International Review of Financial Analysis 25 (2012) 94–105

Contents lists available at SciVerse ScienceDirect

International Review of Financial Analysis

Lessons from the Bank of England on 'quantitative easing' and other 'unconventional' monetary policies ☆

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ARTICLE INFO

Available online 21 August 2012

JEL classification:
E41
E52
E58

Keywords:
Central banking
Credit creation
General-to-specific methodology
Intermediate targets
Monetary policy
Operating tools
Qualitative easing
Quantitative easing
QE
Zero bound

ABSTRACT

This paper investigates the effectiveness of the 'quantitative easing' policy, as officially implemented by the Bank of England since March 2009. A policy of the same name had previously been implemented in Japan, which serves as a reference. While the majority of the previous literature has measured the effectiveness of QE by its impact on interest rates, in this paper the effectiveness of all Bank of England policies, including QE, is measured by their impact on the declared goal of the QE policy, namely nominal GDP growth. Further, unlike other works on policy evaluation, in this paper we use the general-to-specific econometric modelling methodology (a.k.a. the 'Hendry' or 'LSE' methodology) in order to determine the relative importance of Bank of England policies, including QE. The empirical analysis indicates that QE as defined and announced in March 2009 had no apparent effect on the UK economy. Meanwhile, it is found that a policy of 'quantitative easing' as defined in the original sense of the term (Werner, 1995c) is supported by empirical evidence: a stable relationship between a lending aggregate (disaggregated M4 lending, singling out bank credit for GDP transactions) and nominal GDP is found. The findings imply that the central bank should more directly target the growth of bank credit for GDP-transactions, which was still contracting in late 2011. A number of measures exist to boost it, but they have hitherto not been taken.

1. Introduction

Quantitative monetary targets were the mainstay of monetary policy in the early 1980s. Later that decade, however, most central banks abandoned this approach, since it was considered to have failed. As Werner (2012) argues, this failure was largely due to the perceived instability of velocity and the money demand function in many countries since the 1980s. Since then central banks have emphasised interest rate policies in their official statements, and central bank watching has come to focus on interest rate decisions and how actions of central banks might affect interest rates, in line with the 'new monetary policy consensus', as proposed, among others, by Woodford (2003).

The interest rate-centred approach to monetary policy implementation became predominant despite a conspicuous absence of empirical evidence that interest rates are negatively correlated with economic growth in a consistent and robust manner, and that statistical causation runs from interest rates to the economy. Over the prior three decades it had gradually become an increasingly open secret that in empirical studies interest rates often did not 'behave well'.[1]

☆ The authors would like to thank many colleagues who have commented on parts of this paper, as well as the participants of the ECOBATE 2011 conference in Winchester Guildhall, and finally Kostas Voutsinas for his excellent contributions. Werner is the corresponding author, who would like to acknowledge the source of all wisdom (Jeremiah, 33:3).

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http://dx.doi.org/10.1016/j.irfa.2012.08.001

[1] See Werner (2005), as well as Werner and Zhu (2011), and the empirical studies citied therein. The latter present a new empirical analysis of the relationship between interest rates and growth in four major economies (US, UK, Germany and Japan) and found the evidence not supportive of standard theoretical suppositions. See also the citations in Werner (2012), some of which are reproduced here for convenience: "King and Levine (1993) did not find evidence to support the hypothesised relationship between real interest rate and economic growth in a cross-section of countries. Taylor (1999) found that the link between real interest rates and macroeconomic aggregates such as consumption and investment is tenuous." " Kuttner and Mosser (2002) pointed out the positive correlation between GDP growth and interest rates in the US between 1950 and 2000. Dotsey, Lantz, and Scholl (2003) examined the behaviour of real interest rates. Their results disclosed that the real interest rate series is contemporaneously positively correlated with lagged cyclical output. Other studies finding a positive correlation between interest rates and growth include Gelb (1989) and Polak (1989). This positive relationship between interest rates and growth is also acknowledged in a leading textbook in advanced macroeconomics (Sorensen & Whitta-Jacobsen, 2010)".

The interest rate-based monetary consensus encountered a further major empirical challenge when more than a dozen interest rate reductions over a decade failed to stimulate the Japanese economy in the 1990s. The Bank of Japan had previously been one of the major supporters of the interest-based approach, arguing that due to their preference for interest rate smoothing they could not also control the money supply. This approach was unceremoniously abandoned on 19 March 2001, as the Bank of Japan reverted to a regime of targeting quantitative monetary aggregates, namely bank reserves, while using open market operations to achieve it. Despite signifying a return to standard monetary targeting of the type that had been abandoned in the 1980s (in fact the oldest form, namely 'narrow money' targeting), the policy was, from 2002 onwards, presented as 'new', primarily by choosing a relatively new expression to describe it — 'quantitative easing' (QE) (see Voutsinas & Werner, 2010). In March 2009, the Bank of England followed suit and announced the introduction of 'quantitative easing', in circumstances that resembled the Japanese ones in a number of ways. The Federal Reserve also adopted a variety of new measures, many of which also centred on monetary operations defined by the quantity of injected funds, rather than their price — although avoiding the expression 'quantitative easing' in official statements.[2]

While the interest rate consensus view of monetary policy seemed to survive the Japanese challenge – Japan sometimes being dismissed as an outlier – the North Atlantic banking crisis and monetary policy responses by the Federal Reserve and Bank of England exposed its flaws.

This dramatic shift in monetary policy regimes from prices to quantities calls for a thorough evaluation of the effectiveness of recent measures. Surprisingly, studies of their effectiveness have however focused on analysing their impact on interest rates.[3] This seems counterintuitive, since they had been adopted precisely because the interest rate based approach had been abandoned by central banks, and despite the fact that researchers failed to provide any evidence that interest rates are in a stable relationship with a final target variable such as nominal GDP. If nothing else, this underlines the extent of the prior dominance of the interest rate based approach. It would seem that the prior preoccupation with interest rates has left an indelible mark in the minds of economists, many of whom take it for granted that it is sufficient to evaluate whether a policy tool affects interest rates.

This focus on analysing the effect of QE (or similar policies) by their impact on interest rates has left researchers and policy-makers with little information about the effectiveness of such policy in influencing the macroeconomic variables that matter most to governments, central banks and the public at large. Voutsinas and Werner (2010) suggested therefore to examine the effectiveness of monetary policy in a nested general model of an ultimate goal that most stakeholders could agree with: nominal GDP growth. They employ this for an analysis of the accountability of the Japanese central bank, utilising the general-to-specific econometric modelling methodology (a.k.a. the 'Hendry' or 'LSE' method, following Hendry & Mizon, 1978). The final policy target of nominal GDP growth is regressed on a large number of explanatory variables, potential and actual tools and intermediate targets that were actually or could have been deployed by the central bank. With this approach, the effectiveness of actual and potential tools or intermediate targets can be empirically evaluated, including the significance of new policy regimes. They find no evidence that the reserve expansion policy had been effective.

Another innovation is their use of disaggregated credit as one of the explanatory variables, on the basis that credit for GDP transactions is more likely to be in a stable relationship with nominal GDP, while credit for non-GDP transactions is associated with asset price movements (Werner, 1992, 1997c, 2005). This approach solves the problem of the 'velocity decline' that had confounded earlier attempts at identifying stable empirical models of nominal GDP.

In the present paper the Voutsinas–Werner methodology is employed for the first time to assess the effectiveness of the policy announced by the Bank of England in March 2009, which is also referred to as 'quantitative easing' (QE). The choice of nominal GDP growth as policy goal is particularly uncontroversial in the UK case, because the Bank of England has stated explicitly that the ultimate target of its policy is indeed nominal GDP growth. The Bank of England staff (Joyce, Lasaosa, Stevens, & Tong, 2010) stated that the policy of QE was adopted

> "with the aim of … increasing nominal spending growth" (p. 1),

while

> "…the effectiveness of the MPC's asset purchases [QE] will ultimately be judged by their impact on the wider macroeconomy" (p. 5).

So far few empirical studies have been conducted on the UK case, and none adopting this methodology. According to Joyce et al. (2010)

> "Our analysis suggests that the [asset] purchases [of the central bank] have had a significant impact on financial markets and particularly gilt yields, but there is clearly more to learn about the transmission of those effects to the wider economy" (p. 4).

It is the goal of this paper to investigate the transmission of monetary policy and the effect of particular tools and intermediate targets (actual and potential) "on the wider economy", as measured by nominal GDP.

We find that there is no empirical evidence that bank reserves, bond purchases, or even the maturity structure of central bank bond holdings – the key characteristics of the Bank of England's QE – have the predicted impact on nominal GDP. No evidence is found that the relationship between nominal GDP and its determinants changed in any way in March 2009. As a result, we conclude that we cannot demonstrate empirically that the new policy announced in March 2009 made any impact. Furthermore, the results suggest that the Bank of England would be well advised to give up targeting reserves and using bond purchases as its main policy tool, and instead adopt a policy of 'quantitative easing' defined in the original sense of the term as proposed in Japan in 1994 by one of the co-authors (Werner, 1995c, see below): Such a policy aims at expanding credit creation used for GDP transactions, and indeed a stable empirical relationship between a lending aggregate (disaggregated M4 lending for GDP transactions) and nominal GDP is found.

The findings imply that BoE policy should more directly target the growth of bank credit for GDP-transactions, as suggested in Werner (1992, 1994a,b,c, 1995a,c, 1997b,c, 2005) for post banking-crisis situations. In fact, despite the BoE's efforts, bank credit growth contracted by record amounts in late 2011, as a result of which the UK economy turned into a double-dip recession in the first half of 2012 — as was predicted by our model.

The paper is organised as follows: In Section 2, the historical origin of the term 'quantitative easing' is briefly discussed, followed by an overview of the Bank of England's monetary policy and use of this term. Section 4 reviews the literature on the effectiveness of QE. Section 5 implements a new test of the effectiveness of QE in the UK. Section 6 concludes.

[2] While the popular press and many observers have simply proceeded to refer to the Federal Reserve policies as 'quantitative easing', in official statements the Fed has conspicuously avoided this expression. The reason is probably the reluctance of the Chairman of the Board of Governors to adopt it, which Ben Bernanke explained in his LSE Lecture on 15 January 2009 (Bernanke, 2009). This further supports the interpretation of this policy that is advanced in this paper.

[3] See the papers mentioned below or the Bank of England's (2011) call for papers to its research conference on the 'effectiveness of quantitative easing' in November 2011, which focused on the potential impact of QE on interest rates, the term structure of interest or the yield curve, as witnessed by the selection of data prepared for potential participants by the Bank of England. Papers of the conference are due to be published in a feature in the *Economic Journal*. This paper was submitted for the conference, but rejected by the conference organisers, supporting the hypothesis that the Bank of England was mainly seeking studies on the impact of QE on interest rates.

2. Historical origin of the term 'quantitative easing'

Today, QE is often used synonymously with an expansion in the quantity of narrow money (such as bank reserves or high powered money/M0), which is figuratively referred to as 'printing money' by media commentators. The original Japanese expression for "quantitative easing" (量的緩和, *ryōteki kanwa*) is an abbreviation of the expression "quantitative monetary easing" (量的金融緩和, *ryōteki kin'yū kanwa*). Both expressions are used interchangeably in Japanese. They were used for the first time as a description of its policy by a central bank in the Bank of Japan's Japanese-language publications. The English translation 'quantitative easing', which is a very literal translation of the Japanese expression, was also produced by translators employed by the Bank of Japan and so first appeared in its English-language publications.

In its announcement of 19 March 2001 – universally cited by commentators as the first time a policy called QE was implemented by a central bank – the Bank of Japan announced a high target of bank reserves held with the central bank, which would (at least partly) be achieved by purchasing more government bonds (Bank of Japan, 2001b). Such a policy is identical with traditional monetarist targeting of "narrow money" and can thus variously be called an expansion of bank reserves or high powered money, monetary base, base money, M0 or narrow money.

Since already half a dozen well-known such expressions existed to describe the Bank of Japan's traditional monetarist policy adopted in 2001, it is not immediately obvious why a new, synonymous expression, especially one that had previously been defined differently, as will be seen, needed to be utilised — and with such fanfare. The plot thickens when the policy announcement of 19 March 2001 (Bank of Japan, 2001b) is actually perused, since the expression "quantitative easing" or its variants are nowhere to be found in the Japanese original statement or its official English translation, as was pointed out by Voutsinas and Werner (2010). It is only in a speech given on 9 December 2002, almost two years later, that the Bank of Japan governor stated for the first time that the central bank was indeed implementing 'quantitative easing'. During 2001, only 11 speeches out of the 29 given by the Bank of Japan board members made any mention of the term 'quantitative easing' at all, and none of them claims that the policy was being implemented by the Bank of Japan. June 2003 seems to mark a turning point in the usage of this expression by the Japanese central bank, as central bank governor Toshihiko Fukui (newly appointed in February 2003) stated that "The current framework [which the BoJ is] adopting is called quantitative easing and was introduced on March 19, 2001". In his speech, Mr Fukui uses the expression 'quantitative easing' 26 times, hitherto the highest use on record by a senior central banker. The expression 'quantitative easing' was thus only officially used to describe the policy action of March 2001 retrospectively.

This is not to say that Japanese central bank staff had not frequently used the expression 'quantitative easing' in earlier publications in previous years. In fact, they used it often, and consistently, in order to argue that a policy by such a name would not work and hence should not be introduced. The central bank staff published official reports as late as February 2001 – one month before the claimed date of introduction of QE by the Bank of Japan – explaining that a policy of "quantitative easing… is not effective" (Bank of Japan, 2001a).

The reason for the central bank's long-standing negative stance towards a policy by such a name is likely connected to the fact that it had originally been deployed by a critical voice outside the central bank. The first time the expression QE was used prominently in the context of a needed change in monetary policy was in 1994, by the then chief economist of Jardine Fleming Securities (Asia) Ltd. in his numerous client presentations and speeches in Tokyo. He used a macroeconomic model not reliant on frictionless markets and general equilibrium but assuming rationing and credit constraints and incorporating a credit-creating banking sector. In his previous publications (Werner, 1991, 1992, 1994a), Werner had warned of the likely collapse of the Japanese banking system and a major economic slump. In the following years, Werner made recommendations about how the Japanese economy could be stimulated and the recession ended (e.g. Werner, 1995b, 1997a,b,c). Based on the model of Werner (1992), published in English in Werner (1997c), Werner (1994a, 1995c) argued that neither interest rate reductions (even though they were still above 4% at the time) nor fiscal stimulation, implemented via bond issuance, would trigger a recovery. Moreover, Werner (1994a, 1997c) had argued that traditional monetarist bank reserve or money supply expansion would also not create an economic recovery.

Werner's (1994a, 1995c) central argument was that a necessary and sufficient condition for an economic recovery was a policy that would boost the *quantity of credit creation*, which was Werner's original definition of QE, and which he argued could be achieved through a variety of measures. In these and other publications (see Werner, 2005, for numerous references of the relevant publications), Werner suggested

- direct purchases of non-performing assets from the banks by the central bank;
- direct lending to companies and the government by the central bank; purchases of debt and equity instruments by the central bank from the non-bank private sector;
- to stop the issuance of government bonds and instead fund the public sector borrowing requirement directly from banks through standard loan contracts (specifically on this proposal, see Werner, 1998a, 2000).
- Werner (1994a, 1997b, 1998b, 2001, 2003, 2005) also suggested that the central bank directly targets and increases the quantity of credit creation by the overall banking system (including the central bank), which could be facilitated by relaxing capital adequacy requirements for banks, wholesale purchases of nonperforming assets from the banks at face value by the central bank, and central bank loan guarantees, indemnifying the risk-averse banks.

Werner (1995c) had proposed a title for this contribution to the Nikkei (*Nihon Keizai Shinbun*) – the world's most widely read financial newspaper – stating that an economic recovery required an increase in the '*quantity of credit creation*' by the overall banking system (defined in the article as banks plus central bank). However, editors advised that the Japanese expression for 'credit creation' was likely to appear obscure to Nikkei readers and thus unsuitable in the title headline of the article. Thus Werner chose a new expression that would convey a sense of its meaning, while immediately differentiating the policy both from interest rate policy and traditional monetary targeting as recommended by monetarist economists. He combined the standard Japanese-language expression for expansionary monetary policy (*kin'yū kanwa*, 'monetary easing') with the Japanese expression for 'quantitative' (*ryōteki*). The result was 'quantitative monetary easing' or, in short, 'quantitative easing' (both of which expressions are used synonymously).

Why the Bank of Japan much later chose to use this expression to refer to its traditional monetarist base money expansion (for which already a plethora of epithets existed) is puzzling. In his publications around the time, Werner had already explained that standard policies of reducing interest rates, expanding narrow money (bank reserves, M0) or broad money supply (M1, M2) would be ineffective, due to the problems in the banking sector.[4]

The Bank of Japan had introduced a new name to describe an old policy (of bank reserve targeting). That old policy had been flagged up as ineffective beforehand — by the proponents of a truly different policy called "quantitative easing" – and it was ineffective. Japan's central bank had been unsuccessful in achieving price stability or stable economic

[4] Werner (1994a, 1996, 1997b, 1997c). Federal Reserve governor Ben Bernanke, who was an active participant in the debates around the Bank of Japan policy in the 1990s, chose to distinguish his own policies at the Fed in 2008 from others by calling them "credit easing", an expression much closer to Werner's original definition of QE. Bernanke (2009) seems to agree that a policy of "changing the quantity of bank reserves [uses] a channel which seems relatively weak, at least in the U.S. context".

Table 1
Variables in the empirical model.

Policy instrument or intermediary target	Relevant variable in the UK	Abbreviation in econometric model
Interest rates	Bank Rate	Bankrate
Bank reserves	Reserves	Res
Asset purchases	BoE B/S	BoETA
'Qualitative easing'/ balance sheet composition	Ratio of long-term assets of central bank B/S	QualEasing
Money supply	M4 (holdings of the entire economy)	M4
Bank credit (M4 lending) to the 'real economy'	M4 lending to all sectors except the financial one (non-financial corporations, individuals, unincorporated businesses and non-profit institutions serving households)[a]	M4LRE

[a] See Appendix 1 for further explanations.

Table 2
The general model.
EQ (1) Modelling nGDP by OLS.
The estimation sample is: 1995 (2) to 2010 (4).

$$YoYGDPt = \alpha_j + \Sigma\beta_j YoYGDP_{t-j-1} + \Sigma\gamma_j YoYM4LRE_{t-j} + \Sigma\phi_j YoYM4_{t-j} + \Sigma\omega_j BankRate_{t-j} + \Sigma\rho_j YoYBoETA_{t-j} + \Sigma\tau_j YoYRes_{t-j} + \Sigma\varphi_j QualEasing_{t-j} + \varepsilon_\tau$$

Sigma	0.0090	RSS	0.0023
R^2	0.9403	F(34,28) =	12.98 [0.000]**
Log-likelihood	232.827	DW	2.33
No. of observations	63	No. of parameters	35
Mean (YoYnGDP)	0.0476	Var (YoYnGDP)	0.0006
AR 1–4 test:			F(4,24) = 2.0656 [0.1170]
ARCH 1–4 test:			F(4,20) = 0.4229 [0.7902]
Normality test:			$Chi^2(2)$ = 2.5366 [0.2813]
RESET test:			F(1,27) = 0.2024 [0.6564]

** Indicates significance at the 1% significance level.

growth (Japan holds the world record for deflation in the era of regular GNP or GDP statistics as Japan's post-crisis economic underperformance is entering the third decade). Bizarrely, even while it was implementing its policy of reserve expansion, the Bank of Japan argued that this policy was not going to be effective - thereby agreeing with the proponent of a policy to expand credit creation that he originally called 'quantitative easing'. When the Japanese government called upon the Bank of Japan in November 2009 to resume its policy of quantitative easing, the Bank of Japan governor Shirakawa declined, arguing that such a policy was not effective.[5] The question why the Bank of Japan chose to implement a policy it correctly believed would fail, and why it chose to use the name of a different policy that, as will be shown, remains the most promising avenue to help the economy, still awaits a comprehensive answer.

Voutsinas and Werner (2010) established that its so-called policy of QE made no difference empirically. Their paper discusses an interpretation of these events that takes the political economy of central banking into consideration – the central bankers' potential desire to evade accountability, and to play "policy games" – a concept familiar in the economics literature (see, for instance, Barro & Gordon, 1983; Kydland & Prescott, 1977; for further details on the Bank of Japan's policy games, see Werner, 2003).

3. The implementation of QE by the Bank of England

As part of its response to the recent North Atlantic banking crisis and to a sharp downturn in domestic economic prospects, the Bank of England's Monetary Policy Committee (MPC) cut Bank Rate by a factor of ten, from 5% at the start of October 2008 to 0.5% on 5 March 2009. But the Committee also decided that it needed to ease monetary conditions further through a programme of asset purchases financed by the issuance of central bank reserves (BoE, 2010). This programme was termed 'quantitative easing', in reference to prior Bank of Japan policies labelled by this name.

Although the BoE claimed that QE was first implemented in March 2009, measures had been undertaken earlier that are not dissimilar. The Special Liquidity Scheme was introduced in April 2008, allowing banks and building societies to swap some of their illiquid assets (notably asset-backed securities) for liquid UK Treasury bills for a period of up to three years. As these trades are lending transactions they remain off-balance sheet. The drawdown period for the scheme closed on 30 January 2009. Furthermore, from January 2009, under a remit from the Chancellor of the Exchequer, the Bank established a subsidiary company, the Bank of England Asset Purchase Facility Fund (BEAPFF). Its initial objective was to improve the liquidity of the corporate credit market by making purchases of high-quality private sector assets. In March 2009, the remit of the BoE was extended by the Chancellor to allow purchases of assets (now including gilt-edged securities) in pursuit of its monetary policy aims via the BEAPFF. Unlike the BoJ, and in line with Werner (1995c), the BoE sought to purchase assets from the non-bank private sector. At its March 2009 meeting the MPC decided that the Bank would buy £75 billion of assets financed through the creation of central bank reserves. This policy was referred to as 'quantitative easing', and it was combined with a change in the system of reserve averaging, which was suspended, while banks' reserve accounts with the Bank of England now earned Bank Rate.

Additional asset purchases were decided by the MPC in May 2009 (£50 billion), August 2009 (£50 billion) and November 2009 (£25 billion), raising the total to £200 billion. The asset purchases resumed in October 2010 (£75 billion), in February 2012 (£50 billion) and in July 2012 (£50 billion), amounting to £375 billion to date. With this money the Bank of England bought not only predominantly UK government securities (gilts), but also private sector assets (BoE, 2009).

In addition to the asset purchase programme, the Bank of England increased the average maturity of its outstanding operations — dubbed 'operation twist' when implemented by the US Federal Reserve. The range of collateral eligible for longer-term repo operations was widened.

Apart from the asset swap scheme, most of the measures taken by the Bank of England in response to the financial crisis used instruments or procedures that already existed in the operational framework of the bank (Lenza, Pill, & Reichlin, 2010). Similar to the experience in Japan, this raises the question of just what was new about the BoE's policies labelled "QE". This calls for a careful empirical examination to determine whether a change in monetary policy did in fact occur in 2009.

4. Recent literature on QE

Voutsinas and Werner (2010) suggest that the performance of central banks can be measured in two ways: either 'process-based performance' (which they term 'input performance') or by achieving relevant final economic outcomes ('result performance', 'outcome performance', what they call 'output performance'). Accordingly, the literature on central bank performance can be divided into two groups.

The literature on 'output performance' focuses on whether a final target variable, such as price stability or growth performance (and sometimes also currency stability) has been achieved (Alesina & Summers, 1993, Bade & Parkin, 1980, Cukierman, Neyapti, & Webb, 1992, Emerson, Gros, Italianer, Pisani-Ferry, & Reichenbach, 1991, Hasan & Master, 2008). While this is in many ways the natural way to approach central bank performance measurement, it remains

[5] See, for instance, Financial Times, Lex column, 'Bank of Japan', 1 December 2009.

Table 3
Parsimonious model A.
EQ (2) modelling YoYnGDP by OLS.
The estimation sample is: 1995 (2) to 2010 (4).

	Coefficient	Std error	t-Value	t-Prob	Part. R^2
YoYnGDP_1	0.3870	0.0810	4.78	0.000	0.2934
YoYnGDP_4	−0.3528	0.0789	−4.47	0.000	0.2665
Constant	−0.0131	0.0045	−2.92	0.005	0.1343
YoYM4LRE	0.1805	0.0531	3.40	0.001	0.1733
YoYM4LRE_1	0.2144	0.0674	3.18	0.002	0.1556
BankRate	0.0071	0.0012	6.08	0.000	0.4021
YoYBoETA_4	−0.0143	0.0028	−5.19	0.000	0.3286
QualEasing_1	−0.0090	0.0030	−2.97	0.004	0.1386

Sigma	0.0081	RSS	0.0036
R^2	0.9050	F(7,55) =	74.83 [0.000]**
Log-likelihood	218.167	DW	2.02
No. of observations	63	No. of parameters	8
Mean (YoYnGDP)	0.0476	Var (YoYnGDP)	0.0006

AR 1–4 test:	F(4,51) = 0.6505 [0.6292]	Hetero test:	F(14,40) = 0.6319 [0.8222]
ARCH 1–4 test:	F(4,47) = 0.4463 [0.7745]	Hetero-X test:	F(35,19) = 0.7057 [0.8185]
Normality test:	Chi^2(2) = 0.3478 [0.8404]	RESET test:	F(1,54) = 2.1717 [0.1464]

Solved static long run equation for YoYnGDP

	Coefficient	Std error	t-Value	t-Prob
Constant	−0.0135	0.0049	−2.74	0.008
YoYM4LRE	0.4090	0.0691	5.92	0.000
BankRate	0.0073	0.0007	11.30	0.000
YoYBoETA	−0.0148	0.0026	−5.68	0.000
QualEasing	−0.0094	0.0031	−3.06	0.003

Long-run sigma = 0.0084
ECM = YoYnGDP + 0.0135 − 0.4090*YoYM4LRE
−0.0073*BankRate + 0.0148*YoYBoETA + 0.0094*QualEasing;
WALD test: Chi^2(4) = 304.295 [0.0000]**

Analysis of lag structure, coefficients:

	Lag 0	Lag 1	Lag 2	Lag 3	Lag 4	Sum	SE (Sum)
YoYnGDP	−1	0.387	0	0	−0.353	−0.966	0.111
Constant	−0.0131	0	0	0	0	−0.0131	0.0045
M4LRE	0.18	0.214	0	0	0	0.395	0.0575
BankRate	0.0071	0	0	0	0	0.0071	0.0012
YoYBoETA	0	0	0	0	−0.0143	−0.0143	0.0028
QualEasing	0	−0.0090	0	0	0	−0.0090	0.0030

Tests on the significance of each variable

Variable	F-test	Value [Prob]	Unit-root *t*-test
YoYnGDP	F(2,55) =	20.535 [0.0000]**	−8.7328**
Constant	F(1,55) =	8.5358 [0.0050]**	
M4LRE	F(2,55) =	24.972 [0.0000]**	6.8683
BankRate	F(1,55) =	36.984 [0.0000]**	6.0815
YoYBoETA	F(1,55) =	26.919 [0.0000]**	−5.1884
QualEasing	F(1,55) =	8.8468 [0.0044]**	−2.9744

Tests on the significance of each lag.	Tests on the significance of all lags up to 4.
Lag 1 F(3,55) = 32.002 [0.0000]**.	Lag 1–4 F(5,55) = 29.945 [0.0000]**.
Lag 4 F(2,55) = 18.738 [0.0000]**.	Lag 2–4 F(2,55) = 18.738 [0.0000]**.
	Lag 3–4 F(2,55) = 18.738 [0.0000]**.
	Lag 4–4 F(2,55) = 18.738 [0.0000]**.

agnostic about the details of the monetary transmission mechanism and fails to engage in any debate concerning the suitability of particular monetary policy instruments, intermediate targets or approaches, as it leaves 'input performance' up to the central bank.

Meanwhile, a new literature on 'input performance' has sprung up that focuses on the effectiveness of specific monetary policy instruments, tools or intermediate targets under conditions of extremely low interest rates. In principle, this is a welcome development. However, researchers have gone to the other extreme and ignored 'output performance' measurements in their analyses. Thus the literature analysing the effectiveness of monetary policy under conditions of very low interest rates and/or QE (the 'zero bound' literature), has defined the 'effectiveness' of such monetary policy not in terms of a final economic outcome, such as a sustainable economic recovery with steady nominal GDP growth of 2.5% or so. Instead, the criterion for performance measurement is process-based 'input performance'; namely, whether such policy has an impact on interest rates — another intermediate target, and one with a tenuous link to final policy goals. As noted, no empirical evidence is presented that interest rates are in a stable relationship with or a reliable proxy for any relevant output performance goal.

Most authors of existing research evaluating QE propose a theoretical general equilibrium model with rational expectations, including Krugman (1998), Fujiki, Kunio, and Shinegori (2001), Woodford (2003), Svensson (2003), Eggertsson and Woodford (2003) and Benhabib, Schmitt-Grohé, and Uribe (2003). This literature tends to share the assumptions of complete and efficient financial markets, whereby agents face no constraints on their ability to borrow against future income. Instead of featuring a mechanistic monetary transmission mechanism, the models rely on the role of (unobservable) expectations and their impact on interest rates, which are assumed to be the main component of monetary transmission.

The assumptions stated above led researchers to define the 'effectiveness' of QE by its impact on interest rates (whether only short-term rates, as for instance in Krugman, 1998, or "the entire expected future path of short-term real rates, or very long term real rates" in Eggertsson & Woodford, 2003). In Eggertsson and Woodford (2003), the only way to stimulate the economy is through a change in the general equilibrium level of interest so that "'quantitative easing' that implies no change in interest-rate policy should neither stimulate real activity nor halt deflation; and this is equally true regardless of the kind of assets purchased by the central bank". Lenza et al. (2010) argue that both quantitative easing and other "non-standard" (i.e. non-interest) measures introduced by the central banks that changed the composition of the asset side of their balance sheets (so-called 'qualitative easing') acted mainly "through their effects on interest rates and, in particular, on money market spreads, rather than solely through 'quantity effects' in terms of the money supply". They estimate that the effect of compressing spreads has acted on the real economy with a delay and that "these effects are very much in line with what has been found for the transmission of a standard monetary policy shock in normal times". This is also the finding of Ugai (2006), who reported "the largest effect of QE [was] found in form of its impact on expected future short-term interest rates". Fujiki et al. (2001), of the BoJ, denied the effectiveness of QE in February 2001, because of the zero interest rate lower bound, although QE was reported (retrospectively) to have been introduced by their employer one month later. BoJ staff Kimura, Kobayashi, Muranaga, and Ugai (2002) and Shirakawa (2002) also measure the effectiveness of the Bank of Japan's new measures by the impact it had on interest rates and conclude that one year after its introduction this policy was not effective.

Kobayashi, Spiegel, and Yamori (2006) find that "quantitative easing succeeded in reducing longer-term rates, and excess returns were larger among firms with weaker main banks". In their 2007 paper, Oda and Ueda share this more positive assessment: they infer that the zero interest rate commitment has been effective in "lowering the expectations component of interest rates, especially with short- to medium-term maturities".

In conclusion, the literature on quantitative easing and unorthodox monetary policy (at the 'zero interest rate bound') has largely confined itself to an analysis of the impact of such policies on another intermediate target, namely interest rates.

Voutsinas and Werner (2010) began the task of filling the gap in the literature by conducting empirical work on the effectiveness of Japanese monetary policy tools and instruments (i.e. input performance; engaging with details of the transmission mechanism) that relates performance

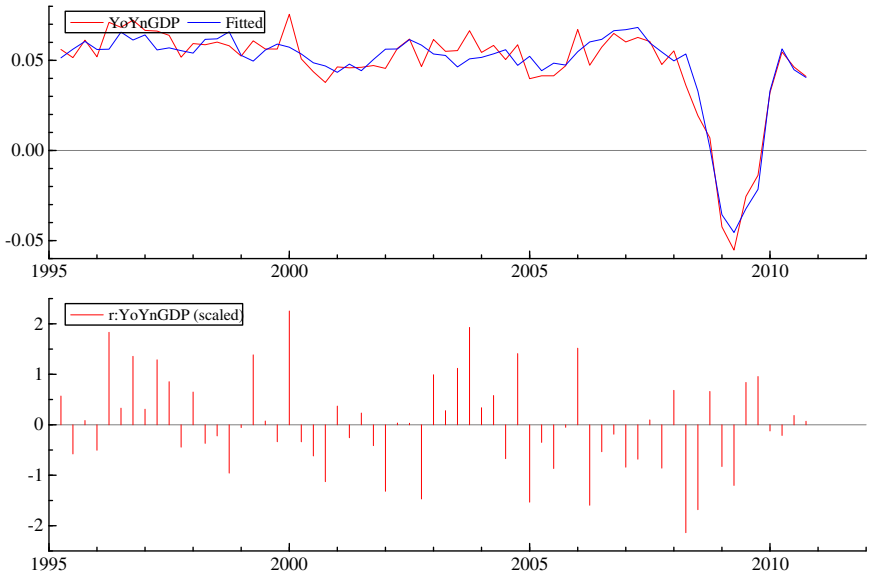

Fig. 1. Actual and fitted nominal GDP (model A), error terms.

measurement to a final target variable (output performance). We do the same for the UK and test which actual and potential monetary policy instruments and intermediate targets performs better in influencing a common overall policy goal (nominal growth), by conducting a 'horse race' test between them. The empirical data are from the Bank of England, which introduced and carried out 'quantitative easing' from March 2009 onwards. Based on the results, meaningful conclusions can be made concerning the actual performance of the central bank's policies.

5. Empirical work

5.1. Methodology

We compare a list of potential central bank tools and instruments (including different interpretations of what could be meant by 'quantitative easing') with a generally accepted final target variable for monetary policy. In general, the literature on central bank performance has identified price stability, maximum economic growth, and stable currencies as the three key outputs of monetary policy.[6] Prices and output can be examined in one combined target variable, nominal GDP. As cited above, the Bank of England has stated that its ultimate target of policy, including that of QE, is nominal GDP growth (Joyce et al., 2010).

We will attempt to establish empirically, based on historical relationships, which policy tools and instruments are more likely to be useful in influencing nominal GDP growth. An attractive empirical methodology for this purpose is the general-to-specific model selection methodology (the 'London School of Economics methodology', also known as the 'Hendry method'). The general-to-specific methodology has a good track record when it comes to estimating robust time series models (see e.g. Bauwens & Sucarrat, 2010; Voutsinas & Werner, 2010; Werner, 2005).[7] It allows all competing monetary policy tools, intermediary instruments and differing interpretations of 'quantitative easing' to be equally represented in the first general model, whose features and statistical characteristics can also be tested (see Campos, Ericsson, & Hendry, 2005). Afterwards, a sequential downward reduction to the parsimonious form is implemented, which amounts to a horse-race between the contenders and enables us to assess the relative performance of the competing policy models.[8] This empirical benchmark can then be compared with particular actions taken by central banks in order to assess their likely relevance or effectiveness. The findings are likely to aid the design of effective monetary policy in general, and effective 'quantitative easing' policy in particular.

A policy to increase open market purchases by the central bank can combine manipulation of both size and composition of central bank balance sheets (Bernanke, Reinhart, & Sack, 2004; Werner, 1994a). In a financial and economic crisis, both the asset and liability sides of the central bank balance sheet can play a role in countering adverse shocks to the financial system. The asset side works as a substitute for private financial intermediation, for example, through the outright purchase of credit products. The liability side, especially expanded excess reserves, functions as a buffer for funding liquidity risk in the money markets. This is the rationale for including both measures of central bank assets and liabilities in our list of policy tools.

We thus settle on the following potential central bank policy instruments or intermediate targets, as they have been cited in the literature as being of relevance:

(a) Price tool: interest rates. *Bank Rate*, the United Kingdom's policy rate.
(b) Quantity tool I: traditionally, monetarist theory emphasised 'high powered money', which consists of two components: Notes and Coins in circulation and banks' reserves held in their accounts with the central bank. Given the policies adopted, the relevant variable is *bank reserves*.
(c) Quantity tool II: the growth of *central bank total assets*.
(d) 'Quality tool': the role of the composition of the central bank's balance sheet. Willem Buiter has proposed a terminology to distinguish *quantitative easing*, or an expansion of a central bank's balance sheet, from what he terms *qualitative easing*, with the latter defined as a shift in the composition of assets towards less liquid and riskier assets. While a more complex analysis of the impact of various aspects of the composition of

[6] Hasan and Master (2008, p. 6) state: "…while the tasks assigned to particular central banks have changed over the years, their key focus remains macroeconomic stability, including stable prices (low inflation), stable exchange rates (in some countries), and fostering of maximum sustainable growth (which may or may not be explicitly listed as a goal of the central bank in enabling legislation). See, e.g., Tuladhar (2005), Sibert (2003), Lybek (2002), McNamara (2002), and Healey (2001), Amtenbrink (1999), Maier (2007), and Caprio and Vittas (1995)." Not everyone shares the focus on maximum growth. Cecchetti and Krause (2002) define central bank performance as a weighted average of output and inflation variability.

[7] "The GETS models are relatively consistent in that they tend to be more accurate than the benchmark models on most horizons and according to both our forecast accuracy measures." (Bauwens & Sucarrat, 2010).

[8] Theoretical discussions about the usefulness of a particular tool may turn out to be futile if this tool is not significant as an explanatory variable of the target variables.

Table 4
Parsimonious model B.
EQ (3) modelling YoYnGDP by OLS.
The estimation sample is: 1995 (2) to 2010 (4).

	Coefficient	Std error	t-Value	t-Prob	Part. R^2
YoYnGDP_1	0.5654	0.0711	7.96	0.000	0.5263
YoYnGDP_4	−0.3625	0.0851	−4.26	0.000	0.2413
Constant	−0.0069	0.0046	−1.51	0.137	0.0384
YoYM4LRE	0.2719	0.0490	5.55	0.000	0.3506
BankRate	0.0059	0.0013	4.68	0.000	0.2778
YoYBoETA_4	−0.0100	0.0028	−3.52	0.001	0.1788

Sigma	0.0091	RSS	0.0047
R^2	0.8764	F(5,57) =	80.83 [0.000]**
Log-likelihood	209.885	DW	2.37
No. of observations	63	No. of parameters	6
Mean (YoYnGDP)	0.0476	Var (YoYnGDP)	0.0006

AR 1–4 test:	F(4,53) = 1.4870 [0.2193]	Hetero test:	F(10,46) = 0.9910 [0.4648]
ARCH 1–4 test:	F(4,49) = 0.7327 [0.5741]	Hetero-X test:	F(20,36) = 0.9374 [0.5494]
Normality test:	Chi^2(2) = 1.2823 [0.5267]	RESET test:	F(1,56) = 2.0787 [0.1549]

Solved static long run equation for YoYnGDP

	Coefficient	Std error	t-Value	t-Prob
Constant	−0.0087	0.0061	−1.42	0.162
YoYM4LRE	0.3412	0.0807	4.23	0.000
BankRate	0.0074	0.0009	8.58	0.000
YoYBoETA	−0.0125	0.0034	−3.70	0.000
QualEasing	−0.0094	0.0031	−3.06	0.003

Long-run sigma = 0.0114
ECM = YoYnGDP + 0.0087 − 0.3412*YoYM4LRE − 0.0074*BankRate + 0.0125*YoYBoETA;
WALD test: Chi^2(3) = 158.023 [0.0000]**

Analysis of lag structure, coefficients:

	Lag 0	Lag 1	Lag 2	Lag 3	Lag 4	Sum	SE (Sum)
YoYnGDP	−1	0.565	0	0	−0.362	−0.797	0.115
Constant	−0.0069	0	0	0	0	0.272	0.049
YoYM4LRE	0.18	0.214	0	0	0	0.395	0.0575
BankRate	0.0059	0	0	0	0	0.006	0.0013
YoYBoETA	0	0	0	0	−0.010	−0.010	0.0028

Tests on the significance of each variable

Variable	F-test	Value [Prob]	Unit-root *t*-test
YoYnGDP	F(2,57) =	43.404 [0.0000]**	−6.9447**
Constant	F(1,57) =	2.2741 [0.1371]	
YoYM4LRE	F(1,57) =	30.776 [0.0000]**	5.5476
BankRate	F(1,57) =	21.925 [0.0000]**	4.6824
YoYBoETA	F(1,57) =	12.407 [0.0008]**	3.5224

Tests on the significance of each lag.	Tests on the significance of all lags up to 4.
Lag 1 F(1,57) = 63.317 [0.0000]**.	Lag 1–4 F(3,57) = 35.373 [0.0000]**.
Lag 4 F(2,57) = 12.075 [0.0000]**.	Lag 2–4 F(2,57) = 12.075 [0.0000]**.
	Lag 3–4 F(2,57) = 12.075 [0.0000]**.
	Lag 4–4 F(2,57) = 12.075 [0.0000]**.

the central bank balance sheet on the target variables may be of interest in the future, here the basic *ratio of long-term central bank assets to total assets* is tested. These are defined to include both government bonds and direct loans to legal entities.

(e) Intermediate target I: the money supply. Monetary aggregate *M4* will be taken into account, as it provides a measure of monetary holdings in the economy.

(f) Intermediate target II: bank credit. There is a substantial body of literature, including the so-called 'credit view' that considers bank lending important and 'special' (see e.g. Bernanke & Gertler, 1995). In this paper a more refined credit aggregate, namely *bank credit to the real economy* (excluding the sectors closely associated with non-GDP, financial transactions) is used which has been shown to be superior theoretically and empirically in accounting for nominal GDP (Werner, 1992, 1997c, 2005).

The variables are summarised in Table 1, including their abbreviations in the econometric model. The sources and construction of the variables defined above can be found in Appendix 1.

5.2. Empirical findings

5.2.1. The general model

Stationarity tests indicate that all variables (except interest rates) are I (2) processes. Year-on-year growth rates are calculated (except for interest rates) and the general model is formulated with nominal GDP as the dependent variable. The independent variables are Bank Rate (Bankrate), bank reserves (Res), the proportion of long-term assets on the central bank's balance sheet (QualEasing), BoE total assets (BoETA), the traditional money supply measure M4 and the measure of broad credit used for GDP transactions (M4LRE). Test results of the general model are shown in Table 2 (EQ 1). Tests of the error properties of the model found no normality problems.

5.2.2. The parsimonious model

Following the 'gets' methodology, this general model is reduced to its parsimonious form by sequentially dropping the least significant variable and then re-estimating the new model after each variable omission, until all coefficients are significant at the 5% level. Additionally, the downward reduction is checked for validity using F-tests and linear restriction tests (the progress report in PcGive). As a cut-off for the validity of the reduction progress, the 1% level was chosen. The result is the parsimonious model A (Table 3), with a clean progress report on model reduction.

As can be seen, parsimonious model A has no noticeable problems and appears to be a valid empirical model of nominal GDP growth. No significant variables were dropped at this point.

The charts of the actual and fitted curves for nominal GDP growth are shown in Fig. 1.

We find that the coefficient for the Bank of England's total assets is negative. This might be explained by a distortion, since the time series for the assets of the BoE prior to 2006, comprising "advances and other accounts" (AEFK) relate to the BoE's participation in the TARGET system which began with the introduction of the Euro in January 1999.[9]

We also find that the coefficient for qualitative easing is negative. Meanwhile, the coefficient for interest rates is positive, as in other empirical studies.

Given these findings, parsimonious model A was further reduced, in order to drop the first lag of qualitative easing (QualEasing, due to its counter-intuitive sign), as well as the first lag of M4 lending to the real economy (M4LRE). This leads to parsimonious model B (see Table 4).

Parsimonious model B has no noticeable problems either. This model seems valid as an empirical model of nominal GDP growth,

[9] "The large increases in Reserves and other accounts, and Advances and other accounts from January 1999 arise from the Bank of England's role in TARGET, as a result of which other European central banks may hold substantial credit balances or overdrafts with the Bank." Also, the subsequent fall in December 2000 is related to accounting changes, as cited in the Bank's 2001 annual report: "The size of Banking Department's balance sheet has, for the past two years, been largely determined by the bilateral positions between central banks in the TARGET system. As explained in previous years these balances reflected the net flows between the individual countries through the central banks and fluctuated with such payments. Although the net position was what mattered for most operational purposes, the individual balances were with different legal entities and had therefore to be shown gross under UK accounting rules. A netting arrangement was implemented from 30 November 2000, under which the bilateral balances that arise intra-day between the central banks are netted into a single position with the European Central Bank." See http://www.bankofengland.co.uk/statistics/ms/articles/artjun06.pdf

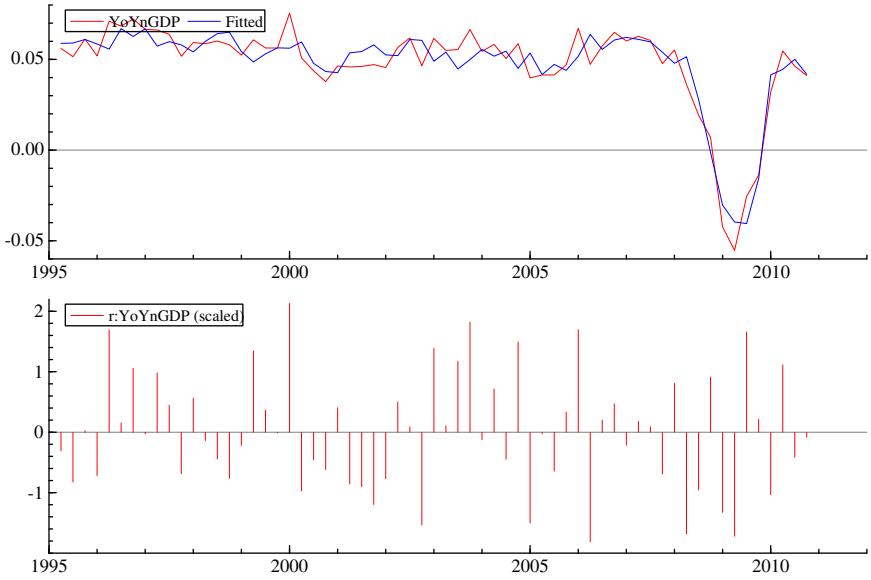

Fig. 2. Actual and fitted nominal GDP (model B), error terms.

although the "progress report" indicates the omission of significant variables (QualEasing_1 and M4LRE_1, as we were aware). The charts of the actual and fitted curves for nominal GDP growth are shown in Fig. 2.

Granger-causality tests show that there is evidence for unidirectional 'causality' from lending variable M4LRE to nominal GDP, and not in the other direction (Table 5).

Finally, structural break tests are conducted, to examine whether there were any breaks in the relationship between nominal GDP and monetary variables, especially at the moment when we were told a new policy regime was introduced in March 2009, but also in quarter 2 of 2006, when money market reforms potentially changed the transmission. First, the recursive graphical tests were conducted (Fig. 3). As can be seen, there is no indication that a structural break occurred either in March 2009 or in 2006.

A more precise test of whether the relationship between nominal GDP and its explanatory variables changed in the period of 2009 Q1 or in 2006 Q2 can be conducted by the inclusion of a dummy variable. We introduced dummies in the general model and in the two parsimonious forms. In the downward reduction process, the dummy for QE drops at an early stage. The dummies are found to be insignificant (Tables 6 and 7). Models A and B with dummies did not show any problems. The F-tests for exclusion of the dummies indicated that they can be dropped. The final forms, identical with the above, did not have any problems (see Tables 3 and 4).

Based on the various tests above, we conclude that no statistical evidence of a significant change in the relationship between potential monetary policy tools or intermediate targets and nominal GDP could be found when quantitative easing was officially implemented in March 2009.

We find that there is no empirical evidence that bank reserves, bond purchases, or even the maturity structure of central bank bond holdings – the key measures of the BoE's QE – have the predicted impact on nominal GDP. As a result, we conclude that we cannot demonstrate empirically that the policy announced in March 2009 made any impact. Furthermore, the results suggest that the Bank of England would be well advised to give up targeting reserves and using bond purchases as its main policy tool, and instead adopt a policy of 'quantitative easing' defined in the original sense of the term as proposed in Japan in 1994 by one of the co-authors (Werner, 1995c): Such a policy aims at expanding credit creation used for GDP transactions, and indeed a stable empirical relationship between a lending aggregate (disaggregated M4 lending for GDP transactions) and nominal GDP is found.

Unlike parsimonious model B, parsimonious model A finds a structural break in 2006 (Q2). One could therefore argue that the strategy of the BoE has changed at the point at which the money market reforms of May 2006 were introduced, although no difference is found in May 2006, either in parsimonious model B (Table 7) or in the recursive structural break tests (Fig. 2).

The results suggest that the research strategy of measuring the effectiveness of QE by the perceived impact on nominal interest rates or the term structure – as has been dominant in the literature – may not be fruitful. The findings also differ from much of the literature in that there appears to be a stable relationship between nominal GDP growth and a broad (though disaggregated) money lending aggregate, confirming earlier findings (Voutsinas & Werner, 2010; Werner, 1997c).

Table 5
Granger 'causality' test: autoregressive distributed lag model.

Test on the significance of independent variables	nGDP dependent M4LRE independent	nGDP independent M4LRE dependent
Dynamic analysis:	F(4,54) = 7.7773 [0.0001]**	F(4,54) = 2.3729 [0.0636]

6. Concluding remarks

The quantity equation relationship between M4 lending growth, when adjusted for non-GDP transactions (see Appendix 1), is found to be in a stable long-term relationship with nominal GDP growth. The lack of such disaggregation had previously been identified as the reason for the apparent 'velocity decline' (Werner, 1997c, 2005). Meanwhile, other monetary policy tools or intermediate targets do not perform in line with theory, calling for a revision of the equilibrium-based approaches.

The 'new consensus' of monetary policy implementation by central banks had focussed on nominal short-term interest rates (see e.g. Curdia & Woodford, 2010, Lenza et al., 2010; Woodford, 2003), at least until the 2008 crisis. However, contrary to the claims of this approach, interest rates are found to be positively correlated with

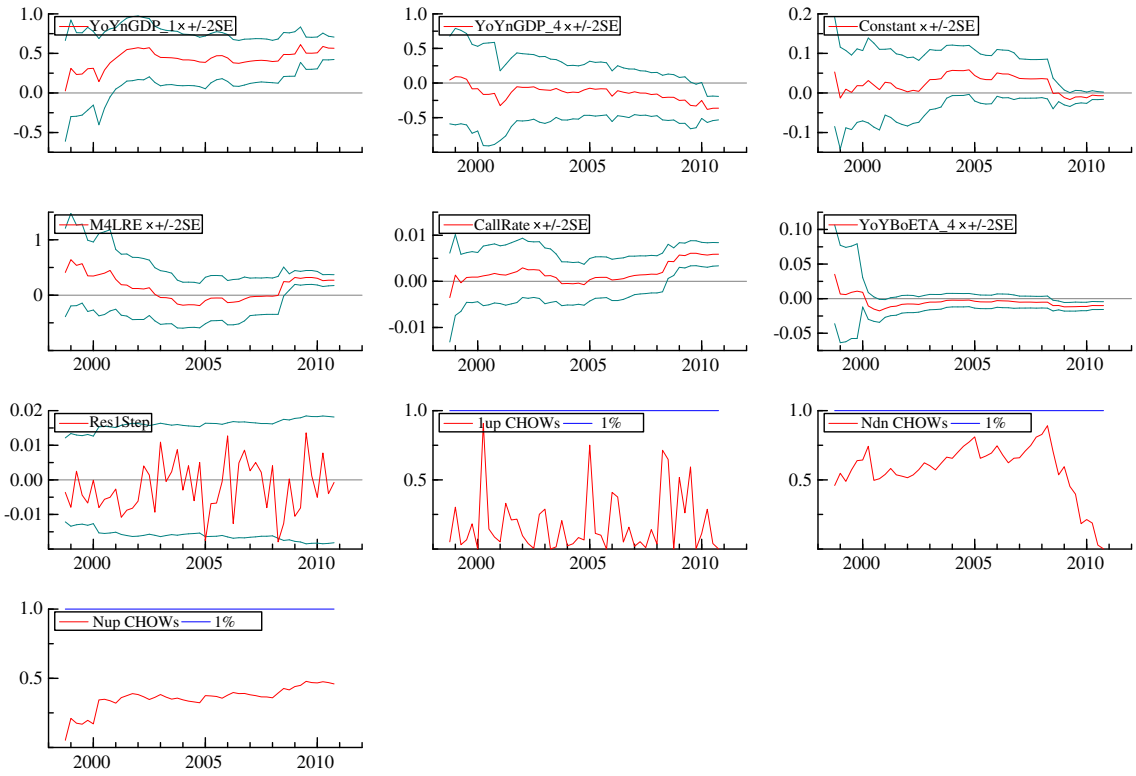

Fig. 3. Recursive structural break tests.

GDP. This shows that earlier studies that defined the effectiveness of QE by its impact on interest rates may be misleading, since interest rates are positively, not negatively correlated with nominal GDP.

The BoE's announcement of March 2009 claimed that a break with past policy was made and a new policy of significant asset purchases was adopted. However, central banks routinely engage in asset purchases and asset sales, without much-touted policy statements attached to them. In this paper, monetary policy is examined by analysing the relationship between a number of actual and potential monetary policy tools and intermediate targets on the one hand, and the target variable of nominal GDP growth on the other. Empirically it was found that there is no evidence that monetary policy changed in a meaningful way in March 2009, as claimed. Total assets do not appear to have a significant positive correlation with nominal GDP growth, while interest rates did not have a negative correlation – just as other literature had found, which is in contradiction to key aspects of prevailing theory.

Table 6
Dummy variable for QE and 2006 into parsimonious model A.
EQ (4) Modelling YoYnGDP by OLS.
The estimation sample is: 1995 (2) to 2010 (4).

	Coefficient	Std error	t-Value	t-Prob	Part. R^2
YoYnGDP_1	0.3663	0.0774	4.73	0.000	0.2972
YoYnGDP_4	−0.4129	0.1054	−3.92	0.000	0.2247
Constant	−0.0023	0.0120	−0.19	0.851	0.0007
YoYM4LRE	0.1442	0.0528	2.73	0.009	0.1232
YoYM4LRE_1	0.2165	0.0771	2.81	0.007	0.1296
BankRate	0.0066	0.0013	5.26	0.000	0.3431
YoYBoETA_4	−0.0137	0.0030	−4.59	0.000	0.2845
QualEasing_1	−0.0114	0.0030	−3.80	0.000	0.2139
Dummy2006	−0.0078	0.0028	−2.79	0.007	0.1283
DummyQE	−0.0021	0.0099	−0.21	0.835	0.0008

Sigma	0.0077	RSS	0.0032
R^2	0.9174	F(9,53) =	65.4 [0.000]**
Log-likelihood	222.582	DW	2.14
No. of observations	63	No. of parameters	10
Mean (YoYnGDP)	0.0476	Var (YoYnGDP)	0.0006

AR 1–4 test:	F(4,49) = 0.1807 [0.9473]
ARCH 1–4 test:	F(4,45) = 0.5445 [0.7039]
Normality test:	Chi^2(2) = 0.5728 [0.7510]
Hetero test:	F(16,36) = 0.6364 [0.8327]
RESET test:	F(1,52) = 2.0217 [0.1610]

Table 7
Dummy variable for QE and 2006 into parsimonious model B.
EQ (5) modelling YoYnGDP by OLS.
The estimation sample is: 1995 (2) to 2010 (4).

	Coefficient	Std error	t-Value	t-Prob	Part. R^2
YoYnGDP_1	0.5184	0.0739	7.02	0.000	0.4723
YoYnGDP_4	−0.4825	0.1028	−4.69	0.000	0.2858
Constant	0.0139	0.0109	1.28	0.208	0.0287
YoYM4LRE	0.2072	0.0566	3.66	0.001	0.1959
BankRate	0.0048	0.0013	3.58	0.001	0.1892
YoYBoETA_4	−0.0076	0.0030	−2.56	0.013	0.1067
Dummy2006	−0.0045	0.0031	−1.45	0.152	0.0369
DummyQE	−0.0157	0.0094	−1.66	0.102	0.0479

Sigma	0.0089	RSS	0.0043
R^2	0.8869	F(7,55) =	61.61 [0.000]**
Log-likelihood	212.681	DW	2.18
No. of observations	63	No. of parameters	8
Mean (YoYnGDP)	0.0476	Var (YoYnGDP)	0.0006

AR 1–4 test:	F(4,51) = 0.5942 [0.6684]
ARCH 1–4 test:	F(4,47) = 1.1006 [0.3674]
Normality test:	Chi^2(2) = 0.5728 [0.7510]
Hetero test:	F(12,42) = 0.9591 [0.5010]
Hetero-X test:	F(32,22) = 1.0740 [0.4381]
RESET test:	F(1,54) = 1.1215 [0.2943]

Total central bank asset growth was not found to be helpful as far as the recovery of the economy is concerned. It is thus unlikely to be attractive as a main monetary policy instrument.

The 'qualitative easing' strategy of changing a central bank's balance sheet composition (by increasing long-term holdings of assets) does not seem to have a significant impact on the economy, as this particular indicator dropped out from the model.

The findings raise the prospect of a revival of a more traditional, quantity-based approach, but modified by the use of disaggregated credit counterparts instead of monetary aggregates (Werner's Quantity Theory of Credit).[10] We conclude that BoE policy should more directly target the growth of bank credit for GDP-transactions, as suggested in Werner (1992, 1994a,b, 1997a, 2005) for post banking-crisis situations. Despite the BoE's policies, bank credit growth contracted by record amounts in late 2011. Consequently, the UK economy turned into a double-dip recession in the first half of 2012 – as our model predicted.

There seems no need to take recourse to 'unorthodox' monetary policy: targeting a broad monetary aggregate is an orthodox idea, albeit refined here by the use of a disaggregated credit counterpart. This appears to be a promising avenue for research and policy applications.

As credit for GDP-transactions is found to have highest significance in explaining economic growth, policy-makers need to consider the methods that may influence this variable. Suggestions are made in Werner (1994a, 1998a,b, 2005, 2012) and include the substitution of bond issuance with government borrowing from banks. This would boost credit creation which, ironically, was the original meaning of the term 'quantitative easing'. Another, more controversial method would be the re-introduction of a regime of credit guidance ('window guidance') to boost bank credit creation to finance corporate investment. Such proposals are also relevant for the eurozone, where the effectiveness of ECB policies is currently debated (see the first article of this special issue).

Appendix 1

Data sources

Nominal GDP (GDP): Office for National Statistics and available from its *Economic and Labour Market Review monthly issue*.

Bank Rate (Bankrate): The quarterly average of the official Bank Rate, as provided by the Bank of England (time series IUQABEDR).

Bank of England Reserves (BoEReserves): No complete time series of the reserves of banks with the Bank of England or for the Bank of England's total assets is provided on the central bank's website. Time series are discontinued in June 2006. BoE staff members explain that this discontinuation is due to the introduction of new calculation methods as a result of the implementation on 18 May 2006 of money market reforms.[11] Data are only complete after 2006 (see further explanations below).[12] Therefore the authors had to combine different data to build a continued series (the BoE's balance sheet being quite different before and after 2006). Before June 2006, the authors used the initial definition of M0 to calculate the reserves: As M0 equals reserves plus Notes and Coins in circulation outside the Bank of England, the authors calculated the time series for reserves as the difference between M0 *prior* 2006 (time series LPMAVAD) and Notes and Coins outside the BoE (time series LPMAVAA). After June 2006, the data on BoE reserves from the new balance sheet was kept unchanged (Table B1.1.1, time series BL38). The obtained time series for BoE reserves from 1985 to 2010 is not available online but it can be provided by the authors on demand.

	Prior June 2006	*Post* June 2006
Authors' time series for BoE reserves (*Res*)	LPMAVAD − LPMAVAA (= M0 − Notes and Coins outside the BoE)	BL38 (= BoE reserves)

Bank of England Total Assets (BoETotAssets): As in the above case, due to the money market reforms implemented in June 2006, no continuous data series of BoE total assets is available in the BoE database. Concerning the data before June 2006, the authors calculated the BoE total assets by adding up the values of all the assets owned by the central bank, namely: Banking Department's securities – including Treasury bills – issued by Central Government (RPQAEFJ); Banking Department's advances and other accounts (RPQAEFK); Banking Department's premises equipment and other securities (RPQAEFL); Banking Department's holdings of Notes and Coins (RPQAEFM); Issue Department's securities issued by Central Government (RPQAEFC) and Issue Department's other securities (RPQAEFD). *Post* 2006, the authors kept unchanged the time series of total assets of the Issue Department (BL37) plus total assets of the Banking Department (BL56) that can be found on the BoE balance sheet (Table B1.1.1)

	Prior June 2006	*Post* June 2006
Authors' time series for BoE total assets (*BoETA*)	RPQAEFJ + RPQAEFK + RPQAEFL + RPQAEFM + RPQAEFC + RPQAEFD (= securities 1 + advances and other + premises equipment and other + Notes and Coins + securities 2 + other securities)	BL37 + BL56 (= total assets of the Issue Department + total assets of the Banking Department)

Qualitative easing (QualEasing): We have chosen to focus on the ratio of long-term central bank assets to total assets. Once again, an adjustment was needed in the data, and a time series for qualitative easing had to be constructed by the authors. Before June 2006, we took the ratio of the long term assets of the Issue and Banking Departments (which is the sum of the value of the Issue Department's long term assets, RPQAEFC, plus the banking Department's long term assets, RPQAEFJ) over total assets (obtained with the method explained above). After June 2006, this ratio was calculated by dividing the value of the long term assets of the Issue and Banking Departments that can be found on the BoE balance sheet. It is the sum of the value of the Issue Department's long term assets, BL35, plus the Banking Department's long-term assets, BL53, over BoE's total assets (see above). In this manner, the authors obtain a continuous time series of qualitative easing from 1988 to 2010, representing the ratio of the BoE long term assets to total assets.

	Prior June 2006	*Post* June 2006
Authors' time series for Qualitative Easing (*QualEasing*)	(RPQAEFC + RPQAEFJ)/BoETA (= (Issue Dpt's long term assets + Banking Dpt's long term assets)/total assets of the BoE)	(BL35 + BL53)/BoETA (= Issue Dpt's long term assets + Banking Dpt's long term assets)/total assets of the BoE)

Monetary aggregate M4: As explained by BoE staff members during conversations with the authors, B6NM is not an accurate time series for M4 excluding other financial corporations, despite its name. The BoE members were not able to explain why, as "prior to 1996 data were collected differently and unfortunately we (the BoE, *author's note*) are unable to break down clearly its contributions".

[10] See, for instance, A Japanese puzzle, *The Economist*, Business, 19 June 1993, p. 74.

[11] See http://www.bankofengland.co.uk/statistics/ms/articles/artjun06.pdf.

[12] See http://www.bankofengland.co.uk/statistics/ms/articles/artjun06.pdf: Reserve balances replaced operational deposits in 2006 and these are much larger than operational deposits, as banks and building societies were able to hold voluntary interest-bearing reserves with the BoE from 2006 onwards. Unfortunately, the BoE does not publish reserve balance data prior to 2006.

In order to introduce the M4 monetary aggregate into the regression, the authors had to build their own time series of M4 from the BoE database. In order to add to the time series of "M4 holdings of other financial corporations" (LPQAVHA) and get a general M4 aggregate for the whole economy, the authors built a time series different from B6NM in order to account for M4 holdings of the real economy. This latter is a sum of M4 holdings of private non-financial corporations (LPQAVHB) and M4 holdings of the household sector (LPQVSCL).

The time series for M4 was in the end a sum of M4 holdings of other financial corporations (LPQAVHA), of private non-financial corporations (LPQAVHB) and of the household sector (LPQVSCL).

	Prior June 2006	*Post* June 2006
Authors' time series for monetary aggregate M4 (*M4*)	LPQAVHA + LPQAVHB + LPQVSCL (= M4 holdings of other financial corporations + private non-financial corporations + household sector)	

Note: From 1982 to 1989, our own addition of individual sectors is substantially larger than the total provided by the Bank of England (by more than £100bn). The Bank of England could not provide a satisfactory explanation.[13]

M4 lending aggregate to the real economy (M4LRE): The authors have been looking for an accurate lending aggregate that would measure credit for transactions that contribute to nominal GDP (Werner, 1997c, 2005). M4 lending to the real economy is a sum of M4 lending to all sectors excluding the financial one. Instead of using the time series called "M4 lending excluding other financial corporations" (B6NL) provided by the Bank of England, the authors had to build their own M4 lending aggregate for the real economy. Indeed, from personal conversations with the BoE staff, it seems that the central bank cannot explain why B6NL is not a reliable time series, although it admits it is not. We had the same problem as with B6NM (see above for the M4 monetary aggregate). Whereas B6NL should have been a good proxy for bank credit to the real economy, we had to build our own lending to the real economy time series (M4LRE). We added up lending to private non-financial corporations (LPQAVHF); lending to the household sector (secured lending to individuals, LPQAVHG, and unsecured lending to individuals, LPQVVXS) and lending to unincorporated businesses and non-profit making institutions (LPQAVHI).

	Prior June 2006	*Post* June 2006
Authors' time series for M4 lending to the real economy (*M4LRE*)	LPQAVHF + LPQAVHG + LPQVVXS + LPQAVHI (= lending to private non-financial corporations + lending to the household sector (secured + unsecured lending to individuals) + lending to unincorporated businesses and non-profit making institutions)	

[13] An abstract from an email sent by an BoE employee: "Prior to 1996 data were collected differently and unfortunately we are unable to break down clearly its contributions therefore I can't give you an exact reason as to why the data don't add up in the back data. The quality of data improved in 1990 (the summing becomes much more accurate) and then again in 1996 when we started collecting the data under the current methodology. The reason the monthly data sum up exactly is because they only begin in 1996 when our improved methodology began." No light is shed on the reason why B6NM is not an accurate measure of "M4 excluding other financial corporations" although it is presented as such on the BoE website, and no improvement of the data is apparently scheduled in the near future.

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