe and BoJ have reacted to these prices, over a two decadeperiod.
2006	Belke & Polleit	ECB	Journal of Policy Modeling		GMM	To investigate whether the monetary policy, excersiced by both the Fed and the ECB, is line with the Suggestions of the Taylor rule.
2008	Fuhrer & Tootell	FED	Journal of Monetary Economics	1966–2006	OLS	To examine the role of assets in the design of the monetary policy.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

2010	T. Ikeda	ECB	Journal of Macroeconomics	monthly		To investigate whether or not ECB's preferences change asymmetricaly with time.
2010	W.J. Wouter Botzen, P. S. Marey	ECB	Journal of Policy Modelling	monthly	GMM	To investigate the effect of Financial Market developments on ECB's monetary policy, during the pre- crisis period.
2011	J. Klose	ECB	North American Journal of Economics and Finance	monthly	GMM, Space- State model	To investigate whether ECB reacts asymetricaly, with respect to the State of the Economy.
2012	S. Eichler et. Al	ECB	Journal of International Money and Finance	monthly	OLS, GARCH	To examine whether ECB acted as a Lender of Last Resort, during the period of the financial crisis.
2013	Martin & Milas	UK	Journal of Financial Stability	monthly	GMM	To investigate the interest rate setting process in the UK.
2013	A. Belke, J. Klose	ECB, Fed	Economic Modelling	monthly	GMM	To examine the merits of a Taylor Rule specification, after adopting the real interest rate, in an enviroment of negative interest rates.
2016	J. Klose	ECB	The Journal of Economic Asymmetries	monthly	GMM	To investigate the designing of monetary policy, in the euo are, since policies are decided mostly by unanimous vote, in an enviroment where individual country variables differ so significantly.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Section 2

2.1 Deriving of the Model

As expected, the logical point to begin my analysis is with the introduction of the standard Taylor rule specification (Taylor, 1993), which takes the following form:

Eq. (1) $$i_t^T = i_t^* + \alpha_\pi(\pi_t - \pi^*) + a_y(y_t - y_t^*)$$

Thus, as stated by this rule, a monetary authority would set the official policy rate (i_t^T) in agreement with the equilibrium nominal interest rate (i_t^*), aberrations of inflation from its explicit objective ($\pi_t - \pi^*$) and production deviation from its optimum(potential) (y_t- y_t^*), also known as the "output gap".

Taylor suggests the estimates (α_π, α_y) each to take 0.5 value, so that monetary authorities place equal weight on inflation and production aberrations. Since, both deviations can take either upwards or downwards turns, there exist two probable states for each variable, for instance when inflation rate is lying either above or under the explicit mark, thus directing to either inflationary or deflationary pressures and production being either above or beneath optimums, which point toward growths or downturns.

Although, in theory, it is not likely to presume which responses are more robust, still, it is often expected that the response to growing inflation, being more aggressive compared to the reverse scenario[3].

[3] See Ruge-Murcia (2003), Nobay and Peel (2003) or Surico (2003).

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Yet, this assumption is only valid when inflation stays non- negative. Since, periods of heightened deflationary pressures are regarded as the worst possible result, from a monetary perspective. That is precisely why monetary authorities, which set this explicit objective, always choose positive value. In the case of the ECB, this inflation target is close but still less than two percent.

As far as the asymmetric response to output deviations is concerned, it becomes even more difficult to make any assumptions regarding which reaction is likely to be more robust. Since, in reality, there exist two conflicting justifications able to rationalise a stronger response for each deviation, relying on the central bank's mandate.

To begin with, if the monetary authority has to promote economic growth, as is the case of the Fed, it is quite probable that output reductions are tackled more robustly than the case of unsustainable growth.

On the other hand, there might exist a second state, where monetary authorities are bounded by a mandate or constitution to ensure low and stable inflation, as in the ECB case. In this scenario, output expansions might get tackled more aggressively, since they can boost expectations regarding future inflationary pressure.

From our experience with the ECB, ECB seems eager to support production expansion, once its primary objective of price stability is fulfilled. So, at this point, I feel that it is too early to make any predictions regarding the ECB's (asymmetric) response regarding output gap and like Klose (2001), I am also going to defer this task until the empirical section of my dissertation.

Nonetheless, following Klose (2011), we find ourselves capable of identifying the various states of the economy with respect to inflation and production, conditional upon the existence of a constant inflation target. Thus, we are now capable of examining all possible combinations of those regimes.

So, consistent with the suggestions of the Taylor rule, I now am able to distinguish between four different regimes, as shown in the first figure, Fig. 1.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

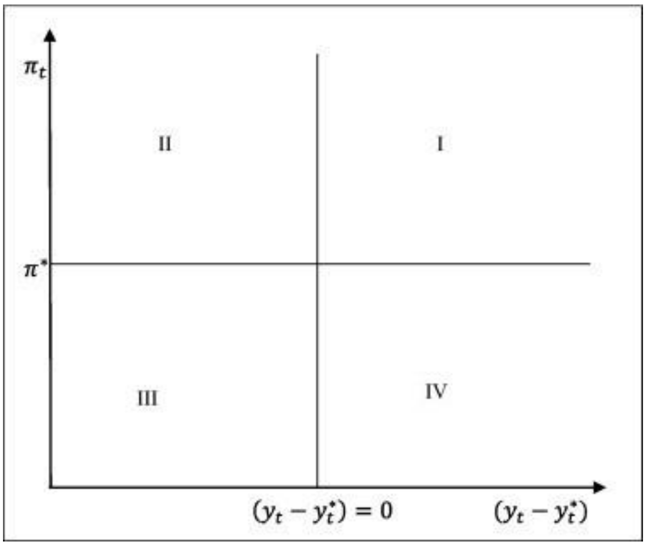

Fig. 1

1. The four states of the economy, as stated by the Taylor rule.

As a result, this figure demonstrates the so- called four states of the economy, that any central bank can come across, when making its interest rate decisions.

As for the production bound, it can be found in a position where real production equals its potential, in other words, when the output gap is zero. Alternatively, If we were interested in the FED case instead, that point would have been the level of production that causes unemployment to be at its natural level.

To quote Klose (2011) "We have to use this measure since the potential output is (as the output itself) a time varying variable".

By taking this approach, it enables us to make a clear distinction between the different regimes where production and inflation are both either above optimums (state I), or production is below potential whilst the inflation rate lies above its target and vice versa (states II and IV). Finally, I come across a situation where both target variables both lie below target/potential (state III).

So, at last, we are now in a position to estimate, for each state, the corresponding response functions and make comparisons between each other.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Still, as shown in the second figure, Fig. 2, there are some differences that hold distinctive interest.

Meanwhile, when equating regimes, I and II, it becomes clear that the only change is in the sign of the production gap, while the inflation gap stays non- negative, in both regimes. The same argument can also be applied to states III and IV, where once more, only the production gap switches signs whereas the inflation deviation persists to be negative.

Therefore, subject to the sign of the inflation deviation, we are now able to evaluate whether there exists indeed a significant difference in the ECB's response regarding production, being above or less than its optimal value. According to Bec et al. (2002), there exists a significant difference conditional upon the sign of output gap, at least for the Fed and the Bundesbank case.

Thus, I am able to observe whether or not this rests on the sign of inflation deviations by making a comparison between the two different states.

If my findings are evidence of an asymmetric conduct, then, at least one of the estimates ($\alpha y_{\pi<2}$, $\alpha y_{\pi>2}$) should be notably different, amongst the two compared regimes.

If both assessments provide us with evidence of an asymmetric effect, then, we have to examine whether this asymmetry points in the same direction, since it is conceivable that for $\alpha y_{\pi>2}$ that I discover a more robust response in the first state, whereas for the $\alpha y_{\pi<2}$ coefficient, I have estimated a more robust response in state III.

This could give rise to opposing findings contingent on the sign of the production gap, which could be followed by inconsequential estimates of the production gap asymmetries, unless I account for the inflation response. In the estimation process, I am not going to restrict the coefficient of inflation, so that they will be able to take different values across competing regimes (I/ II and III/ IV), respectively. Additionally, I am also accounting for asymmetries in the inflation reaction relying on the sign of production gap aberrations.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

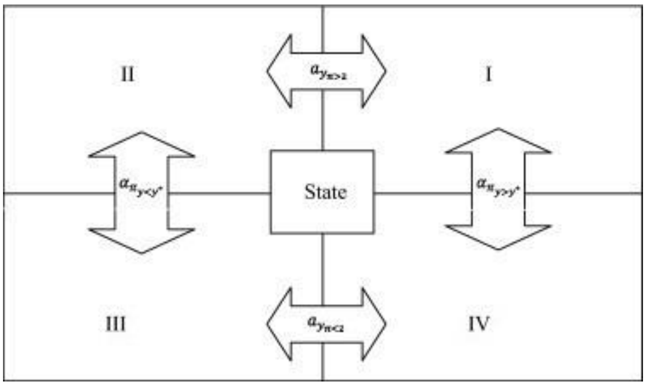

Fig. 2. Identifying asymmetries with respect to the four different regimes.

The same reasoning can be applied when I emphasize on equating asymmetries regarding inflation provided that the production gap is non-negative (states I and IV) or negative (states II and III). Here we concentrate mostly on possible differences of the coefficients and since these show the inflation response.

Taking a step further from the studies of Dolado, Maria-Dolores, and Naveira (2002) and Bunzel and Enders (2010), like Klose (2011), we are also going to permit the production gap coefficients to differ across comparing regimes, thus, explicitly accounting for the sign of the production gap measure.

After, having clarified the motives for my investigation, I can now switch focus to the equations, I am going to use to satisfy the claims defined earlier.

Consequently, as a first order of business, I am going to rearrange Eq. (1), by adopting the Fisher equation, adding a further assumption that of "adaptive expectations", so that $i_t^* = r_t^* + \pi_t$, with r_t^* being the equilibrium real interest rate. [4]

Eq. (2) $$i_t^T = r_t^* + (1 - a_\pi)\pi^* + a_\pi \pi_t + a_y(y_t - y_t^*)$$

with $a_\pi = 1 + \alpha_\pi$. Subsequently, $\alpha_\pi = 0.5$, resulting in an inflation coefficient of $a_\pi = 1.5$.

In practice, a good estimate of $a_{\pi,}$ should at least exceed unity, so that it can meet the so-called "Taylor principle". And, according to the principle, "an increase in inflation is only

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

refuted by an even bigger increase in the nominal interest rate, thus, leading to an increase in the real interest rate." (See Belke and Klose (2011)).

Since, I am only going to examine empirically the ECB, from this point forward, I am assuming an explicit inflation objective of two percent. Additionally, I am going to define a composite constant term(c), as the fusion of the equilibrium real interest rate with the explicit inflation objective. And so, Eq. (2) becomes:

Eq. (3) $$i_t^T = c + a_\pi \pi_t + a_y (y_t - y_t^*)$$

where $c = r^* + (1 - a_\pi)\,\pi^*$. Since r^* and π^* are both constants, differences in c can be tracked back exclusively to different values of a_π, hence variations in the inflation response contingent on the state of the economy.

[4] I am not going to follow Laubach and Williams (2003), Clark and Kozicki (2005), Leigh (2008), or Garnier and Wilhelmsen (2009), recommendations and as in Taylor (1993) and Klose (2011) and assume (as Taylor did) that the equilibrium real interest rate is constant over time.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

At this point, I should present you with these potential regime or state differences. As in Klose(2011; 2016), this is done through the use of a heavyside function, containing an interaction term between the inflation and production measurement. This approach greatly resembles that of Bec et al. (2002), and Bunzel and Enders (2010), who took the same approach, only regarding either production or inflation.

The Introduction of this heavyside function approach transforms Eq. (3) into:

Eq. (4)

$$i_t^T = \begin{cases} c_{ee} + a_{\pi_{ee}}\pi_t + a_{y_{ee}}(y_t - y_t^*) & \text{if } \pi_t > 2 \wedge y_t > y_t^* \\ c_{er} + a_{\pi_{er}}\pi_t + a_{y_{er}}(y_t - y_t^*) & \text{if } \pi_t > 2 \wedge y_t < y_t^* \\ c_{re} + a_{\pi_{re}}\pi_t + a_{y_{re}}(y_t - y_t^*) & \text{if } \pi_t < 2 \wedge y_t > y_t^* \\ c_{rr} + a_{\pi_{rr}}\pi_t + a_{y_{rr}}(y_t - y_t^*) & \text{if } \pi_t < 2 \wedge y_t < y_t^* \end{cases}$$

Here, in Eq. (4), the index -e represents an “expansionary development” implying that either inflation or production are above their respective optimal values. Contrary, the index -r stands for a “restrictive path”, for instance, inflation and output below lie below ideal value.

The first index of each factor denotes the state with regard to inflation and the second index symbolizes the state of production.

Though, conflicting with Taylor’s suggestions, empirical result show that monetary authorities adjust their policy rate in very small stages. Additionally, they also seem to smooth this interest rate adjustment. Thus, Klose (2011), followed the example of Clarida, Gali, and Gertler (1998), and included an interest rate smoothing term to this approach. Consequently, the Target nominal rate arrives in the equation in the resulting manner:

Eq. (5)

$$i_t = \rho i_{t-1} + (1-\rho) i_t^t$$

Since i_t^T is provided by Eq. (4), this turns Eq. (5) into:

Eq. (6)

$$i_t = \rho i_{t-1} + (1-\rho) \begin{cases} c_{ee} + a_{\pi_{ee}}\pi_t + a_{y_{ee}}(y_t - y_t^*) & \text{if } \pi_t > 2 \wedge y_t > y_t^* \\ c_{er} + a_{\pi_{er}}\pi_t + a_{y_{er}}(y_t - y_t^*) & \text{if } \pi_t > 2 \wedge y_t < y_t^* \\ c_{re} + a_{\pi_{re}}\pi_t + a_{y_{re}}(y_t - y_t^*) & \text{if } \pi_t < 2 \wedge y_t > y_t^* \\ c_{rr} + a_{\pi_{rr}}\pi_t + a_{y_{rr}}(y_t - y_t^*) & \text{if } \pi_t < 2 \wedge y_t < y_t^* \end{cases}$$

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Hence, the resulting specification, Eq. (6), enables us to estimate significant alterations in the response coefficients, with respect to the state of the economy. For all its merits, this specification, does not allows us to evaluate whether ECB responds in a non-linear way within each state. This can only be attained by estimating a Taylor response function which includes a volatility (quadratic) term for both the inflation rate and the gap in production, in each state. Since, these quadratic terms are able to capture potential non-linearities.

Thus, in every regime, a specification able to test this hypothesis, should have the following form:

Eq. (7) $$i_{t_{xz}} = \rho i_{t_{xz}-1} + (1-\rho)[c_{xz} + a_{\pi_{xz}}(\pi_t - 2) + a_{y_{xz}}(y_t - y_t^*) + a_{\tau_{xz}}(\pi_t - 2)^2 + a_{\nu_{xz}}(y_t - y_t^*)^2]$$

with x, z = e, r. At this point, it is essential to explicitly model the inflation deviation from the target. So, that I will be able to witness whether the response changes for inflation deviation if the threshold escalates. This, does not constitute a problem for the production gap variable, since this variable has the value “zero”, as threshold. Under the assumption that we find ourselves in state I, where we observe positive values for both inflation deviation and the gap in production, further positive coefficients of the volatility terms, could indicate a more aggressive response to greater deviations from the objective. However, If we witness significantly negative estimates instead, in this case, I may have to argue that the response to slight deviations is more distinct compared to greater deviations. The reverse result also holds true, if instead, I experience negative deviations from optimal value. In this situation, a negative estmate would suggest a more robust response to greater deviations and vice versa (see Klose (2011)).

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Section 3

3.1 *Data Construction and Classification*

Descriptive Statistics		*Linear*	*π<π**	*π>π**	*y<y**	*y>y**	*State I*	*State II*	*State III*	*State IV*
EONIA (i)	Mean	1.818493	1.066852	2.549631	1.585143	2.033421	2.459878	2.804138	0.940625	1.12
	Std. Dev.	1.632076	1.449253	1.463866	1.543989	1.687463	1.582215	1.039349	1.45766	1.452094
HCIP (π)	Mean	1.727	0.963	2.471171	1.219048	2.195614	2.559	2.2241	1.265625	0.835526
	Maximum	4.100	1.900	4.1	2.6	4.1	4.100	2.6000	1.9	1.9
	Minimum	-0.700	-0.700	2	-0.7	0.2	2.000	2	0.2	-0.7
	Std. Dev.	0.977	0.756	0.452747	0.90321	0.793936	0.486	0.1883	0.662161	0.760474
YGAP (y)	Mean	0.010079	-1.023519	-0.00000000000029	-1.699409	1.584607	1.74499	-1.046274	1.173625	-1.948632
	Maximum	6.636547	3.931441	3.238184	-0.019292	6.636547	6.636547	-0.029261	3.931441	-0.019292
	Minimum	-9.070572	-9.070572	-2.90466	-9.070572	0.000646	0.001369	-2.649753	0.000646	-9.070572
	Std. Dev.	2.308683	2.322577	1.164675	1.85233	1.381412	1.450736	0.839185	1.102024	2.065679
	N	219	108	111	105	114	82	29	32	76

Table 1.- Table of Descriptive Statistics

Following an ever-growing part of the literature, the data used in the estimation process, were real- time data. While the chosen estimation method, has been the Generalised method of moments (GMM), following the majority of the related literature (see Section 1.2), in an effort to model the ECB behaviour for an eighteen- year period, starting from 1999 up to 2017. The chosen frequency, consists of monthly data points, since ECB takes interest rate decisions every month and also, this approach allows for smaller Standard Errors. [5]

[5] A summarising study of different "Taylor- like rule" specifications which deal with this frequency issue, for the ECB case, can be found in the papers of Gedersmeier and Roffia (2004; 2005), Sauer and Sturm (2007), Klose (2016).

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Since, it is very significant, for the purpose of this paper, to determine whether the response coefficients change depending on the state of the Economy, hence, the sample is further divided into more subsamples, depending on the approach we take.

Contrary to other papers, for example Belke and Klose (2013), who specifically account for the beginning of the “global financial crisis”, I only implicitly do so with the use of the asymmetric approach. In addition, some authors like Belke (2013), use the real interest rate instead of the nominal, when covering a period comprising of the 2007/2008 financial crises, claiming that monetary institutions can no longer push, policy rates, further down, once they have reached the zero- lower bound. Contrary to this view, I choose to assume that the nominal interest rate can take negative values, since my sample covers different periods, based on the idea that the real policy rate variable is only a linear- transformation of the nominal, and hence the results should differ significantly.

Before switching to the estimation output, let me present you with some evidence of the data used and their structure.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

3.2 *Nature of the data used:*

Following the suggestions of Orphanides (2001), who examined the magnitude of informational problems associated with the implementation and interpretation of common monetary rules. Using the Taylor rule, he proved that real-time policy recommendations differ significantly from those obtained with ex-post revised data. The results of his work, advocate that reliance on the information available to authorities, in real time, is essential for the analysis of monetary rules. Orphanides (2001), concludes, that by using ex-post revised data, makes it impossible to understand whether a monetary authority has actually tracked a specific (discrete) policy rule, since these data were unavailable when policy rates had been decided.

Following Orphanides' recommendations, I rely solely on real- time data for the entirety of my estimation process. According to Belke and Klose (2009), the differences between ex post revised and real-time data stalks from three origins. The primary cause of difference, is what came to be known as uncertainty due to data revisions. Next, comes the statistical uncertainty, since ECB is not able to observe the data for the complete sample period (only up to distinct point). Following, the time lag which in the case of ECB is two months for the inflation rate(hicp) and three months for the industrial production. The initial two factors, influence only our series of the production gap, since the inflation proxy(hicp) is barely ever reviewed and the inflation rate is calculated instead of estimated, showing that there is not any statistical uncertainty. Still, the issue of the time lag of publication persists for the inflation rate. Following the example of Klose (2011), I adjust this two month time lag by constructing forecasts based on an AR (3)- process.[6]

As argued by Klose (2011), since the gap in production is a variable affected by all three of the above-mentioned causes, it is probably to be more influenced by the choice of real- time instead of ex- post revised data. Here, I have followed the approach of Klose (2011), Sauer and Sturn (2007) who estimated each observation distinctly depending on the last ten years of data. Trying to make up for the infamous end of sample bias of the HP- filter, as shown by Razzak (1997), I added twelve months forecast based on an AR (3)- process to each time

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

series. Meanwhile, since the policy rate itself is not subject to any review, we are able to assess this method by using this adjusted sample.

Interestingly enough, by adjusting for the time lag of two and three months respectively, as suggested by Klose (2011), I implicitly estimate a "forward-looking" Taylor specification, as I used predictions of both the inflation rate and the production gap.

And, in accordance with the previous literature, I checked for significant variances in the results, if I had used the data of six and twelve month- ahead, as estimated by an AR (3)-process, instead. However, these outcomes led me to inconclusive results, as they did in the case of Klose (2011; 2016).

In addition, since I cannot prove that these forecasts present the predictions in possession of ECB's policy makers when making their choice. The same holds true if I had assumed rational expectations or perhaps survey data, designed by the ECB. However, there exists just one way to admit a forward- looking Taylor response equations in a consistent manner, by relying on the ECB staff projections (as proposed by Klose (2011)).

Unfortunately, such predictions are available only two times per year and only from 2001 on. So, using these projections would have left us with less than enough data points, to come up with consistent estimates.

Here, I have strayed from Klose's (2011) path, since I relied on a slightly different instrument list by using the first twelve lags of inflation rate, output gap, interest rate, effective exchange rate, money demand, exchange rate and stock price growth. So, the instrument list, contains additionally twelve lags of m3. The instruments are chosen, under the effective market hypothesis, based on their correlation with the right-hand variables. The J-statistics confirm the appropriateness of the choice of instruments.

[6] All data, apart from the Us/Euro exchange rate, stem from the ECB real- time database. For further guidance on this database one can refer to the seminal work of Giannone et al. (2012).

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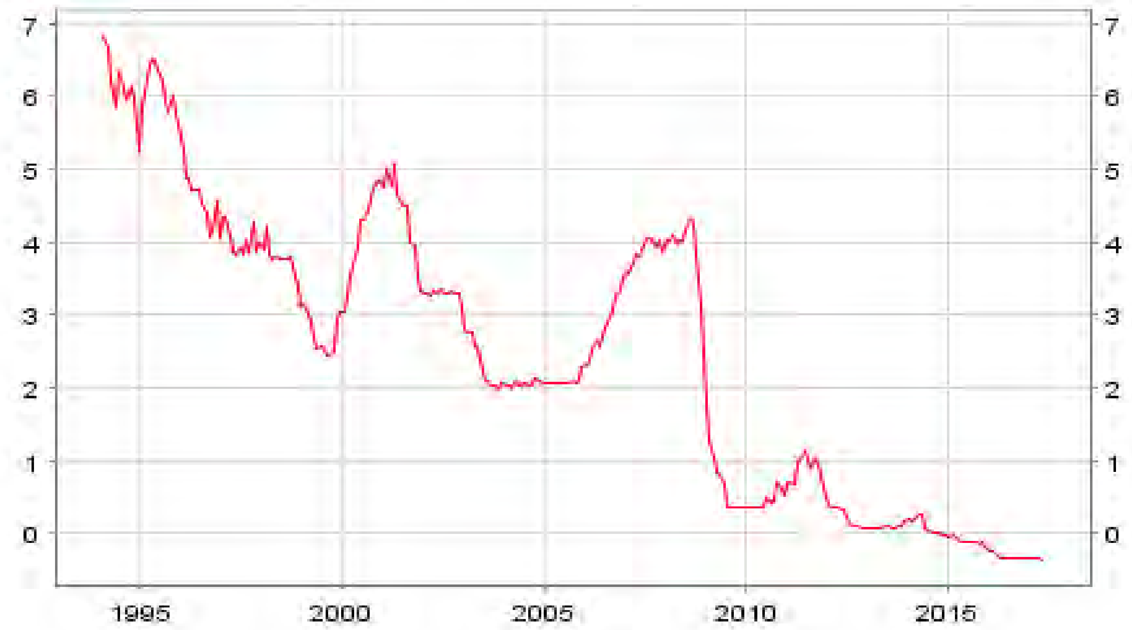
3.3 *Variables*

Nominal Interest Rate (i_t): The nominal short- term interest rate which in our case plays the role of the dependent variable in equated equations, is also the main policy rate of ECB. This policy rate is none other than Euro Interbank Offer Rate also known as “Euribor”. There different “Euribor rates” for different durations. The Euribor rate is a composite rate based on the 57 interbank lending rates that were in place between the European banks.

The euro area banks both lend and borrow capital from one another at these Euribor prices. For the purposes of the present paper, I choose to use the EONIA rate. EONIA, is short for Euro Over Night Index Average. And, it is the 1-day interbank interest rate for the Euro zone. Therefore, EONIA is considered to be the 1-day Euribor rate.

Fig.3- Eonia (3-month) source: the ECB real- time database.



Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Inflation (π_t): The Harmonized Index of Consumer Prices – HICP is the measure of price growth used by the ECB's governing council for the assessment of price stability across the union. This index is comprised by Eurostat and is harmonized to account for all members of the currency union. The HICP is calculated (rather than estimated) as the annual percentage change in the index price. In line with the ECB, inflation is calculated as the year-on-year percentage change in the harmonized index of consumer prices (HICP).

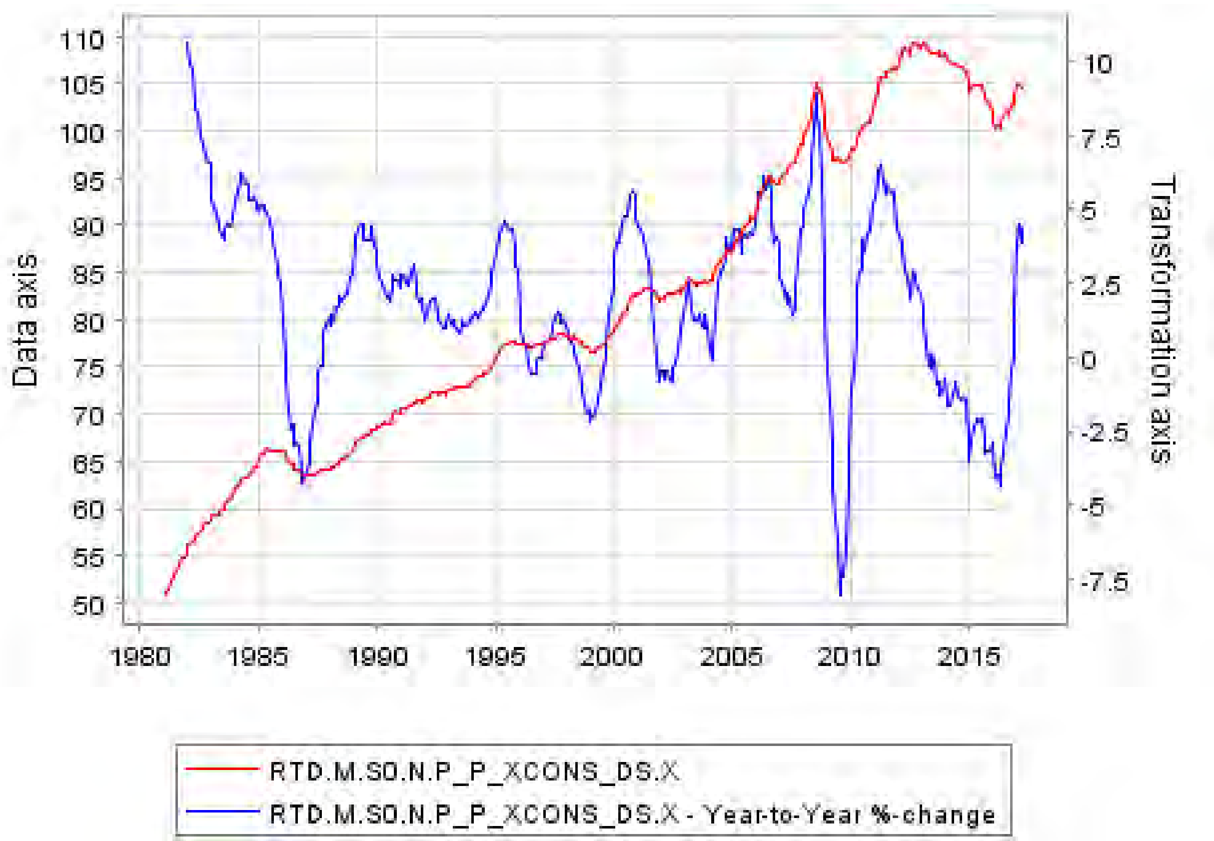
Fig.4- HICP source: the ECB real- time database.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Output gap ($Ygap_t$): As output gap, we define the difference of actual GDP from its potential. However, when using monthly data, one needs a monthly measure of the Euro Area wide GDP, which is not available. Thus, when monthly estimates are carried out, output is mostly proxied by industrial production (see e.g. Gerdesmeier and Roffia, 2004 or Sauer and Sturm, 2007).

As far as the potential output is concerned, it has been estimated as a HP-filtered version (Hodrick and Prescott, 1997) of the industrial production index (monthly frequency, smoothing parameter is λ= 14400). And as mentioned above, in order to account for the well-known end of sample bias in the HP-filter the industrial production index has been appended by a six-month forecast based on an AR (3)-process. Lastly, it is worth mentioning that there are other variables which can approximate GDP as well, and they constitute part of the reason for diversified results amongst papers (see e.g. Belke and Polleit, 2006).

fig.5- Industrial production (excl. construction) source: the ECB real- time database.



Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

The following variables are used only as instruments.

Money Supply (M3): As a definition for money supply, ECB has chosen M3, a wide monetary measurement, which is comprised from M2, plus a variety of tradable financial instruments, like repos, money mutual fund shares, and other tradables with duration less than two years issued from monetary and financial Institutions.

Dow Jones Eurostoxx 50 (Stock): It is a Stock market index with weights based on the capitalization of the 50 largest European companies, also known as “blue- chips”, that operates within the euro area. This index is composed from 18 Euro Stoxx indexes of the Dow Jones sector, where the members are classified based on their respective size and then are placed in a selection list.

(Foreign) Exchange Rate (us_eur): It is the agreed upon price for which two national currencies are being exchanged for. In this case, it is the amount of dollars required to buy one euro.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

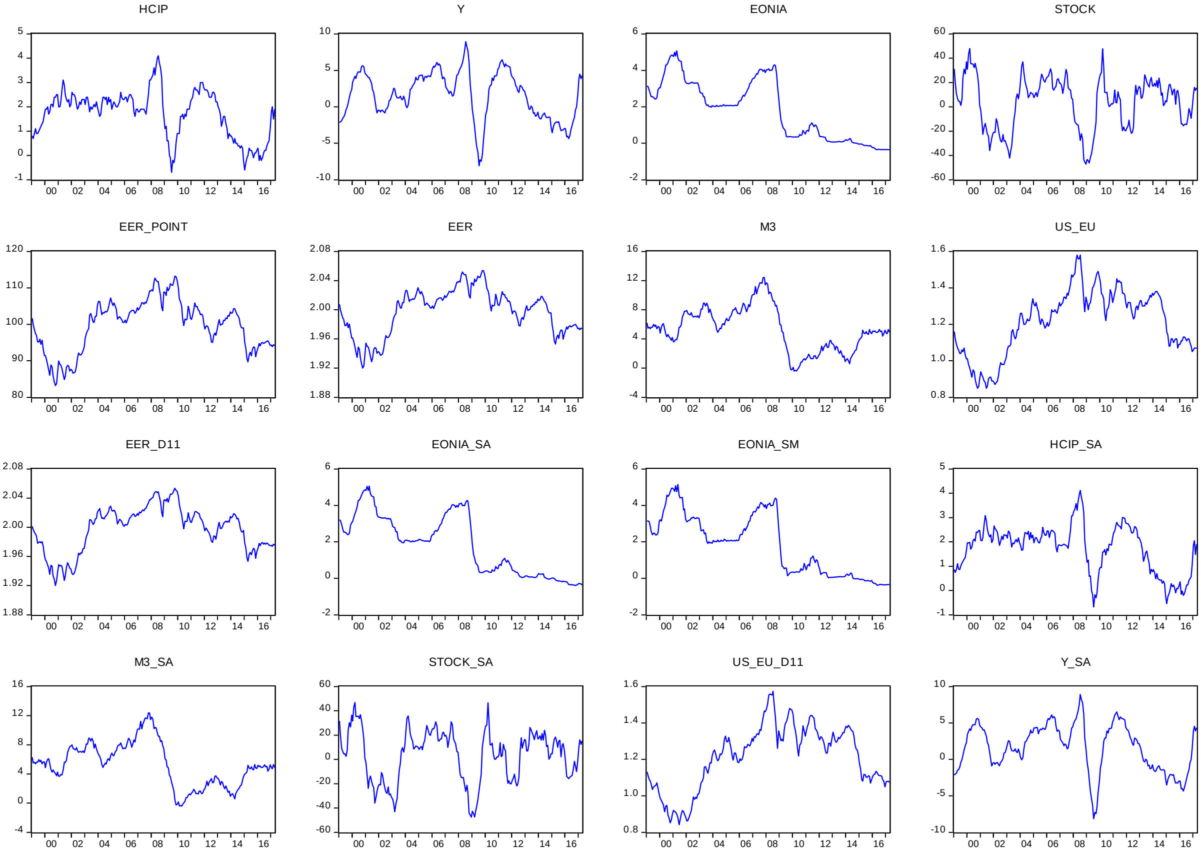


Figure. 6

Figure 6, provides us with a summary of all the variables considered and/or used. In the estimation process, all data used were raw data (neither seasonally adjusted nor smoothened), due to the fact that seasonality was ruled out and the estimates produced from raw data, proved to be closer to what theory might suggest and also more robust. One last thing, that it is worth mentioned, is the fact that, with the exception of Eonia, all other variables used, were annual percentage changes.

Having constructed the data, we are now able to divide them into the four regimes just by announcing the threshold measures as shown in Fig. 1. The descriptive statistics of the different regimes together with the statistics for each bound and the linear specification of the rule are displayed in Table 1.

Quite a few fascinating intuitions are provided by Table 1. To begin with, periods of inflation and production aberrations above and/or beneath optimums, seem to be well-balanced and so

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

we witness sufficient observations, in each regime, to observe consistent estimates. Furthermore, for their respective grouping supplied by the four states of the economy, the same inference is applicable.

Next, the descriptive statistics demonstrate that production gap is lesser if inflation is beneath the objective and how inflation is lesser if production is beneath the natural level. Consequently, we witness the lowest means for inflation and the production gap in state III where both variables lie beneath the required levels. Contrary, the highest means are found in the first regime where the reverse holds true. Another noteworthy result, that I find, in these two regimes, is that larger standard deviations regarding inflation and the gap in production, differing from states II and III. Subsequently, there is more volatility within the variables in these regimes. Therefore, in these two regimes, we constantly find the extreme realizations of the inflation rate and the production gap(values).

Moreover, interest rate peaks in the first regime (state I), following the recommendations of the Taylor rule. Hence, suggesting that policy rates ought to be high in periods of inflation and production above optimums. On the other hand, the reverse should also be true. Hence, policy rate is found to have its lowest value in state III, which is also consistent with the so-called Taylor framework. For periods with assorted indications, confronted by the ECB, for instance states II and IV, the average rate is higher for state II (inflation surpasses the objective, production gap is beneath potential), showing that contrary to the results of Klose (2011), who uses a different sample, ECB seems to tackle inflation deviations rather aggressively.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Section 4

4.1 *Empirical Results*

All valuations (estimates) in this Section are performed using the Generalized Method of Moments (GMM). This approach becomes essential since, according to Belke and Polleit (2007), ECB is not able to observe the contemporaneous right-hand side variables. Still, I make the same assumption as Klose (2011), that ECB knows from the beginning, the current state of the Economy. The instrument list is composed only from lagged variables that were available to ECB's governing council at the time they were setting policy rates.

Following the example of Klose (2011), I choose to only rely on a constant set of variables so that my results are not linked to different choices of those, in different specifications. The instrument list includes the first twelve lags of Eonia (or the first differences of this policy rate), the inflation rate, the production gap, the year-on-year stock price development, the effective exchange rate vis-a-vis the 19 most important trading partners and the money supply (M3). This instruments selection, makes us pass the J-test of the validity of over-identifying restrictions, which tests the suitability of the selected instruments list, in every case.

As for the appropriate weighting matrix, I choose, the heteroskedasticity and autocorrelation consistent HAC matrix by Newey and West (1987), which is in line with all related literature. All equations were estimated with the help of Eviews.

Thus, at the end, I estimate five equations in this section. The respective estimated reaction functions are presented underneath:

Eq. (8) $$i_t = \rho i_{t-1} + (1-\rho)[c + a_\pi \pi_t + a_y(y_t - y_t^*)] + \varepsilon_t$$

(linear Specification)

Eq. (9) $$i_t = \rho i_{t-1} + (1-\rho)\{[c_e + a_{\pi_e}\pi_t + a_{y_e}(y_t - y_t^*)^{\pi_t>2}] + [c_r + a_{\pi_r}\pi_t + a_{y_r}(y_t - y_t^*)^{\pi_t<2}]\} + \varepsilon_t$$

(asymmetric specification with respect to the inflation rate)

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Eq. (10) $$i_t = \rho i_{t-1} + (1-\rho)\{[c_e + a_{\pi_e}\pi_t + a_{y_e}(y_t - y_t^*)^{y_t > y_t^*}] + [c_r + a_{\pi_r}\pi_t + a_{y_r}(y_t - y_t^*)^{y_t < y_t^*}]\} + \varepsilon_t$$

(asymmetric specification with respect to the production gap)

Eq. (11) $$i_t = \rho i_{t-1} + (1-\rho)\left\{\begin{array}{l} [c_{ee} + a_{\pi_{ee}}\pi_t + a_{y_{ee}}(y_t - y_t^*)]^{\pi_t > 2,\, y_t > y_t^*} \\ +[c_{er} + a_{\pi_{er}}\pi_t + a_{y_{er}}(y_t - y_t^*)]^{\pi_t > 2,\, y_t < y_t^*} \\ +[c_{re} + a_{\pi_{re}}\pi_t + a_{y_{re}}(y_t - y_t^*)]^{\pi_t < 2,\, y_t > y_t^*} \\ +[c_{rr} + a_{\pi_{rr}}\pi_t + a_{y_{rr}}(y_t - y_t^*)]^{\pi_t < 2,\, y_t < y_t^*} \end{array}\right\} + \varepsilon_t$$

(asymmetric specification depending on the state of the economy)

Eq. (12) $$i_t = \rho i_{t-1} + (1-\rho)\begin{cases} [c_{\text{du}} + a_{\pi\text{du}}\pi_t + a_{y\text{du}}(y_t - y_t^*)] & \text{if Duisenberg is the Central Banker.} \\ +[c_{\text{tr}} + a_{\pi_{\text{tr}}}\pi_t + a_{y_{\text{tr}}}(y_t - y_t^*)] & \text{if Trichet is the Central Banker.} \\ +[c_{\text{dr}} + a_{\pi_{\text{dr}}}\pi_t + a_{y_{\text{dr}}}(y_t - y_t^*)] & \text{if Draghi is the Central Banker.} \end{cases}$$

(asymmetric specification depending on the governing period (Central Banker)).

The following table, Table 2, contains the estimates of the linear Taylor rule specification and also the asymmetric specifications of the rule with respect to either inflation or the production gap. So, the results of Equations (8)– (10) are presented in Table 2:

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Table 2.	*Eq. (8)*		*Eq. (9)*		*Eq. (10)*
ρ	0.976701		0.969432		0.908115
	(0.027155)		*(0.009378)*		(0.021804)
c	-2.146978	***			
	(1.258192)				
c_e			8.889974		-0.432482
			(4.431958)		*(0.211115)*
c_r			-1.326611		-0.513797
			(0.471661)		(0.209064)
α_π	2.323946				
	(0.756167)				
$\alpha_{\pi r}$			-3.293939	***	-1.897255
			(1.889016)		*(0.759696)*
$\alpha_{\pi e}$			1.370664		1.327876
			(0.392998)		(0.654115)
α_y	-0.003955	*			
	(0.535062)				
α_{ye}			1.609492		1.166798
			(0.497935)		(0.28262)
α_{yr}			-0.287926		-0.467154
			(0.129465)		(0.218591)
N	208 after adjustments		207 after adjustments		207 after adjustments
R^2 *(R- sq. adj.)*	0.991765		0.991448		0.920651
Prob. (J-statistic)	0.679075		0.999849		0.999194

Notes: GMM estimates, standard errors in parentheses, for significant differences in a_π and a_y the standard Wald- test is used, here corresponding p-values in parentheses, R^2 is the adjusted R^2 as a measure of the goodness of fit.

If no asterisk is placed next to a coefficient, this coefficient is significant at least 5% level.

* Insignificance even at the 10% level.

*** Significance at the 10% level.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

With a first glance, the coefficient of interest rate smoothing, ρ, is in all cases near one, hence the last Eonia value explains most of the difference in the current rate. Still, the Taylor estimates show quite significant results. For the linear specification, as shown in the first column (Eq. (8)), I find that the Taylor principle, stating that the inflation coefficient should exceed unity is fulfilled, hence, ECB tackles inflation deviations quite aggressively.

In contrast, the output coefficient is approximately -0.004, and it is only significant at the 10% level, which is clearly not consistent with Taylor's recommendation of 0.5. These results may differ from those reported in Klose (2011), but still there are in line with the ECB's mandate, since ECB's main objective is only to keep price growth less but close to two percent. This production gap coefficient, proves Taylor's (2009) point, that interest rates were kept too low for two long.

Now, taking only into account the asymmetries regarding the inflation reaction (Eq. (9)), I observe highly positive responses to inflation, that exceed unity, only in the case of economic expansion. In periods where inflation is below target, meaning that ECB's main objective is fulfilled, we observe a negative sign, showing, ECB's effort to pursue the implicit aim of further Economic growth (output expansion). This result comes as no surprise, since it is usually assumed that the ECB responds less inertially to positive than to negative deviations from the objective. Moreover, this result is supported by Castro (2008) and Belke (2013).

When looking at the production response, I am not able to find any significant difference. Even though the ECB responds significantly negative to the production gap if inflation is below objective, the response coefficient surpasses unity if inflation surpasses the objective. This leads me to the conclusion that the ECB seems to actively accommodate production expansion only when inflation is consistent, hence, under the two percent margin. In this scenario, ECB, is willing to lower further the policy rate. And as expected, the opposite also holds true.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

So instead, if it surpasses optimum, ECB seems to tackle production expansion aggressively, in order to supress inflationary pressures. When I only take into account asymmetries with respect to production, as measured by the production gap (see Eq. (10)), I am not able to observe important differences regarding inflation and/or production. Hence, the output gap coefficient is significantly larger if output surpasses potential, and so, ECB responds more robustly to a downturn as opposed to an expansion of production. This outcome is also supported by Surico (2003, 2007b), Altavilla and Landolfo (2005) and Klose (2011).

Furthermore, if output gap is below optimums, its coefficient points to a negative response, thus tackling deviations from optimum. As for the inflation response, I observe a significantly larger estimate when production surpasses potential compared to a situation that lies beneath. In the former case, in a situation where production is below the natural level, the “Taylor principle” is not satisfied.

So far, I have observed possible asymmetries regarding either inflation or output gap reaction, which leads me to introduce a new interaction term for both variables, to help me observe which state(s) drive(s) the results presented in Table 2.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

The estimation Output of Eq. (11) is available on Table 3.a:

Table 3. a	***Stage I***	***Stage II***	***Stage III***		***Stage IV***	
ρ			**0.962017**			
			0.007988			
c	8.278341	-12.44714	0.572775	*	-0.592538	*
	(2.403043)	*(6.205812)*	*(0.709611)*		*(0.869931)*	
α_π	-3.299057	5.526172	0.123364	*	-4.191571	***
	(1.036251)	*(2.591885)*	*(0.50397)*		*(2.228925)*	
α_y	1.442115	-0.778268	0.272037	***	1.773299	
	(0.284683)	*(0.60436)*	*(0.154547)*		*(0.685542)*	
N	207 after adjustment					
R^2(R-sq. adj.)	0.991225					
Prob.(J-statistic)	0.999899					

Notes: GMM estimates, standard errors in parentheses, for significant differences in a_π and a_y the standard Wald- test is used, here corresponding p-values in parentheses, R^2 is the adjusted R^2, as a measure of the goodness of fit.

If no asterisk is placed next to a coefficient, this coefficient is significant at least 5% level.

* Insignificance even at the 10% level.

*** Significance at the 10% level.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Yet again, I observe a high interest rate smoothing parameter, ρ, as was also the case for the linear specification and the other two specifications including only asymmetries regarding either inflation or the production gap. Nevertheless, in Table 2, I found with only one exception (Eq. (8), output gap coefficient) significant coefficients for both inflation and the production gap.

Unfortunately, this is not the case here, if I implement the interaction terms which indicates the regime. Here, I only observe in states I and II (where either both inflation and output gap are above optimums or at least inflation surpasses target) significant responses to both inflation and the output gap, for all levels of significance. This could be an indicator that a Taylor- like rule, only applies during "normal" times. If we find ourselves in situations like those described in States III or IV, monetary authorities might have to resort to using other tools to regain financial Stability. And the fact that we found a negative and significant inflation coefficient in state I, where we describe a period of (unsustainable) economic growth, proves again Taylor's (2009) claim, to be true.

This result may seem counterintuitive at first, but it is consistent with the linear specification and the results of Sauer and Sturn (2007), who examine a period with many similarities to State I. Another interesting result, is the fact that only in State II the "Taylor Principle" is fulfilled. A period, defined by mild policy challenge, which traditional policy actions can resolve it.

In addition, the fact the I witness that the Taylor principle, in states III and IV, is violated, should also not surprise us. As stated above, in these states where inflation is beneath the objective and thus, there is no inflationary pressure, ECB can concentrate on its secondary goal of promoting economic development, since price stability is not threatened. This fact, is also supported by the large coefficients of the production gap, in these states.

Moreover, in State III, where we are faced with a period of "deep" recession the fact that none of our coefficients is significant at 5% level, was no surprise, since unconventional policies come at play. The troubling estimate is that of the inflation coefficient in State IV, which states that if inflation raises by 1% and still remain below the target, ECB is going to further decrease policy rate 4.19 % from its previous value, in an effort to stimulate the economy.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

These estimates follow closely the real- time results presented in Klose's (2011) paper, who first proposed this approach.

However, an important result which we have not discussed yet, is the fact that inflation and production gap estimates vary significantly between the different regimes.

As earlier discussed, in a state where inflation and production are above optimums (state I), I find no considerable response of the ECB. This rather surprised me, since this combination leads to a strong suggestion regarding ECB's action consistent with the traditional Taylor rule. But, I am unable to confirm that in this scenario, ECB raise policy rates.

Up until now we have not estimated whether variances across regimes are significant or not. Those results are presented in Table 4.a below:

Table 4. a	***Reaction to inflation (α_π)***	***Reaction to output gap (α_y)***
State I = State II	*-8.825229*	*2.220383*
($\alpha_{wI} = \alpha_{wII}$)	*(0.0036)*	*(0.0026)*
State III = State IV	4.314934 ***	*-1.501262*
($\alpha_{wIII} = \alpha_{wIV}$)	*(0.0641)*	*(0.0312)*
State I = State III	*-3.422421*	*1.170078*
($\alpha_{wI} = \alpha_{wIII}$)	*(0.0088)*	*(0.000)*
State II = State IV	*9.717743*	*-2.551567*
($\alpha_{wII} = \alpha_{wIV}$)	*(0.0046)*	*(0.0102)*

Table 4.a- Differences in inflation and output responses depending on the state of the economy in real-time.

Notes: Results of Wald tests given the estimations in Table 3. a, p-values are reported in the parentheses, w = π, y, the results in italics show those for the variables indicated in Fig. 2.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

In agreement to my previous results, (see Table 2) I am able, yet again, to discover in every scenario, considerable variances between regimes for at least one of the two variables. Hence, this provide us with valuable insights regarding the results in Table 4.a. To spot these coefficients, I am primarily keen on finding variations regarding the analysis made in Fig. 2. These results are written in italics.

At a first glance to the first row of Table 4.a, I am able to witness asymmetric behaviour between states I and II, i.e. ECB does indeed responds significantly different to production expansions or contractions provided that inflation surpasses the explicit target. On the other hand, when comparing states III and IV (second row), I witness an asymmetric conduct corresponding only to the production gap, for all levels of significance. The results shown in the second row are hence compatible with those from Eq. (10), presented in Table 2. Thus, I am confident to state that the estimates presented in Table 2, are driven by those results when inflation lies below optimums.

Focusing on asymmetries in the inflation response coming from a given production aberration, I observe, by comparing states I and III (third row) a considerably higher reaction in state I to inflation than in state III. This outcome is not so mystifying, since we normally expect a considerably higher reaction when inflation surpasses the objective compared to the reverse scenario. Somewhat puzzling is the value of that coefficient but we have already discussed it. Since, in state III we are going through a period of deflation, which is thought to be the worst possible outcome for any economy, a less aggressive response to inflation is often chosen. And, it seems that in this situation, ECB is willing to even lower the interest rate further even as inflation pressure rises, perhaps as a last resort before commencing unconventional policies.

Obviously, these results make it difficult to determine ECB's "comfort zone". Hence, in a scenario where inflation is in line with ECB's objectives, a smaller reaction expected, meaning that ECB's actions are not that robust if inflation deviation is small, even if it still surpasses the target. In a state where production surpasses potential (fourth row) the inflation response is still asymmetric, regarding inflation deviations as it was also shown by Eq. (9) in Table 2. Also, with the difference being significant, the estimates in Table 3.a reveal, that

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

inflation responses are usually higher when production surpasses potential and thus, the reverse outcome is found when equating states II and III.

Finally, I arrived at the conclusion that asymmetries in the response function regarding production deviations are determined by those coefficients where inflation lies beneath target, whereas for the asymmetric reaction to inflation observed in Table 2, the opposing guidelines of the estimated coefficients reling on the states where production either surpasses or lies beneath optimums, are responsible. So, these results mainly depend on the respective production deviations.

4.2. *Robustness tests*

Since the above analysis may be subject to quite a few weaknesses, I am going to try to account for them by conducting additional Robustness tests.

4.2.1. *Bounds approach*

All in all, ECB has done a decent job keeping the inflation rate close to its explicit objective of near two percent, with the current crisis period, being the only exception. Thus, it could be argued that the ECB does respond inertially to inflation rate deviation if it does not deviate far enough from optimums. Additionally, if ECB also detects that the production level remains close to the objective, then again, no policy action is taken.

I am going to revisit this issue throughout this section where I am going to present you with evidence that there exist indeed non-linearities within every regime.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Although, times where inflation and the production gap are close to optimums are typically incorporated within traditional Taylor rule, in this case, this could lead to biased outcomes, if this is an element only found in certain regimes but not in all.

Therefore, following the example of Klose (2011), I decided to exclude all data points between 1.9 and 2.1 for the inflation rate and between −0.2 and 0.2 for the production gap. Using these limits, I exclude 15 data points, resulting in a sample consisting of 206 points, where both inflation rate and production gap go beyond the upper and below the lower limits.

The following tables, 3.b and 4.b, contain the estimation results of Eq. (11) and the changes in inflation and production reactions relying on the state of the economy, for this modified sample, respectively. The J-statistics, yet again, confirm the appropriateness of the instrument list, as displayed in Table 3.b.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Table 3. b.	*Stage I*		*Stage II*		*Stage III*		*Stage IV*	
ρ				0.964537				
				(0.007511)				
c	9.286102		-13.42337	*	0.515459	*	-0.58686	*
	(2.487494)		*(6.384603)*		*(0.702438)*		*(0.890242)*	
α_π	-3.736835		5.989695		0.100188	*	-4.302776	***
	(1.075841)		*(2.663863)*		*(0.502856)*		*(2.314874)*	
α_y	1.523331		-0.768953		0.286517	***	1.805776	
	(0.291713)		*(0.628774)*		*(0.160554)*		*(0.71764)*	
N	206							
R^2 *(R-sq adj.)*	0.991276							
Prob(J-statistic)	0.999911							

Table 3.b- Estimating results of Eq. (11), with these modified sample period.

Notes: GMM estimates, standard errors in parentheses, for significant differences in aπ and ay the standard Wald- test is used, here corresponding p-values in parentheses, R^2 is the adjusted R^2, as a measure of the goodness of fit.

If no asterisk is placed next to a coefficient, this coefficient is significant at least 5% level.

* Insignificance even at the 10% level.

*** Significance at the 10% level.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Table 4.b	***Reaction to inflation (α_π)***	***Reaction to output gap (α_y)***
State I = State II	-9.72653	2.292284
($\alpha_{wI}= \alpha_{wII}$)	*(0.0016)*	*(0.0028)*
State III = State IV	2.393405***	-1.519259
($\alpha_{wIII}= \alpha_{wIV}$)	*(0.0658)*	*(0.036)*
State I = State III	-3.837023	1.236814
($\alpha_{wI}= \alpha_{wIII}$)	*(0.0031)*	*(0.000)*
State II = State IV	10.29247	-2.574729
($\alpha_{wII}= \alpha_{wIV}$)	*(0.0028)*	*(0.0136)*

Table 4.b- Differences in inflation and output responses depending on the state of the economy (Bounded Approach).

Notes: Results of Wald tests given the estimations in Table 3. b, p-values are reported in the parentheses, w = π, y, the results in italics show those for the variables indicated in Fig. 2.

Looking closely to Table 3.b, I am not witnessing any significant differences, by taking this approach. Granted that coefficients are not exactly identical, compared to the whole sample results, for instance take a look at the production gap, but still they remain more or less the same. By witnessing substantial deviations in all regimes, I admit that the response seems to be the different, depending on whether or not, the other target variable either surpasses or lie beneath its target.

This holds true for both the production gap response, as well as for the inflation response. As stated above, by taking this approach I am drawn to the same conclusion as in my previous analysis. And, this is the importance of taking into account the different states of the economy, when trying to analyze ECB's actions. I suspect that this statement also holds true, for all major monetary institutions, but this goes beyond the scope of my dissertation.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

4.2.2. *The Central Banker Approach*

Taking a step further from the analysis of Klose (2011), I investigate the asymmetries in a Taylor-like reaction function where asymmetries depend on the ECB's different governing councils. In other words, instead of estimating a heavyside Taylor-like reaction function where asymmetries depend on the state of the economy, in this case asymmetries depend crucially on the different "policy makers", instead of a combination of inflation and production deviations. This approach is pretty straight forward and can be easily understood by simply looking again at Eq.(12):

Eq.(12)
$$i_t = \rho i_{t-1} + (1-\rho)\begin{cases} [c_{\mathrm{du}} + a_{\pi_{\mathrm{du}}}\pi_t + a_{y_{\mathrm{du}}}(y_t - y_t^*)] & \text{if Duisenberg is the Central Banker.} \\ +[c_{\mathrm{tr}} + a_{\pi_{\mathrm{tr}}}\pi_t + a_{y_{\mathrm{tr}}}(y_t - y_t^*)] & \text{if Trichet is the Central Banker.} \\ +[c_{\mathrm{dr}} + a_{\pi_{\mathrm{dr}}}\pi_t + a_{y_{\mathrm{dr}}}(y_t - y_t^*)] & \text{if Draghi is the Central Banker.} \end{cases}$$

One could think of this approach, as a way of making a "simple" comparison between what weights more when interest rate decisions are made, is it the state of the economy or the views and policies that the governing council wants to implement. To rephrase that, "Is ECB simply blindly following its mandate or is there room for political decisions?".

Tables 3.c and 4.c, contain the estimation results of Eq. (12) and the differences in inflation and production reactions depending on the "Central Banker", respectively. Still, the J-statistics confirm the appropriateness of the instrument list, as displayed in Table 3.c.

The following table, contains a detailed summary of Taylor- like functions estimated for both the ECB and the Bundesbank, across different periods. The purpose of this matrix is to act as Yardstick, something to compare against our estimates, so far.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Review of Monetary (Taylor- like) rule for the ECB and the Bundesbank

Paper	Year	Type of the Rule	Sample Period	ρ	α	α_{π}	α_{y}
Clarida et.al	1998	forward looking	1979M03: 1993M012	0.91	3.14	1.31	0.25
Peersman and Smets	1998	forward looking	1979M01: 1997M012	0.93	2.52	1.3	0.28
Gerlach and Schnabel	2000	backward looking	1990Q1: 1998Q4	-	2.4	1.58	0.45
Fourcans and Vranceanu	2002	Contemporaneous/ forward looking	1999M04: 2002M02	0.73	1.22	1.16	0.18
Ullrich	2003	Contemporaneous	1991M01: 2002M08	0.19	2.96	0.25	0.63
Surico	2003	Contemporaneous	1997M07: 2002M10	0.77	3.77	0.77	0.47
Adema	2004	Contemporaneous	1994Q1: 2004Q4	0.75	4.95	1.8	1.72
Carstensen and Colavecchio	2004	forward looking	1999M01: 2004M02	0.95	0.02	1.01	1.36
Gerdesmeier and Roffia	2005	Contemporaneous	1999M01:2003M06	0.99	2.86	0.61	2.14
Sauer and Sturn	2007	Contemporaneous	1991M01: 2003M10	0.94	4.81	-0.84	1.45
Gorter et al	2008	Contemporaneous	1997M01: 2006M012	0.95	3.15	0.09	0.37
				0.86	3.6	1.39	1.52
T. Ikeda	2010	Contemporaneous	1999M01: 2008M09	0.56	3.69	0.06	0.46
Belke and Klose	2011	Contemporaneous	1998: 2011	0.97	1.48	-6.13	3.68
Klose	2011	Contemporaneous	1997M01: 2009M12	0.96	0.75	0.83	0.42
			Stage I		10.9	−2.77	4.88
		(Real- time Data)	Stage II	0.94	−3.03	1.36	−3.57
			Stage III		1.72	−0.14	0.57
			Stage IV		4.93	3.44	−16.33
Belke	2013	Contemporaneous	1998M09: 2007M07	0.82		3.21	2
			2007M08: 2012	0.57		-0.57	0.11
Klose	2016	Contemporaneous	2000M01-2014M12	0.87		−0.05	0.12
			2000Q1-2014Q4	0.15		−0.77	-0.11

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Table 3.c	*Duisenberg*		*Trichet*	*Draghi*	
ρ			0.905		
			(0.022026)		
c	3.264931		1.702325	0.168365	*
	(0.946398)		*(0.231558)*	*(0.695152)*	
α_π	-1.564076	*	2.857647	1.197757	*
	(1.750497)		*(0.905818)*	*(1.001657)*	
α_y	1.052784		-0.47644	-0.42103	*
	(0.37835)		*(0.215879)*	*(0.333334)*	
N	207 after adjustments				
R^2 (R-sq adj.)	0.990204				
Prob(J-statistic)	0.999367				

Table 3.c- asymmetric specification depending on the Central Banker.

Notes: GMM estimates, standard errors in parentheses, for significant differences in aπ and ay the standard Wald- test is used, here corresponding p-values in parentheses, R^2 is the adjusted R^2, as a measure of the goodness of fit.

If no asterisk is placed next to a coefficient, this coefficient is significant at least 5% level.

* Insignificance even at the 10% level.

*** Significance at the 10% level.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Table 4.c	***Reaction to inflation (α_π)***	***Reaction to output gap (α_y)***
Duisenberg= Trichet	-4.421723	1.52922
($\alpha_{wDu}= \alpha_{wT}$)	*(0.0513)*	*(0.0025)*
Trichet= Draghi	1.65989	-0.055411
($\alpha_{wT}= \alpha_{wD}$)	*(0.2601)*	*(0.8761)*
Duisenberg= Draghi	-2.761834	1.473808
($\alpha_{wDu}= \alpha_{wD}$)	*(0.2289)*	*(0.605)*

Table 4.c- Differences in inflation and output responses depending on the Presidency period (Central Banker).

Notes: Results of Wald tests given the estimations in Table 3.c, p-values are reported in the parentheses, w = π, y, the results in italics show those for the variables indicated in Fig. 2.

To begin with, the estimation results, vary significantly across different governing period. The first period, also known as, the "Duisenberg period", reports results comparable to those from states I and II, of the previous approach. This is something to be expected, since Duisenberg reigned mainly over period of economic expansion, having only to clean up the aftermath of the dot- com bubble. And to do that, only "conventional" measures where required.

Next, comes the period of Trichet, whose command ended on September 2011, before nominal interest reached the zero- lower bound. Trichet's periods, was not so straightforward. Trichet, found himself directing the ECB through a variety of different states. The results show, that during his presidency, ECB seemed committed to pursuing both targets. The one required from its mandate, keep inflation expectation at bay, thus satisfying the "Taylor Principle" and also, its secondary goal of output expansion.

Thus, we are able to observe a coefficient of 2.85 for the inflation coefficient and -0.47 for the output. The negative sign in the output estimate, states that "every time that production surpasses its potential, ECB lowers its interest rate by 0.47% further from its previous value"

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

and thus showing Trichet's true commitment to economic growth. This last result, was somewhat expected, since it was on his watch that Lehman Brothers failed and crises began.

However, in all fairness, during his presidency, ECB acted less inertially and showed real commitment to satisfying both objectives, while keeping interest rates above the zero- lower bound.

Finally, the "Draghi period". During this period, none of our estimates is significant, even at the 10% level. This, is something to be expected, since Draghi reigned over the worse financial Crisis since the "Great Depression". During this period, for the first time, unconventional tools were introduced and the Taylor rule was set aside, for the first time after nearly 20 years.

Turning now to Table 4.c, the table displays the differences in inflation and the production reactions, depending on the governing period. By looking at the different rows of Table 4.c, we immediately spot asymmetric conduct across all the different governing periods, meaning that ECB's actions and goals are greatly dictated from each President.

Hence, by observing different rows, I am witnessing significantly different (asymmetric) behaviour. These results, are comparable to those from our previous analysis (section 4.2). An intuitive explanation would be that, since a "governing period" can be broken down to different subsamples, each divided with respect to each state, the estimation results could be viewed as a summation of all state, with each state holding a different weight. Thus, explaining the numerous similarities.

4.3 *The Asymmetries of Taylor Rule framework within each regime:*

Up until now, I have mainly examined whether there exists asymmetric conduct regarding inflation and production gap between the states of the economy. Meanwhile, I have not witnessed any noteworthy differences between the original approach, including all data points and the sample bounded approach, I can now, switch my effort to identifying whether there exists a non-linear response to inflation and/ or the production gap within each state.

For estimation purposes, like Klose (2011), I now estimate Eq. (7) in each regime distinctly, trying to witness these non-linearities. Since, there is still a sufficient number of observations

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

left in each state, I decided not to make any changes in the number of lags my instrument lists uses. The results are presented in Table 5.a.[7]

Table 5. a	*Stage I*		*Stage II*		*Stage III*		*Stage IV*	
	Linear Approac	Non-linearities	inear Approac	Non-linearities	inear Approac	Non-linearities	inear Approac	Non-linearities
c	4.456029	5.694998	-2.763117	-6.983219	-0.631475	1.392085	-0.068811	-0.215879
	-1.606653	-0.218576	*-1.315841*	-1.031164	*-0.331382*	-0.419736	*-0.009851*	-0.066544
ρ	0.959137	0.943182	0.954202	0.936963	0.983098	0.984227	0.864938	0.90253
	-0.011518	-0.000896	*-0.005371*	-0.008232	*-0.007485*	-0.003476	*-0.008983*	-0.021017
α_{π}	-1.587671	-1.602784	1.89174	4.114746	1.631011	-1.626258*	-0.233512	-1.069723
	-0.779959	-0.078326	-0.561765	-0.406271	*-0.445418*	-1.334773	*-0.025839*	-0.307857
α_{y}	0.983282	1.622103	-0.098227*	-1.776896	0.562827	1.999566	0.14289	0.087542*
	-0.299267	-0.033363	*-0.073884*	-0.356316	*-0.333715*	-0.636969	*-0.015559*	-0.170337
α_{π}_sq	-	0.318097	-	-29.50868	-	-8.319062	-	-1.834696
		-0.10607		-1.667629		-2.201042		-0.720709
α_{y}_sq	-	-0.143775	-	-0.621375	-	0.554911	-	0.214417
		-0.00759		-0.160818		-0.155442		-0.086305
Adjusted R^2 :	0.989012	0.986732	0.981264	0.984176	0.988344	0.987583	0.888405	0.889586
Included obse	82	52	29	29	67	74	31	30
b(J-statistic) :	0.998296	0.999891	0.984246	0.976414	0.973328	0.999539	0.994043	0.979562

Notes: GMM estimates, standard errors in parentheses, for significant differences in a_{π} and a_y the standard Wald- test is used, here corresponding p-values in parentheses, R^2 is the adjusted R^2, as a measure of the goodness of fit.

If no asterisk is placed next to a coefficient, this coefficient is significant at least 5% level.

* Insignificance even at the 10% level.

*** Significance at the 10% level.

[7] For the remaining of this section, when I talk about linear inflation or output deviations, I refer only to the linear terms of the non- linear approach (Eq. (7)). I am going to discuss the linear approach results, in the next section (Section 4.3.1).

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Table 5.a, displays some interesting results concerning the non-linear actions of the ECB, across different regimes. Primary, if inflation aberrations are positive (states I and II), we are unable to observe any significant improvement to our results, whether we decide to include a volatility term for inflation and the production gap. A noteworthy result, is the pattern of significant estimates displayed in these states. As it was also the case, in our earlier analysis (Section 4.1). This is a significant difference between this paper and that of Klose (2011), who finds a pattern of insignificant results instead, when examining the same states. Nevertheless, this can be attributed to the difference in samples used and also to my usage of real- time data.

On the other hand, in a scenario where inflation aberrations turn out to be negative (States III and IV), I observe significant negative results, showing a more robust response to larger deviations. At this point, I have to call attention to the fact that nearly all of the volatility terms, with State III being the only, are significant, proving that their inclusion was justified.

However, only when ECB find itself in situation similar to that of States III or IV, only then these volatility terms actually improve the model. I am going to further discuss these results in the next section.

With the coefficient of inflation deviation being significantly negative, I arrived at the conclusion that ECB reacts to inflationary pressures, by raising policy rates further, only when these deviations seem to be outside its "comfort zone". This translates to ECB addressing this issue only for larger deviations from the explicit objective (of two percent).

So, from the analysis above, I observe that, despite ECB's binding mandate, which sets an explicit inflation target, it does not always follow it (to the letter).

And as for the production gap response, I am witnessing significant estimates of the production gap volatility term, in all states.

Still, the sign differs among the different regimes.

In states I and II, we encounter negative coefficients, hence, ECB seems to react less aggressively to larger deviations in these states. In the other two states, where we experience positive output gap measures, states III and IV, they show, a positive estimate of the quadratic term.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Since the estimate of the linear term is negative, it can be viewed as a negative response to the production gap for mild deviations from the objective, in this particular regime. Thus, agreeing with my earlier results from Section 4.1, which only become positive for larger deviations.

In the states II and III where production is beneath the optimum, I witnessed opposing signs for the quadratic terms. In state II, the estimate is negative which shows a stronger reaction to larger deviations, while the reaction coefficient in state III is positive, meaning that ECB reacts more inertially to greater deviations in this regime.

All things considered, I arrived to the conclusion that ECB responds in a non-linear manner for deviations in inflation and production. However, how they behave, depends crucially on the state of the Economy, that ECB finds itself in, when setting the interest rate.

As for inflation, the response is non-linear if inflation is beneath the explicit oblective, which points to a more distinct response to larger deviations.

Now turning to production deviations, the propensity is mixed, since in states I and III the response is more robust for slighter deviations (from the objective), while in states II and IV the opposite holds true.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

4.3.1 *Taking this approach a step further:*

In his seminal work, Schaefer (1981), described how one could solve the "portfolio optimization problem", using linear programming. Schaefer states that "If short-selling is not possible, we have to use linear programming methods to analyse the market". Schaefer explained, that by allowing only for non-negative coefficients, using Linear Programming, we are able to solve the portfolio optimization problem. This task, can be viewed as either a minimization of portfolio's variance for a given return or as maximizing return for a given level of volatility. In this paper, I apply the same principle to solve for the minimum variance residual of the Taylor Rule, in each State. Perhaps, a visual aid could be helpful at this time.

Think of the linear specification of the Taylor Rule with interest rate smoothing, Eq. (14). Instead, I solve for the error term, Eq. (15), and through the use of linear programming[8], I obtain the coefficients that minimize the residual variance.

$$i_t = \rho i_{t-1} + (1-\rho)[c + a_\pi \pi_t + a_y(y_t - y_t^*)] + \varepsilon_t \quad \text{Eq. (14)}$$

$$\text{Eq. (15)} \qquad \varepsilon_t = i_t - [\rho i_{t-1} + (1-\rho)[c + a_\pi \pi_t + a_y(y_t - y_t^*)]]$$

[8]Although, I refer to the process used as linear programming, I used the GRG nonlinear method, which available in Solver, since it produces the same results with Simplex LP, when dealing with a linear Specification problem.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

This process, is quite straight forward. By, minimizing the variance of the residuals, for given values of the interest rate, I manage to obtain an "optimal" (most efficient) Taylor rule, in each state. This version of the rule, I call it "optimal" since it produces the most efficient residuals, in every state. Thus, creating a Yardstick, to compare against the estimated versions of the rule, of Section 4.3. The results, are reported in Table 5.

However, before turning to the result, I need to discuss first the restrictions I introduced, in order to receive these "optimal" results. These constrains restrict, all of the coefficients to only take non-negative values, so Schaefer's assumption holds. The constant term, is calculated separately, since it does not come from the minimization process. Next, the sum of the output gap and the inflation coefficients must equal unity. This last restriction, is put in place so that my results are in line with Taylor's (1993) suggestions, regarding the coefficient weight. [9]

Table 5, presents some interesting results concerning ECB's conduct, in different states. By keeping in mind fig.1, which displays the four states of the Economy, one can see how this approach delivers "optimal results", in each State. In states where inflation surpasses the explicit target, ECB pursue almost explicitly its primary objective. Only when the inflation requirement is addressed, only then, ECB shows interest towards accommodating output expansion.

---

[9] $\alpha_\pi = 1 + a_\pi$

Table 5.	The Four Stages of the Economy Non- linear Taylor reaction function for each state.											
	NLP	GMM		NLP	GMM		NLP	GMM		NLP	GMM	
c	-1.675191127	4.456029	5.694998	-1.419526138	-2.763117	-6.983219	-1.3251	-0.631475	1.392085	-1.66609509	-0.068811	-0.215879
		1.606653	0.218576		*1.315841*	1.031164		*0.331382*	0.419736		*0.009851*	0.066544
ρ	0.967845202	0.959137	0.943182	0.760783017	0.954202	0.936963	0.88750941	0.983098	0.984227	0.93852724	0.864938	0.90253
		0.011518	0.000896		*0.005371*	0.008232		*0.007485*	0.003476		*0.008983*	0.021017
α_π	0.787999832	-1.587671	-1.602784	1	1.89174	4.114746	0.5	1.631011	-1.626258***	0.98866248	-0.233512	-1.069723
	$a\pi=(1+\alpha\pi)$	0.779959	0.078326	$a\pi=(1+\alpha\pi)$	0.561765	0.406271	$a\pi=(1+\alpha\pi)$	*0.445418*	1.334773	$a\pi=(1+\alpha\pi)$	*0.025839*	0.307857
α_y	0.212001168	0.983282	1.622103	0	-0.098227***	-1.776896	0.5	0.562827	1.999566	0.01133752	0.14289	0.087542***
		0.299267	0.033363		*0.073884*	0.356316		*0.333715*	0.636969		*0.015559*	0.170337
α_{π_sq}	-	-	0.318097	-	-	-29.50868	-	-	-8.319062	-	-	-1.834696
			0.10607			1.667629			2.201042			0.720709
α_{y_sq}	-	-	-0.143775	-	-	-0.621375	-	-	0.554911	-	-	0.214417
			0.00759			0.160818			0.155442			0.086305
Adjusted R-squared:		0.989012	0.986732		0.981264	0.984176		0.988344	0.987583		0.888405	0.889586
Included observations:		82	52		29	29		67	74		31	30
Prob(J-statistic) :		0.998296	0.999891		0.984246	0.976414		0.973328	0.999539		0.994043	0.979562

Notes: GMM estimates, standard errors in parentheses, for significant differences in aπ and ay the standard Wald- test is used, here corresponding p-values in parentheses,

R2 is the adjusted R2, as a measure of the goodness of fit.

If no asterisk is placed next to a coefficient, this coefficient is significant at least 5% level.

* Insignificance even at the 10% level.

*** Significance at the 10% level.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

By obtaining this Yardstick measure, it allows us to observe the actual fit of our estimated equations. I refer to both the linear specification and the one containing the inflation and output gap volatility term, of the previous section.

This is done in a quite simple way. Since, we already posse the most efficient residual in every state, we compare them with the residual, coming from the estimated equations. Hence, witnessing how close the estimated results are to the Yardstick. Additionally, this approach, has the added benefit of showing us how much the inclusion of the quadratic term improves our model and in which states.

The following figures, provide us with this information[10]:

[10]The graph on top, provides us with comparison of the "optimal" residuals against those from the linear specification. Whereas the bottom graph, contains a comparison between these "optimal" residuals and those from specification which includes the volatility terms.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Fig.3

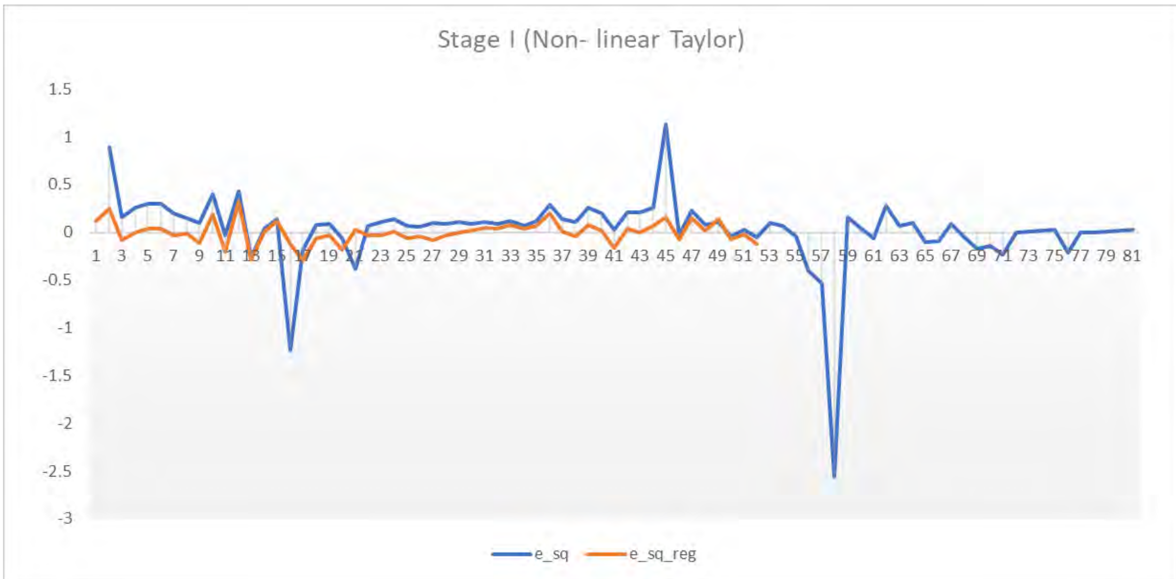


Fig.4

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

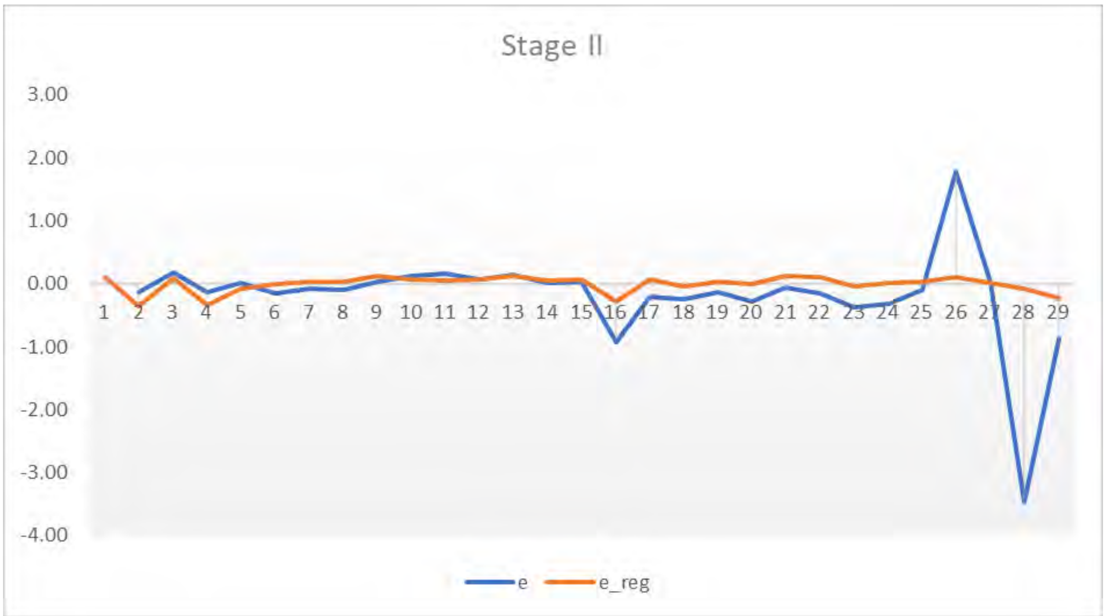


Fig.5

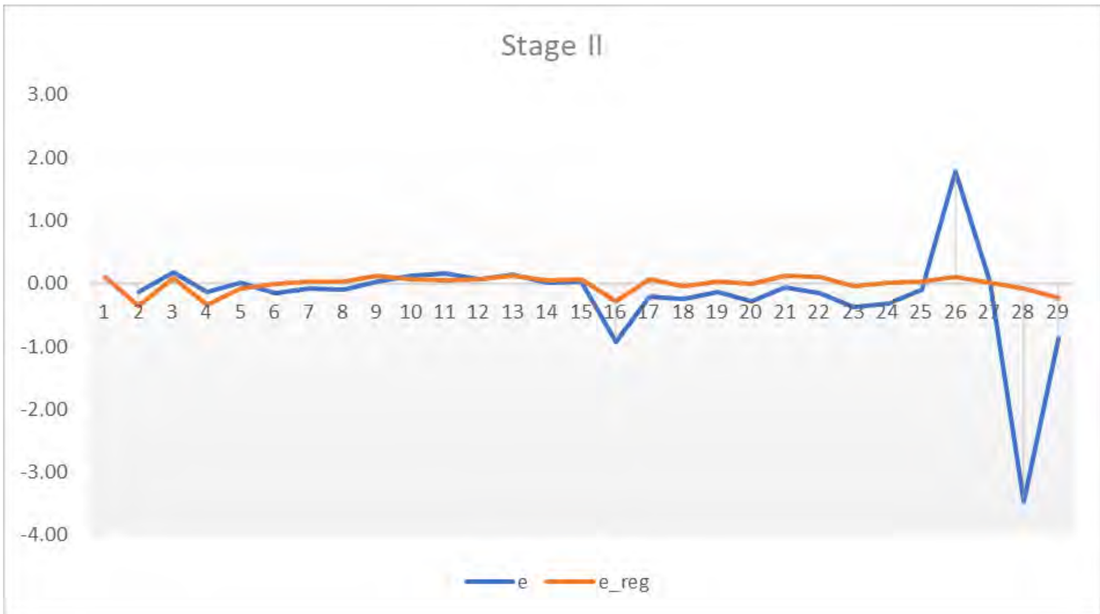


Fig.6

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

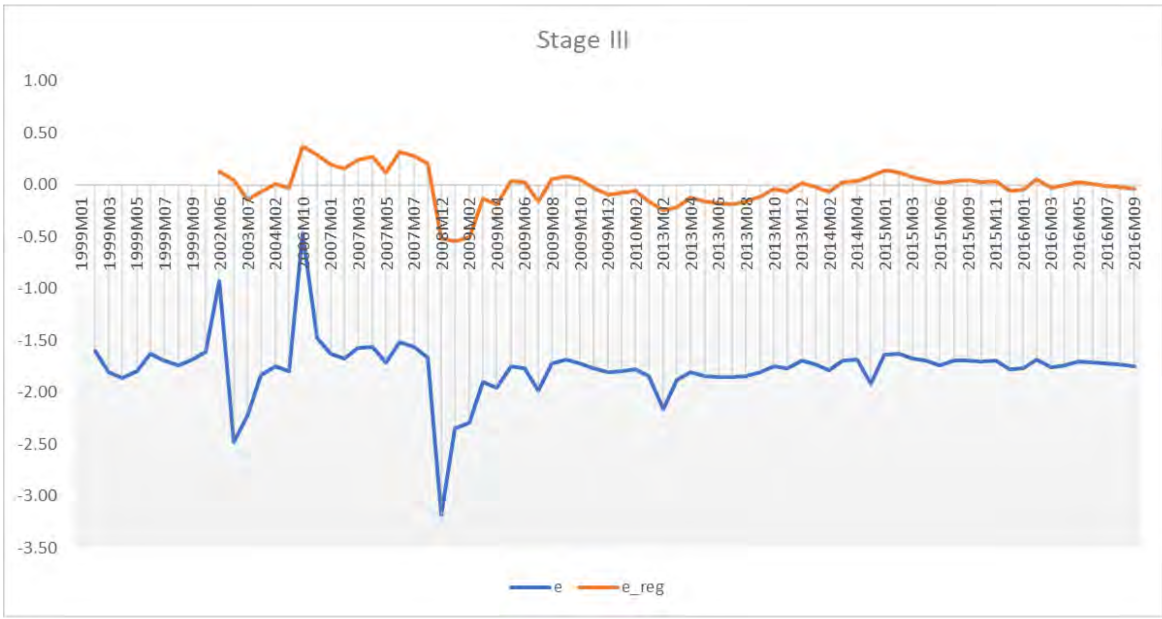


Fig.7

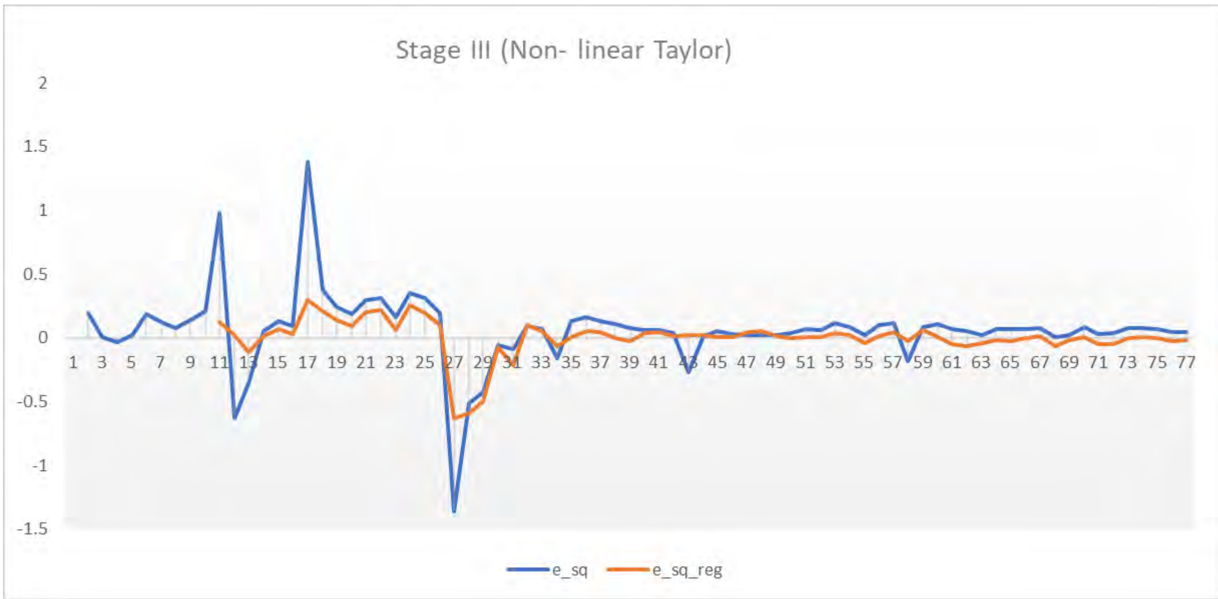


Fig.8

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

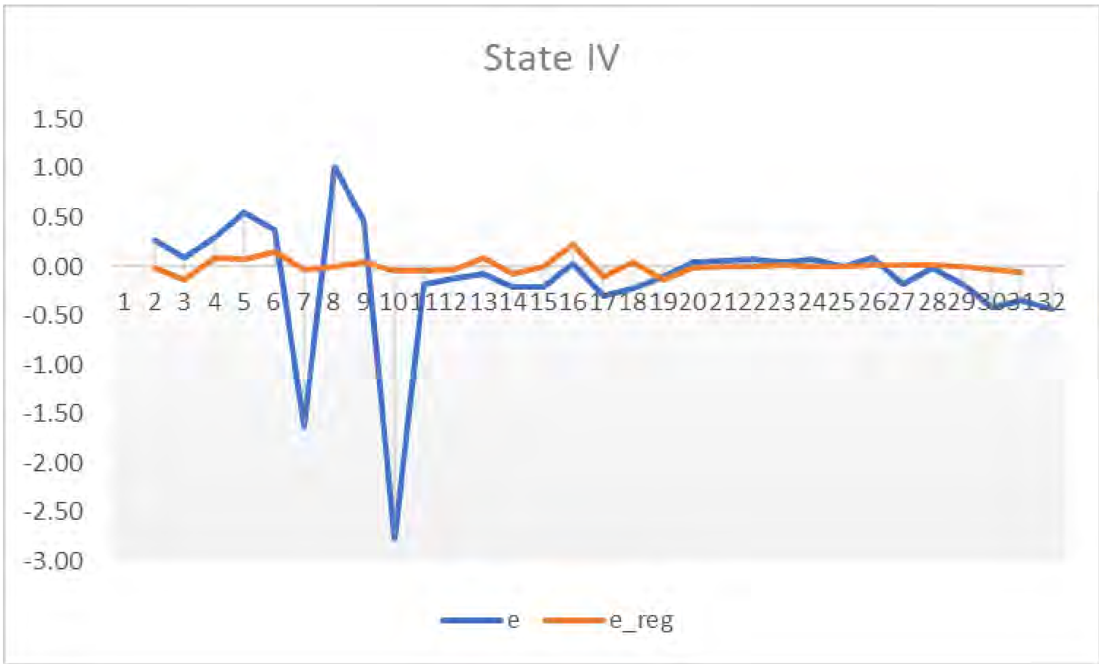


Fig.9

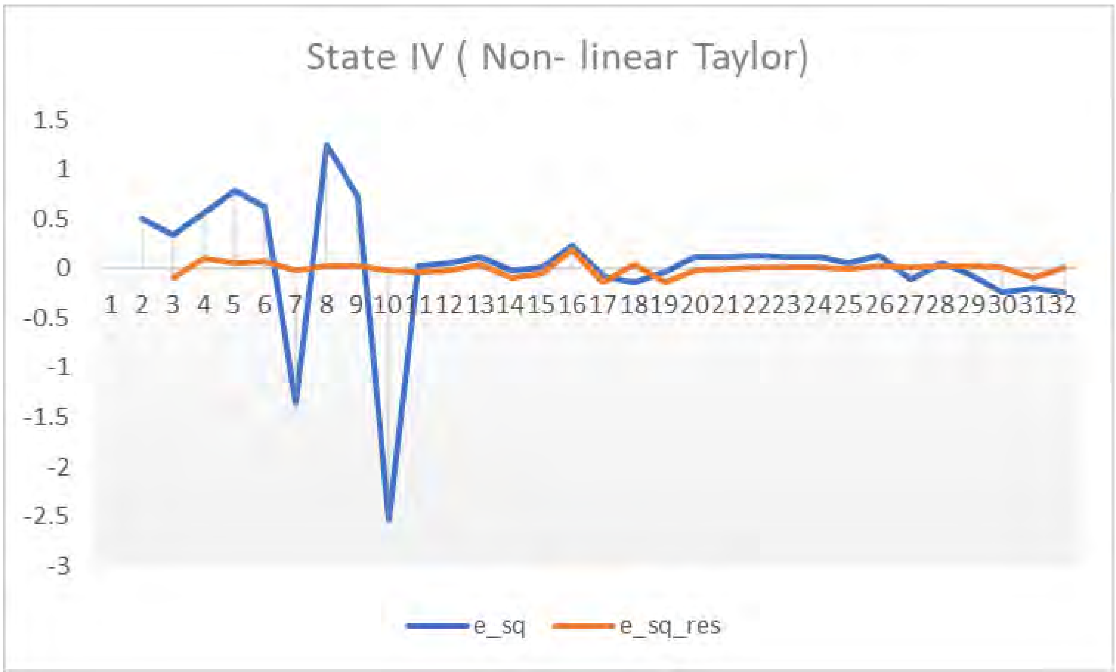


Fig.10

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

With just a glance, we are immediately able to detect that in (nearly) all states, both the linear specification and the one containing the non-linear terms, follow the Yardstick, quite closely. Thus, providing further evidence that, in almost every state, an estimated Taylor rule (for the ECB case) does indeed a very good job describing ECB's behaviour.

At this point, we need to highlight two results. The first being that as expected, the inclusion of the quadratic inflation and output gap terms, always improves the model. Especially, in States III and IV, where ECB finds itself in Crisis period and thus, we are more interested in the volatility rather than the actual size of inflation or the output gap. The other noteworthy result, which again does not surprise us, is the fact that in State III, the linear specification approach, does such a poor job describing ECB's behaviour. However, as stated above, in this state, "unconventional" tools were introduced and thus, Taylor rule loses all its merit, as the nominal interest rate reaches the zero-lower bound.

All in all, we conclude that Taylor rule estimates follow quite closely the Yardstick, thus providing us with very reliable results in (almost) all states. And also, the inclusion of the volatility terms always improves the typical linear specification.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Section 5

5.1 *Conclusions*

In this paper, I have mainly adopted the recently introduced approach of Klose (2011; 2016), who recognised asymmetries in ECB's behaviour via the typical Taylor rule framework. Their method relies on the state of the economy, hence on a mixture of whether inflation and/ or production lie above or below their respective optimum. I should mention, that Klose (2011) did not come up with this approach. This approach, is a merger of Bec et al. (2002) who first invented a comparable method by only taking production deviations into account and that of Bunzel and Enders (2010), who did the same regarding only to inflation deviation.

However, there are also significant differences between my approach and those described above. Although, it is true that in the first step of my approach, I adopt the above mentioned, Klose (2011; 2016) approach. However, following that, I take a different approach, which allows me to additionally identify asymmetries in central bank actions via the typical Taylor reaction functions, but in different manor. This new approach, relies on the governing period instead of the state of the economy.

In other words, it explores how much, each president, dictated ECB's objectives. Or to put it differently, it explores whether the Presidents of the ECB has been blindly following the mandate or whether there is been actual room for discretionary policies. Later, I also introduced a linear-programming component, designed to produce "optimal" Taylor rule weights, in each state, operating as a "state's Yardstick".

Like Klose (2011; 2016), I too chose ECB as a candidate for the estimation of á- la- Taylor function. I followed this approach, since, ECB has announced an explicit inflation objective as opposed to the example of the Fed, thus allowing our analysis to recognise significant differences between regimes.

I witness a more robust response to accommodate output expansion if production is below optimums, in comparison to states where production surpasses potential. In both cases, I always assume inflation to be beneath target. So, when inflation surpasses its optimum, there is no difference in the response to production, regardless of the situation.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Regarding the responses to inflation deviations, I can only observe a significant difference, given that production gap stays positive, meaning that production surpasses its optimums. In this scenario, ECB responds more aggressively to inflation being beneath target compared to a place where inflation lies above.

Now turning to possible non-linearities existing in every regime, I have presented you with evidence that including the quadratic inflation and output gap terms, always improve the model. This improvement, is more significant in States III and IV, where ECB finds itself in a "Crisis" situation. Thus, showing that ECB responds more robustly to larger inflation deviations only at times when inflation is beneath the explicit objective. This provides us with further evidence regarding EBC's "comfort zone", which is given for slight negative deviations of inflation from the explicit objective (of less but close to two percent).

As for the production response, I have shown it depends significantly on the state of the economy, that ECB finds itself in.

In scenarios with a strong reference for the ECB, meaning states I and III, hence production and inflation are both either above or beneath target, ECB's response is more robust for slighter deviations, whereas in regimes with assorted indications, given by either production or inflation, the opposite holds true.

As a final remark, I wish to quote a phrase from Beckmann et.al (2017), "It should be noted, that the Taylor rule acts as a rule of thumb and leaves out many factors that might be actually relevant for monetary policy.".

The reason I chose to quote this phrase, is to highlight the fact that Taylor- like specifications are but a piece of the puzzle. If one wishes, to design a model that describes ECB's whole decision- making process, much more complicated models are need, and they go far beyond the scope of this dissertation.

Eq. (1)- Eq. (11) are borrowed from Klose (2011), Since in the first part of my analysis, I estimate the same model, only for a different sample and a different data set.

Section 6

6.1 *Bibliography*

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