View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by Research Papers in Economics

ISSN 1750-4171

DEPARTMENT OF ECONOMICS

DISCUSSION PAPER SERIES

A Cost-Benefit Analysis of Basel III: Some Evidence from the UK

Meilan Yan
Maximilian J. B. Hall
Paul Turner

WP 2011 - 05

Department of Economics
School of Business and Economics
Loughborough University
Loughborough
LE11 3TU United Kingdom
Tel: + 44 (0) 1509 222701
Fax: + 44 (0) 1509 223910
http://www.lboro.ac.uk/departments/sbe/economics/

Loughborough University

A Cost-Benefit Analysis of Basel III: Some Evidence from the UK

Meilan Yan[a], Maximilian J.B. Hall[a,1], Paul Turner[a,2]

[a] *School of Business and Economics, Loughborough University, Leicestershire, LE11 3TU, UK*

Abstract

This paper provides a long-term cost-benefit analysis for the United Kingdom of the Basel III capital and liquidity requirements proposed by the Basel Committee on Banking Supervision (BCBS, 2010a). We provide evidence that the Basel III reforms will have a significant net positive long-term effect on the United Kingdom economy. The estimated optimal tangible common equity capital ratio is 10% of risk-weighted assets, which is larger than the Basel III target of 7%. We also estimate the maximum net benefit when banks meet the Basel III long-term liquidity requirements. Our estimated permanent net benefit is larger than the average estimates of the BCBS. This significant marginal benenfit suggests that UK banks need to increase their reliance on common equity in their capital base beyond the level required by Basel III as well as boosting customer deposits as a funding source.

JEL Classification: C32; C53; G01; G21; G28

Keywords: Basel III, Cost-Benefit analysis, Tangible Common Equity Capital, Liquidity

1. Introduction

Banking crises have been much more frequent than we would like. The annual probability of a crisis is 4-5% in both industrial and emerging market countries (Walter, 2010). There are many factors that contribute to the vulnerability of the banking sector. At the top of the list are too little high-quality capital and too much unsecured liquidity. Moreover, banking crises are usually associated with significant economic losses. In order to promote financial stability, the Basel Committee (BCBS, 2010a) has therefore established stronger capital and liquidity requirements (i.e. Basel III).

This paper assesses the long-term United Kingdom economic impact of the Basel III capital and liquidity requirements (the 'the requirements'). The results suggest that, in terms

Email address: M.L.Yan@lboro.ac.uk (Meilan Yan)

[1] Professor of Banking and Financial Regulation

[2] Reader in Economics

of the impact on output, there is considerable room to further tighten capital and liquidity requirements, while still providing positive effects for the United Kingdom economy.

Similar to the cross-country analyses conducted by the Basel Committee on Banking Supervision (BCBS)(2010b) and Angelini et al. (2011), the benefit of the requirements is assumed to be represented by the forestalled loss (in terms of the level of GDP) of a banking crisis, which in turn is determined by the extent to which the requirements reduce the probability of a banking crisis occurring and the associated GDP loss. Therefore, we identify the benefit of the new requirements as the reduction in the probability of a banking crisis multiplied by the expected loss arising from a one-off crisis. The main channel driving the economic costs of the requirements is through the bank credit market, in which higher lending rates reduce output levels. Here, we quantify the cost of the new requirements as a negative function of the lending spread.

Comparing with previous studies, the first contribution of this paper is to estimate the long-term economic impact of *both* tighter capital and liquidity requirements for the UK economy. Second, we calculate the capital and liquidity ratios based on the Basel III definitions, rather than the more commonly used Tier 1 capital ratio and the Loans-to-Deposits liquidity ratio. Third, we choose a non-linear-in-factor probit model including bank capital and liquidity to forecast the probability of a bank crisis by considering the imperfect substitutability between UK banks' capital and liquidity. And fourth, we estimate the long-run cost of the requirements with a Vector Error Correction Model (VECM), which shows holding higher capital and liquidity would reduce output by a small amount but increase bank profitability in the long run.

We use quarterly data over the period 1997:q1 to 2010:q2. The bank-specific data were collected from Bankscope and banks' annual reports. The macroeconomic data were collected from the the Bank of England (BOE) database, the Office for National Statistics (ONS) database, and the International Financial Statistics (IFS) database. Our maximum temporary net benefit and permanent net benefit is shown to be 1.284% of pre-crisis GDP [3] and 35.484% respectively when the tangible common equity ratio stays at 10%. Assuming all UK banks also meet the Basel III long-term liquidity requirements, the temporary net benefit and permanent net benefit will be 0.347% and 14.318% of pre-crisis GDP respectively.

The structure of the paper is as follows: Section 2 reviews the existing literature on the economic benefits and costs of the Basel III requirements. Section 3 explains the data used. Section 4 describes the methodology we use to estimate benefit and cost. Section 5 presents

[3] The pre-crisis GDP in this paper is expressed as real GDP in 2007:q4.

the main empirical results. And Section 6 summarises and concludes.

2. Literature Review

2.1. Economic Benefits

The economic benefits of the enhanced capital and liquidity regulations reflect mainly the fact that a more robust banking system would be less prone to crises, which can impose large losses in terms of forgone output. This section synthesizes the evidence on these two effects. It firstly reviews the literature on the impact of capital and liquidity regulation on the probability of systemic banking crises occurring. It then proceeds to review the approaches adopted to assess the GDP loss associated with a specific banking crisis.

2.1.1. The impact of capital and liquidity requirements on the probability of banking crises occurring

Table 1 shows the main methods used to estimate the relationship between regulatory requirements and the probability of a banking crisis occurring in a given year; reduced-form models, calibrated portfolio models and calibrated stress test models. The results, summarised in Table 1, point to a clear role for capital. But the impact of liquidity is addressed by far fewer models, even though liquidity has been shown to be just as important for maintaining the stability of banking systems. It is worth noting that the definitions of both bank capital and bank liquidity used in these models are not exactly the same as those specified by Basel III. We will discuss this in greater detail below.

Barrell et al. (2009), Kato et al. (2010) and Wong et al. (2010) adopt reduced-from probit models for a panel of countries over a period of years. The probability of a crisis occuring is based on the statistical relationship between the incidence of crisis episodes and aggregate data on bank capital and liquidity, as well as other variables that serve as controls. Comparing with Barrell et al. (2009), Kato et al. (2010) use a general-to-specific approach to choose the preferred specification by considering the substitutability between Japanese banks' capital and liquidity.

Tarashev and Zhu (2008) use a standard portfolio credit risk model to estimate links between capital and the probability of bank default, which is treated as a signal for a systemic banking crisis. They interpret the banking system as a portfolio of banks and estimate the loss distribution arising from bank defaults. Bank failures are correlated and the correlations can be estimated from market information.

Gauthier et al. (2010) use a stress testing model to generate loss distributions under severe but plausible scenarios. This methodology assumes losses arise from systemic spillover effects, either from counter-party exposures in the interbank markets or from asset fire sales that affect the mark-to-market value of banks' portfolios. In this context, a greater capital buffer can only be beneficial insofar as it helps the bank avoid asset fire sales. Therefore, the probability of bank asset fire sales, which depends on holdings of capital, is a key trigger of systemic banking crises. Meanwhile, Miles et al. (2011) use an assumed probability distribution for changes in annual GDP to calculate the probability of a banking crisis occurring in any given year for different levels of bank capital. They generate distributions of GDP with added stressed shocks by using calibrated parameters.

However, neither the portfolio model nor the stress testing models can assess the impact of liquidity requirements. With this in mind, we estimate the reduced-form relationship between the probability of a banking crisis occurring and UK banks' capital and liquidity ratios.

2.1.2. Expected GDP loss associated with a banking crisis

The paths of GDP over the different phases of a banking crisis are generally measured from the peak of the business cycle prior to the crisis to a subsequent trough point for GDP; the end phase is when GDP remains on a new sustainable path. Therefore, two types of GDP loss might occur in a specific banking crisis. The first one is a temporary GDP loss since the path of GDP may regain its pre-crisis trend growth rate. The second is a permanent GDP loss because of a permanently lower GDP growth trend than the pre-crisis one (see Figure 1).

Bordo et al. (2001), Demirguc-Kunt et al. (2000), and Hutchison and Noy (2002) measure the temporary GDP loss from the pre-crisis cycle peak to the point when the pre-crisis trend growth rate has been retrieved. Cecchetti et al. (2009), Laeven and Valencia (2008), and Haugh et al. (2009) measure the cumulative temporary GDP loss through the period of a given banking crisis, which comprises the peak to trough loss of output plus the loss of output until the pre-crisis trend growth rate has been reached. Hoggarth et al. (2002) measure both types of temporary GDP loss. Their findings are summarised in Table 2.

In constrast, Cerra and Saxena (2008), Röger et al. (2010), Furceri and Zdzienicka (2010) and Barrell et al. (2010) calculate the permanent GDP loss from the pre-crisis cycle peak to the point when the new, lower trend growth rate has been established as well as the cumulative permanent loss in GDP, over the pre-crisis cycle peak to trough period plus the period until the new lower growth trend rate is established. Meanwhile, Boyd et al. (2005) and Haldane (2010) calculate just the cumulative permanent loss in GDP. Again, their findings are presented in Table 2.

2.2. Economic Costs

The main channel through which changes in capital and liquidity regulation affect economic activity is via an increase in the cost of bank intermediation. Banks will increase lending rates to compensate for the cost of holding more capital and liquidity. Owing to imperfect substitutability between bank credit and other forms of market financing, this leads to lower investment and lower output.

The computation of the steady-state economic costs of higher capital and liquidity requirements for the level of output are based on a variety of macroeconomic models (see Table 3 for the details and findings of the authors). The models differ in many respects. First, they refer to different countries or areas. Second, some are almost fully estimated, whereas others are entirely calibrated (the value of the coefficients are taken from unrelated, generally microeconomic, studies casting light on the specific parameters). Finally, some models explicitly feature a banking sector and a role for bank capital and liquidity, while others do not.

Gambacorta (2010) and Wong et al. (2010) use an error correction model to estimate long-term output reduction caused by higher lending spreads arising from stronger capital and liquidity standards. The main advantage of this approach is that it helps to disentangle loan demand and loan supply factors in the steady state. Based on aggregated historical data, it can establish the long-run relationship between capital (or liquidity) and the reduction in output. The main disadvantage is that it does not allow for the conduct of counter-factual experiments, such as the introduction of countercyclical capital buffers (BCBS, 2010b).

Röger et al. (2010) calibrate the costs for an Euro Area crisis from both higher capital and liquidity using a DSGE model including financial frictions and a banking sector. Their paper features banks' balance sheets and credit markets explicitly. It provides a unified framework to analyze how changes in capital and liquidity requirements affect banking conditions (spreads and lending) and output. DSGE models also allow counter-factual policy experiments in a conceptually consistent manner. However, since it is fully calibrated, the estimation process is often daunting. And the other DSGE models cited here (i.e. Van den Heuvel (2008),Dellas et al. (2010), and Meh and Moran (2008)) are still experimental, so that they are not fully integrated to the policy-making process.

Locarno (2004) uses semi-structural models; however, these models do not directly incorporate banks' balance sheet conditions and income statements as input variables. Instead, these effects must be incorporated into other variables, such as lending spreads. This means that the first step is to map the impact of the higher capital and liquidity requirements on lending spreads. Therefore, it is difficult to estimate the impact of the cost effect of capital (or liquidity) on output. Moreover, the computation of long-term effects is difficult due to the size of the models, and cost can be approximated only by simulations over a reasonably large number of years.

Miles et al. (2011) assume an alternative channel through which changes in capital affect economic activity, that is via an increase in the funding cost of bank intermediation. The rising bank funding costs (typically referred to in corporate finance theory as the weighted average cost of capital, WACC) are passed on, one-for-one, by banks to their customers, who will suffer a higher cost of capital for external financing. They assume that output is produced with firms' capital and labour in a way described by a single standard production function. The steady-state output will be changed by higher bank capital requirements. Therefore, they apply a production function with a calibrated constant elasticity of substitution to estimate the calibrated output loss caused by banks' higher WACC.

To estimate the long-term cost effect of both higher bank capital and liquidity requirements, we follow Gambacorta (2010) and use a Vector Error Correction Model to estimate the long-run relationships among a small set of variables for the UK. This analysis focuses on the long run effects on interest rates, lending, GDP and bank profitability of the Basel III requirements. It establishes a framework to estimate the effects of higher bank capital and liquidity on output and bank profitability.

3. Data description

3.1. Definitions of Capital and Liquidity

It is crucial to clarify the definitions of capital and liquidity before doing empirical work. In most recent banking sector research, the Tier 1 capital ratio [4] , is the variable chosen to represent bank capital. Likewise, the most commonly used variable for liquidity is the Loans-to-Deposits ratio. However, under Basel III, the focus is on very different ratios.

For the capital base, the first breakthrough in Basel III is to focus on the ratio of tangible common equity capital (i.e. paid-up capital plus retained earnings net of regulatory adjustments) to risk-weighted assets (TCE/RWA), since tangible common equity is the highest-quality component of bank capital:

$$\text{TCE/RWA} = \frac{\text{Common Equity-Intangibles-Goodwill}}{\text{Risk Weighted Assets}} \tag{1}$$

Therefore, any analysis about the Basel III capital requirements should use TCE/RWA as the key capital variable. However, since this variable is only available for a few bank since 2009, most studies have used the core Tier 1 ratio in their analyses, translating the core Tier 1 ratio into the TCE/RWA ratio by assuming a linear link between the two in order to assess

[4]The overall Tier 1 capital ratio includes common equity plus other qualifying financial instruments having a loss-absorbing capacity on a 'going concern' basis in the numerator, with risk weighted assets (RWA) comprising the denominator.

the long-run impact of stronger Basel III capital requirements. Luckily for us, we are able to get accurate historical UK bank data for the TCE/RWA ratio based on information from Bankscope database and UK banks' annual reports.

For liquidity, Basel III evaluates banks' long-term [5] liquidity adequacy using a 'net stable funding ratio' (NSFR), which is the available amount of stable funding (ASF) divided by the required amount of stable funding (RSF). The ASF includes equity, debt and other liabilities (Liabs) with an effective maturity of 1 year or greater, 85% of stable deposits (StbDeposits) with residual maturity less than 1 year, and 70% of less stable deposits (OtherDeposits) with a residual matuirty of less than one year. The RSF includes 5% of government debt (GovetDebt), 50% of Corporate loans (CorpLoans) with less than 1 year to maturity, 85% of Retail loans (RetLoans) having a maturity of less than 1 year and 100% of Other Assets (excluding cash and interbank loans, which attract a 0% weighting) [6]. Accordingly,

$$\text{NSFR} = \frac{\text{Equity} + \text{Debt}_{\geq 1yr} + \text{Liabs}_{\geq 1yr} + 85\%\text{StbDeposits}_{<1yr} + 70\%\text{OtherDeposits}_{<1yr}}{5\%\text{GovtDebt} + 50\%\text{CorpLoans}_{<1yr} + 85\%\text{RetLoans}_{<1yr} + 100\%\text{OtherAssets}} \tag{2}$$

Basel III requires that the NSFR should be more than 1 which means the sources of funding are bigger than the uses of funding. Previous studies have used the same approach to assess the impact of Basel III's liquidity requirements by translating the NSFR into a Loans-to-Deposits ratio. Wong et al. (2010) estimate a one percentage-point increase in NSFR roughly corresponds to a decrease of 46 basis points in the Loans-to-Deposits ratio on average, with the assumption that there is a linear relationship between the two ratios. Even though it is impossible for us to estimate the relationship between the NSFR and the Loans-to-Deposits ratio with a small sample of data, we can get an approximated NSFR by checking UK banks' historical balance sheets and income statements. Accordingly,

$$\text{NSFR} \approx \frac{\text{Equity} + \text{Snrdebt}_{\geq 1yr} + \text{Liabs}_{\geq 1yr} + 85\%\text{RetDeposits}_{<1yr} + 70\%\text{OtherDeposits}_{<1yr}}{5\%\text{Itbloans}_{<1yr} + 50\%\text{DebtSecurities}_{<1yr} + 85\%\text{AdvLoans}_{<1yr} + \text{OtherAssets}}$$

where Snrdebt is senior debts, RetDeposits are retail deposits, Itbloans are interbank loans, and AdvLoans are advances and loans. Given the recent global financial crisis, it might be

[5] The BCBS also uses a 'liquidity coverage ratio' (LCR) to assess the short-term (i.e. up to 30 days) liquidity adequacy of banks-see BCBS (2010a).

[6] N.B. We have used the December 2009 definition of the NSFR here (BCBS, 2009) to allow for comparision with other studies of its effects, especially (BCBS, 2010b). For the final version see (BCBS, 2010a).

too optimistic to exclude cash and interbank loans from the RSF. Therefore, we assume 5% of interbank loans would be funded by ASF. Similarly, since we do not clearly know the portfolio structure of each bank's asset holdings, we apply a 50% discount factor to all less than 1 year Debt Securities, which includes both Government Debt and Corporate Loans. Given the 5% discount factor applied by Basle III to Government Debt, our approximated NSFR is thus less than the real NSFR.

3.2. Data

We use quarterly data over the period 1997:q1 to 2010:q2. The bank-specific data were collected from Bankscope and banks' annual reports. Tables 4 and 5 show that we included only 12 (17) out of a total of 190 UK banks [7] from the Bankscope database for the calculation of the industry capital (liquidity) ratio, because of the unbalanced data limitation. However, those selected banks accounted for 91.48% of total UK bank assets in 2010. The macroeconomic data were collected from the the Bank of England (BOE) database, the Office for National Statistics (ONS) database, and the International Financial Statistics (IFS) database. Detailed description of variables is in Table 6.

To estimate the probitability of a banking crisis occurring, we use a dependent variable-binary banking crisis dummy (one for 2008:q1-2010:q2 and zero otherwise). There are two reasons to identify the first quarter of 2008 as the beginning of the systemic banking crisis in the United Kingdom. First of all, it is the peak point of the business cycle prior to the crisis. Second, the Bank of England announced in February 2008 that it would accept a broad range of mortgage-backed securities and swap those for Treasury Bills for a period of one year to aid banks with liquidity problems. And the reason for identifying the second quarter of 2010 as the end of the systemic banking crisis is because its real GDP growth rate had caught up with its pre-crisis level. Finally,the explanatory variables in this model include the sample UK banks' average tangible common equity capital ratio (TCE/RWA), the average UK banks' net stable funding ratio (NSFR), real estate price inflation ratio (RPI) and the ratio of current account balance to nominal GDP (CA).

The reason for including real estate price inflation has been explained by Barrell et al. (2009). Basically, real estate price inflation , rather than other financial factors such as interest rates or returns on assets, has a superior predictive power than the others. Or, as Kato et al. (2010) argue, the RPI may contain a larger information set than the others. For instance, when

[7] There were 121 incorporated banks operating in the UK, according to the FSA, on 30 June 2011, and 69 building societies. However, this sample does not include banks incorporated outside the UK but accepting deposits through a branch in the UK.

housing markets are booming, interest rates would quite frequently remain low as a backdrop to those asset market bubbles. Finally, the reason for including the current account balance ratio is more straightforward. We know from history that a banking crisis usually tended to coincide with a currency crisis, which were well acknowledged as the 'twin crises'. Given that a large current account deficit can frequently precede a currency crisis, the CA term can thus also predict a banking crisis.

To estimate the steady-state economic cost, we use the following variables: real GDP and real [8] bank lending (L) to private sector, which includes lending to both banking and non-bank financial firms; the real short term interest rate ($i - \pi$), as given by the 3-month interbank rate minus CPI inflation; the lending spread ($r - i$), as given by the 3-month clearing banks' lending rate for different types of loans minus the 3-month interbank rate; the average return on equity (ROE) of UK banks; the average UK banks' tangible common equity capital ratio (TCE/RWA); and the average UK banks' net stable funding ratio (NSFR).

4. Methodology

4.1. Estimation of the economic benefit of new capital and liquidity requirements

The benefit of the new requirements is measured as the reduction in the probability of a financial crisis occuring multiplied by the expected loss arising from a one-off banking crisis. Thus,

$$\text{Benefit} = \Delta Pr * \text{expected loss from a financial crisis} \quad (3)$$

Therefore, estimation of the expected long-term benefit from the regulatory reforms consists of two parts. The first part involves an estimation of the impact of higher capital and liquidity requirements on the probability of a banking crisis occurring. The second part is an estimation of output losses arising from a one-off banking crisis.

4.1.1. The impact of higher capital and liquidity requirements on the probability of a banking crisis occurring

Normally, in the binary-state model, the probability depends on each explanatory variable linearly:

$$Pr_t = \Phi(\alpha_i \text{TCE/RWA}_t + \beta_i \text{NSFR}_t + \gamma_i Z_{it}) \quad (4)$$

where TCE/RWA_t and NSFR_t denote the tangible common equity capital ratio and net stable funding ratio, respectively, and Z_t represents a vector of macroeconomic variables, including real estate price inflation ratio (RPI_t) and the current account balance ratio (CA_t). All of

[8] The real bank lending is calculated by seasonal adjusted banking lending over one plus inflation rate.

these variables are in log form. Φ denotes a cumulative normal distribution function typically used in the standard probit models. Accordingly, Pr denotes the probability of a financial crisis materializing.

However, linear formation, as in the plain-vanilla probit models, gives rise to some difficulties in estimating the cumulative impacts of the regulatory tools used to reduce the probability of crises occurring (Kato et al., 2010). The linear-probit model, imposing the perfect substitution between variables, requires a bank to make a take-it-or-leave-it choice between capital and liquidity. But, both factors are of equal importance to a bank. Indeed, liquidity might be even more important than capital during a systemic banking crisis. As a result, we employ a slightly more flexible (and sensible) form, a non-linear probit model, with a few cross-terms to allow for imperfect substitutability between capital and liquidity indicators. The estimated benchmark specification of the non-linear-in-factor probit model can be expressed as

$$Pr_t = \Phi(\alpha_i \text{TCE/RWA}_t * \text{NSFR}_t + \beta_i Z_{it}) \tag{5}$$

4.1.2. Estimation of output losses arising from a one-off banking crisis

As noted earlier, the paths of GDP over the different phases of a banking crisis of relevance are from the peak of the business cycle prior to the crisis to a subsequent trough point of GDP; the end phase is when GDP returns to a new path. Therefore, two types of GDP loss might occur in a specific banking crisis. The first one is a temporary GDP loss since the path of GDP may regain its pre-crisis trend growth rate. The second is a permanent GDP loss because of a permanently lower GDP growth trend than before the crisis. Both possibilities are examined in our paper.

4.2. Estimation of the output loss arising from higher capital and liquidity requirements

Since it is difficult to measure the long-run relationships between variables during the financial turmoil post 2008, we use quarterly data for the period of 1997:q1-2007:q4 in the VECM model. Figure 2 compares the behavior of real GDP and real bank credit. It shows a high correlation between the two series, suggesting the possibility that they have a long-run relationship. Kashyap et al. (1993) mention that better economic conditions usually increase the number of profitable projects in terms of expected net present value and hence increase the demand for credit. The behavior of the spread and the real short term interest rate are shown in Figure 3. As can be seen, the spreads remained extremely low over the decade under easy bank lending conditions, as did real interest rates. However, a year before the 2008 financial turmoil began, the lending spreads were at a ten year high. It was a warning sign of future systemic financial instability. As can been in Figure 4, both the capital ratio and the liquidity ratio remained quite low over the preiod, mostly because of the widespread use of securitization techniques and cheap wholesale funding. While the significant decrease in bank profitability from 2001 to 2002 is due to the fragile financial system, especially against the background of the 11th September terrorist attack, the collapse of Enron and Argentina's default. To reduce the heteroskedastic problem, we also take logarithmic forms of real GDP (Y), real bank lending (L), return on equity (ROE), the capital ratio (TCE/RWA) and the liquidity ratio (NSFR).

In order to estimate the the output loss arising from higher capital and liquidity requirements, we firstly set these seven variables in a VAR system in which all variables are treated as endogenous:

$$\begin{aligned} & z_t = \mu + \sum_{k=1}^{p} \Phi_t z_{t-k} + \epsilon_t \\ & t = 1, 2..., T \\ & \epsilon_t \sim VWN(0, \Sigma) \end{aligned} \tag{6}$$

where $z_t = [Y, i - \pi, r - i, L, \mathrm{ROE}, \mathrm{NSFR}, \mathrm{TCE/RWA}]$. The deterministic part of the model includes a constant and ϵ_t is a vector of white noise residuals. The number of lags(p) has been set equal to 3 based on the Akaike information criteria (AIC). Normality of the VAR may be achieved with the dummy for 1999:q1 and 2004:q1.

Based on the Augmented Dickey Fuller (ADF) test, we found that all of these data have one unit root. The $I(1)$ nature of the variables included in z_t may imply existing cointegrating relationships. Equation (6) therefore can be rearranged as a reduced-form error correction model:

$$\begin{aligned} & \Delta z_t = \Pi(\mu, z_{t-1}) + \sum_{k=1}^{p-1} \Gamma_k \Delta z_{t-k} + \eta dum_t + \epsilon_t \\ & t = 1, 2..., T \\ & \Pi = (\Theta_1 - \mathrm{I}) = \alpha\beta^{'} \end{aligned} \tag{7}$$

This framework can be used to apply Johansen's trace test to verify the order of integration of the matrix Π. In fact, the rank of Π determines the number of cointegrating vectors r such that α is an $n*r$ matrix of loading coefficients and β is an $n*r$ matrix of cointegrating vectors. The results show the presence of four cointegrating vectors in the model (see Table 7). So there might be four possible long term relationships amongst the variables.

The first long run relationship represents the banks' loan supply curve. Freixas and Rochet (1997) argue that each bank sets the lending rate as the sum of the exogenous cost of the bank's refinancing on the money market, other costs (such as bank capital and liquidity requirements) and a constant mark-up in a model of imperfect competition. Therefore, a bank's spread-setting can be represented as:

$$r - i = \gamma_0 + \gamma_1 \text{TCE/RWA} + \gamma_2 \text{NSFR} \tag{8}$$

The second long run relationship is a Commodities and Credit (CC) curve (Bernanke and Blinder, 1988), where the IS curve is modified to take account of the existence of the credit market. Under the assumption of the imperfect substitutability between loans and other forms of firms' financing, an increase in the lending spread captures a tightening in loan supply that should produce a drop in investment and output. The CC curve has the following form:

$$Y = \alpha_0 + \alpha_1(i - \pi) + \alpha_2(r - i) + \alpha_3 \text{ROE} \tag{9}$$

The third long term relationship is a lending demand curve. Demand for bank lending should be a positive function of real GDP and a negative function of the spread. Similar to Gambacorta (2010), we suppose the existence of a log-linear long run relationship of the following type:

$$L = \beta_0 + \beta_1 Y + \beta_2(r - i) \tag{10}$$

The fourth long term relationship is the bank profitability equation. A bank's profit depends on lending volume and the spreads:

$$\text{ROE} = \delta_0 + \delta_1 L + \delta_2(r - i) + \delta_2(i - \pi) \tag{11}$$

5. Results

5.1. Economic Benefit

The probit model estimation results are set out in Table 8. We took a general-to-specific approach to finally choose the most preferred specification (i.e. spec 12 in Table 8). All coefficients have the expected signs. The negative coefficient of the non-linear-in-factors imply that higher capital and liquidity requirements can prevent the occurrence of a banking crisis. The positive sign of the estimated coefficient on RPI_t shows that higher real estate price inflation would increase the probability of crisis. And the insignificance of the CA_t term implies a limited chance of a currency crisis following the 2008 banking crisis in the UK.

The non-linear-in-factor model does not only capture the high probability of a crisis occuring in 2008 (see Figure 5), but also provides useful information to help assess the cumulative impact of the multiple regulatory requirements. Table 9 shows the relationship between TCE/RWA (or NSFR) and changes in the probability of a crisis occuring. We firstly estimated the base-line probability of a crisis at the mean level of all variables. The average UK historical TCE/RWA (or NSFR) is 6% (or 0.95). Holding other factors constant, a 1% increase in the TCE/RWA ratio will reduce the probability of a crisis occuring by around 3.211%. The probability of a crisis will be reduced by 4.996% when the capital ratio increases to 12%. If the NSFR ratio remains at 1, the reduction in the probability of a crisis will be 2.036%.

We calculate that the cumulative temporary GDP loss associated with a systemic banking crisis from 2008:q1 to 2010:q2 is 10% of pre-crisis UK GDP. Using a conservative discount factor of 5% (i.e.the same as that used by BCBS (2010b)), the converted cumulative permanent GDP loss is estimated to be 210% [9] (see Table 10). Using the probability of crisis estimated by the model presented in the previous section, it is straightforward to quantify the marginal benefit from raising capital (or liquidity) requirements by increaments of one percent. Tables 11 and 12 summarise the economic benefits of higher capital and liquidity requirements. If the TCE/RWA catio stays between 7% and 12%, the range of temporary expected benefit will be from 1.102% to 1.714%, and the range of the permanent expected benefit will be from 23.136% to 35.997%. If the NSFR stays at 1, the temporary and permanent expected benefits will be 0.699% and 14.670% respectively.

5.2. Economic Cost

These are the estimated long run relationships from the VECM model (with standard errors in brackets):

$$\begin{array}{rcl} r - i & = & \underset{}{17.83} + \underset{(1.135)}{5.27\text{TCE/RWA}} + \underset{(4.083)}{10.04\text{NSFR}} \end{array} \tag{12}$$

$$Y = 5.8 - \underset{(0.027)}{0.084(r-i)} - \underset{(0.021)}{0.216(i-\pi)} + \underset{(0.420)}{3.04\text{ROE}} \tag{13}$$

$$L = -11.75 + \underset{(0.185)}{3.21Y} + \underset{(0.021)}{0.15(r-i)} \tag{14}$$

$$\text{ROE} = -0.074 + \underset{(0.028)}{0.11L} + \underset{(0.072)}{0.73(r-i)} + \underset{(0.074)}{0.18(i-\pi)} \tag{15}$$

As for the estimated coefficients, the long run elasticities between the spread and the two regulatory variables are quite low. For a 1% increase in the capital (or liquidity) ratio , the spread increases by 5% (10%). As expected, there is a negative relationship between GDP and

[9] Assuming a current temporary loss of (δ), a growth rate (g) equal to 0 and an interest rate (r) equal to 5% in the infinite horizon, then the present value of the future permanent loss can be calculated as $\delta(\frac{1+r}{r-g})$.

both the real interest rate and the spread. The semi-elasticity between GDP and the lending spread is -0.084. The long-run elasticity between lending and GDP is equal to 3.21. Bank lending, spreads and the short term real interest rate all positively impact bank profitability. The long-run elasticity between ROE and lending is 0.11, and the semi-elasticitiy between ROE and the lending spread (or real short term interest rate) is 0.73 (or 0.18).

Table 13 summarises the long-run impact of TCE/RWA (or NSFR) on output, based on the estimation results. Other things being equal, a one percentage-point increase in the capital ratio will cause a 0.238% loss of pre-crisis output. The maximum reduction in output will be 0.598% when the capital ratio increases to 15%. If the NSFR liquidity requirement is met, the loss of output will be 0.352%.

5.3. Net Benefit

The estimated net benefit for the United Kingdom is dependent on whether banking crises are assumed to result in a temporary or permanent GDP loss. As mentioned in previous sections, the estimated cumulative temporary GDP loss is 10% of pre-crisis UK GDP, and the permanent GDP loss during the recent crisis is estimated to be 210%. The expected economic benefit can thus be quantified as the product of the marginal reduction in probability of a crisis occuring because of increasing capital (or liquidity) requirements and the two types of expected GDP loss arising from a banking crisis. From Table 14, we can see that the maximum net benefit (temporary plus permanent) occurs when the TCE/RWA ratio is set at 10%. At this capital level, the temporary net benefit and permanent net benefit will be 1.284% and 35.484% of pre-crisis GDP respectively. Assuming all UK banks meet the new long-term liquidity requirement, the temporary net benefit and permanent net benefit will be 0.347% and 14.318% respectively (see Table 15).

6. Summary and Conclusions

In summary, the Basel III reforms are expected to generate a significant positive net benefit for the United Kingdom economy. Our estimated optimal level of tangible common equity (the highest quality, loss-absorbing capital) is 10% of risk weighted assets, which is higher than the normal Basel III target for the minimum common equity capital ratio of 7% [10], and even that set for 'systemically important financial institutions' (SIFIs) [11]. This finding supports those who argue for tighter capital standards under Basel III, at least as far as the UK is concerned.

[10] The target, which has to be met by Janurary 2019, comprises a minimum 4.5% common equity capital ratio requirement (to be met by January 2015) and a minimum 2.5% conservation buffer requirment.

[11] The BCBS agreed in June 2011 to phase in (between 2016 and 2019) a capital surcharge of up to 2.5% of RWA for such institutions.

In addition, we estimate the maximum net benefit when banks also meet the Basel III long-term liquidity requirements (i.e. when the NSFR stays at 1). Our results prove there is a clear role for liquidity to prevent banking crises and economic downturns. Overally, our results are consistent with the proposition that the reforms are likely to increase financial stability in the UK by strengthening the quality of both banks' capital bases and funding structures.

Our estimated temporary net benefit is similar to the average estimation for selected economies of the BCBS (2010b). However, the permanent net benefit is higher than the average permanent net benefit calculated by the BCBS (2010b). The temporary net benefit is estimated by us to range from 0.864% to 1.314% compared to the BCBS estimates of 0 to 1.96%; while the permanent net benefit is estimated to range from 22.898% to 35.507% compared to the BCBS estimates of 0 to 5.90%. The reason for the higher expected permanent benefit is that our estimated permanent GDP loss is 210%, which is higher than the average estimate of 158% of the BCBS (2010b).

We acknowledge, however, that the paper has several limitations. First, because only one UK banking crisis has occurred since 1997, we cannot use out-of-sample tests to evaluate the forecasting ability of the non-linear-in-factor probit model. Second, other possible economic benefits and costs arising from the Basel III requirements have not been taken into account in this study due to difficulties in quantification [12]. And third, the estimated benefits (or costs) of the NSFR requirements are sensitive to the assumptions used to calculate the NSFR. Notwithstanding this, we do our best to quantify the long-term economic impact of the new requirements for the UK economy in one of the first stand-alone country analyses of the combined impact of the recently-agreed changes to the international standards for banks' capital and liquidity.

References

Angelini, P., Clerc, L., Cúrdia, V., Gambacorta, L., Gerali, A., Locarno, A., Motto, R., Roeger, W., Van den Heuvel, S. J. and Vlček, J. (2011), Basel III: Long-term impact on economic performance and fluctuations, Working Paper No. 338, BIS.

Barrell, R., Davis, E. P., Fic, T., Kirby, D. H. S. and Liadze, I. (2009), Optimal regulation of bank capital and liquidity: How to calibrate new international standards, Occasional Paper Series No. 38, Financial Services Authority.

Barrell, R., Davis and Liadze, I. (2010), The effects of banking crises on potential output in

[12] For a broad cost-benefit style of analysis of the Basel Capital Accord see (Hall, 2004).

OECD countries, NIESR Discussion Paper No. 358, National Institute of Economic and Social Research.

BCBS (2009), Liquidity risk measurement, standards and monitoring, Basel, December.

BCBS (2010a), Basel III: A global regulatory framework for more resilient banks and banking systems, Basel, December.

BCBS (2010b), An assessment of the long-term impact of stronger capital and liquidity requirements, Basel, August.

Bernanke, B. S. and Blinder, A. S. (1988), 'Credit, money, and aggregate demand', *American Economic Review* **78**(2), 435–39.

Bordo, M., Eichengreen, B., Klingebiel, D. and Martinez-Peria, M. S. (2001), 'Is the crisis problem growing more severe?', *Economic Policy* **16**(32), 51–82.

Boyd, J. H., Kwak, S. and Smith, Bruce D., d. (2005), 'The real output losses associated with modern banking crises', *Journal of Money, Credit, and Banking* **37**, 977–999.

Cecchetti, S. G., Kohler, M. and Upper, C. (2009), Financial crises and economic activity, Working Paper No. 15379, National Bureau of Economic Research.

Cerra, V. and Saxena, S. C. (2008), 'Growth dynamics: The myth of economic recovery', *American Economic Review* **98**(1), 439–57.

Dellas, H., Diba, B. and Loisel, O. (2010), Financial shocks and optimal policy, Working paper No. 277, Banque de France.

Demirguc-Kunt, A., Detragiache, E. and Gupta, P. (2000), Inside the crisis : an empirical analysis of banking systems in distress, Policy Research Working Paper Series 2431, The World Bank.

Freixas, X. and Rochet, J. (1997), *Microeconomics of Banking*, Vol. 1, The MIT Press.

Furceri, D. and Zdzienicka, A. (2010), Banking crises and short and medium term output losses in developing countries: The role of structural and policy variables, MPRA Paper No. 22078, University Library of Munich, Germany.

Gambacorta, L. (2010), Do bank capital and liquidity affect real economic activity in the long run? A VECM analysis for the US, mimeo, BIS.

Gauthier, C., Lehar, A. and Souissi, M. (2010), Macroprudential regulation and systemic capital requirements, Working Paper No. 10-4, Bank of Canada.

Haldane, A. (2010), The 100 billion dollar question, Accepted Paper Series No.22, Bank of England.

Hall, M. J. B. (2004), 'Basel II: Panacea or a missed opportunity?', *Banca Nazionale del Lavoro Quarterly Review* **LVII**(230), 215–264.

Haugh, D., Ollivaud, P. and Turner, D. (2009), The macroeconomic consequences of banking crises in OECD countries, OECD Economics Department Working Paper No. 683, OECD Publishing.

Hoggarth, G., Reis, R. and Saporta, V. (2002), 'Costs of banking system instability: Some empirical evidence', *Journal of Banking and Finance* **26**(5), 825–855.

Hutchison, M. and Noy, I. (2002), How bad are twins? Output costs of currency and banking crises, Pacific Basin Working Paper Series 02-02, Federal Reserve Bank of San Francisco.

Kashyap, A. K., Stein, J. C. and Wilcox, D. W. (1993), 'Monetary policy and credit conditions: Evidence from the composition of external finance', *American Economic Review* **83**(1), 78–98.

Kato, R., Kobayashi, S. and Saita, Y. (2010), Calibrating the level of capital: The way we see it, Working Paper Series No.10-E-6, Bank of Japan.

Laeven, L. and Valencia, F. (2008), Systemic banking crises: A new database, IMF Working Paper No. 08/224, International Monetary Fund.

Locarno, A. (2004), A reduced-scale version of the Bank of Italy Quarterly Model, mimeo, Bank of Italy.

Meh, C. and Moran, K. (2008), The role of bank capital in the propagation of shocks, Working Paper No. 08-36, Bank of Canada.

Miles, D., Yang, J. and Marcheggiano, G. (2011), Optimal bank capital, CEPR Discussion Paper No. 8333., Centre for Economic Policy Research, London.

Röger, W., Székely, I. and Turrini, A. A. (2010), Banking crises, output loss and fiscal policy, CEPR Discussion Paper No. 7815, Centre for Eonomic Policy Research, London.

Tarashev, N. and Zhu, H. (2008), 'Specification and calibration errors in measures of portfolio credit risk: The case of the ASRF model', *International Journal of Central Banking* **4**(2), 129–173.

Van den Heuvel, S. J. (2008), 'The welfare cost of bank capital requirements', *Journal of Monetary Economics* **55**(2), 298–320.

Walter, S. (2010), Basel III and financial stability, Speech given at the 5th biennial conference on risk management and supervision, Basel, November.

Wong, T., Fong, T., Li, K. and Choi, H. (2010), An assessment of the long-term economic impact of the new regulatory reform on Hong Kong, Working Paper Series, Bank of Hong Kong.

Tables

Table 1: Crisis prediction/simulation models

Article	Model type	Reference country	Bank capital	Bank liquidity	Main findings
Barrell et al. (2009)	Reduced	Euro area	yes	yes	Increasing the levels of capital and liquidity by 1% would have reduced the probability of a crisis in the UK by more than 6%, and by smaller amounts in other countries.
Kato et al. (2010)	Reduced	Japan	yes	yes	By introducing a 1% increase in the capital ratio, the probability of a crisis occuring will fall by 3.10% without any increase in liquidity. The probability of a crisis occuring will fall by 2.8% when a 1% increase in the capital ratio as well as a 10% increase in the deposits-to-total-assets-ratio are implemented.
Wong et al. (2010)	Reduced	Hong Kong	yes	yes	Further reductions in the probability of a banking crisis from an increase in the tangible common equity ratio beyond 7% may not be significant. The marginal benefit becomes virtually zero when the TCE/RWA ratio is higher than 11%.
Tarashev and Zhu (2008)	Portfolio	Euro area	yes	no	Increasing capital ratios from 6% to 9%, without any increase in liquidity, decreases the likelihood of a systemic crisis by more than a half (e.g.from 4.9% to 2.3%).
Miles et al. (2011)	Stress testing	UK	yes	no	The probability of a crisis occurring will fall from 4.57% to 0.75%, if banks increase their capital ratio from 5% to 20%.
Gauthier et al. (2010)	Stress testing	Canada	yes	no	Increasing capital ratios from 7% to 8%, without any increase in liquidity, decreases the likelihood of a systemic crisis by two thirds (e.g.from 4.7% to 1.7%).

Table 2: Studies looking at the cost of a banking crisis (relative to pre-crisis GDP)

Study	Estimated mean losses	Estimated cumulative losses
Temporary losses		
Bordo et al. (2001)	6	
Demirguc-Kunt et al. (2000)	7	
Hutchison and Noy (2002)	10	
Laeven and Valencia (2008)		20
Haugh et al. (2009)		21
Cecchetti et al. (2009)		18
Hoggarth et al. (2002)	14	16
Permanent losses		
Cerra and Saxena (2008)	7.5	158
Röger et al. (2010)	9.4	197
Furceri and Zdzienicka (2010)	4.5	210
Barrell et al. (2010)	2	42
Boyd et al. (2005)		302
Haldane (2010)		200

Table 3: Long-term cost estimation/calibration models

Article	Model type	Reference country	Estimated /calibrated	Bank capital	Bank liquidity	Main findings
Gambacorta (2010)	VECM	US	estimated	yes	yes	The impact of changes in capital and liquidity ratio on long-term output are quite small.
Wong et al. (2010)	ECM	Hong Kong	estimated	yes	no	A 1% increase in capital will reduce output by 4.2 basis points in the long run.
Röger et al. (2010)	DSGE	Euro area	calibrated	yes	yes	A 6% increase in capital with no changes of liquidity will reduce output by 0.81%. Fiscal policy appears to matter for the impact of banking crises on headline growth but not on potential output.
Van den Heuvel (2008)	DSGE	US	calibrated	yes	no	The welfare cost of current capital adequacy regulation is found to be equivalent to a permanent loss in consumption of between 0.1% and 1%.
Dellas et al. (2010)	DSGE	US	estimated	no	yes	Monetary policy becomes less accommodating to liquidity shocks under equity market frictions.
Meh and Moran (2008)	DSGE	US	calibrated	yes	no	Bank capital increases an economy's ability to absorb shocks. Following adverse shocks, well-capitalized banking sectors experience smaller decreases in bank lending and less pronounced downturns.
Locarno (2004)	Semi-structual	Italy	estimated	no	no	The mean results are the same as those of the DSGE models.
Miles et al. (2011)	Single equation	UK	calibrated	yes	no	Doubling capital (from 8.4% to 16.8%) would reduce the output 15% where there is no tax effect and 45% M-M offset.

Table 4: Sample of UK banks used to calculate the capital ratio

Incorporated banks in the UK	Building Societies
Barclays Bank plc	Bradford & Bingley Building Society
Clydesdale Bank plc	
Co-operative Bank plc	
HSBC Bank plc	
Investec Bank plc	
Lloyds TSB Bank plc	
NatWest Bank plc	
Northern Rock plc	
Royal Bank of Scotland plc	
Santander UK	
Standard Chartered Bank	

Source: Bankscope; FSA.

Table 5: Sample of UK banks used to calculate the liquidity ratio

Incorporated banks in the UK	Building Societies
Barclays Bank plc	Britannia Building Society
Clydesdale Bank plc	Bradford & Bingley Building Society
Co-operative Bank plc	Nationwide Building Society
HSBC Bank plc	Newcastle Building Society
Investec Bank plc	Skipton Building Society
Lloyds TSB Bank plc	West Bromwich Building Society
NatWest Bank plc	
Northern Rock plc	
Royal Bank of Scotland plc	
Santander UK	
Standard Chartered Bank	

Source: Bankscope; FSA.

Table 6: Description of Variables and Sources Used

Variable	Definitions	Source	Dataset Name/Code
TCE/RWA	The quarterly average ratio of tangible common equity to risk-weighted assets.	Bankscope & FAR*	
NSFR	The quarterly average net stable funding ratio calculated based on the definition in the December 2009 proposal.	Bankscope & FAR*	
ROE	The quarterly average return on equity ratio.	Bankscope	
i	The quarterly average 3-month interbank rate.	BOE	IUQAAMIJ
π	The quarterly inflation rate (CPI % change).	IFS	64....XZF
r	The quarterly average 3-month clearing banks ' lending rate for different types of loans.	IFS	60p...ZF
RPI	The quarterly real estate price inflation rate (% change of real estate price index).	ONS	rpi1q
CA	The quarterly ratio of current account balance to nominal GDP.	ONS	pnbp:B:HBOP & YBHA
GDP(Y)	United Kingdom's quarterly real GDP.	IFS	99B.RWF
L	Quarterly amount of real banking lending to private sector.	BOE & IFS	LPQVQJM & 64....XZF

Note: * FAR is Financial Annual Reports of UK banks.

Table 7: Johansen Cointegration Test (Trace)

	test	10pct	5pct	1pct
r <= 6	7.16	7.52	9.24	12.97
r <= 5	11.51	13.75	15.67	20.2
r <= 4	23.47	19.77	22	26.81
r <= 3	29.54	25.56	28.14	33.24
r <= 2	31.93	31.66	34.4	39.79
r <= 1	42.65	37.45	40.3	46.82
r = 0	61.71	43.25	46.45	51.91

Note: Trace test indicates 4 cointegrating equation(s) at the 0.01 level.

Table 8: Estimation Results

Variable /	Nest				Linear-term-only				Nonlinear-term-included			
Spec	1	2	3	4	5	6	7	8	9	10	11	12
Pr(crisis)=0 or 1												
TCE/RWA*NSFR	844.36	NA	NA	NA					2.06	0.58	-1.99	-4.383*
TCE/RWA	42.31	0.48	-2.7	-6.24*	1.78	0.48	-2.7	-6.24*				
NSFR	2360.02	3.44	10.43	19.41	8.62	3.44	10.43	19.41				
RPI	4.77	0.038	-1.41	-3.14*	0.81	0.04	-1.41	-3.14*	0.85	0.05	1.24	2.518*
CA	-0.02	-0.005	0.5172	0.88*	0.1	-0.006	0.52	0.88*	0.004	-0.049	-0.3	-0.447
lag	0	1	2	3	0	1	2	3	0	1	2	3
Log likelihood	-8.11	-16.8	-15.19	-12.51	-15.68	-16.81	-15.2	-12.51	-15.84	-16.84	-15.75	-14.22

Note: *denotes the 5% level of significance.

Table 9: The relationship between TCE/RWA (or NSFR) and changes in the probability of a banking crisis occurring

TCE/RWA	Reduction in the probability of a crisis	NSFR	Reduction in the probability of a crisis
7%	3.211%	0.96	0.612%
8%	4.634%	0.97	1.020%
9%	4.930%	0.98	1.389%
10%	4.984%	0.99	1.727%
11%	4.993%	1	2.036%
12%	4.996%		
13%	4.996%		
14%	4.996%		
15%	4.996%		

Table 10: Output losses associated with a banking crisis (as a percentage of pre-crisis GDP)

	Difference between GDP at beginning and end of period	Cumulative discounted loss
Period from peak to trough	6	
Period until growth rate recovers	4	
Period from peak to end of crisis		10
Infinite horizon		210*

Notes: *assumes a conservative discount factor of 5%.

Table 11: Economic benefit of higher capital requirements

TCE/RWA	Temporary expected benefit(%)	Permanent expected benefit(%)
7%	1.102	23.136
8%	1.590	33.389
9%	1.691	35.521
10%	1.710	35.910
11%	1.713	35.975
12%	1.714	35.997
13%	1.714	35.997
14%	1.714	35.997
15%	1.714	35.997

Table 12: Economic benefit of higher liquidity requirements

NSFR	Temporary expected benefit(%)	Permanent expected benefit(%)
0.96	0.210	4.410
0.97	0.350	7.349
0.98	0.477	10.008
0.99	0.593	12.443
1	0.699	14.670

Table 13: The relationship between TCE/RWA (or NSFR) and reduction in output

TCE/RWA	Reduction in output	NSFR	Reduction in output
7%	0.238%	0.96	0.318%
8%	0.318%	0.97	0.327%
9%	0.377%	0.98	0.336%
10%	0.426%	0.99	0.344%
11%	0.468%	1	0.352%
12%	0.505%		
13%	0.539%		
14%	0.570%		
15%	0.598%		

Table 14: Economic impact of higher capital requirements

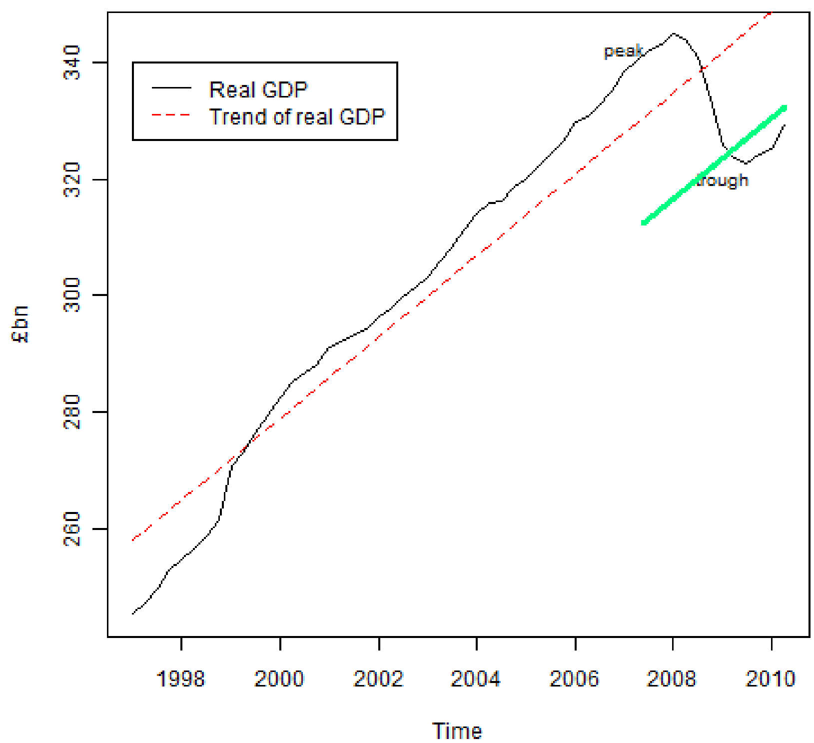
		Temporary GDP loss		Permanent GDP loss	
TCE/RWA	Expected cost(%)	Expected benefit(%)	Net benefit(%)	Expected benefit(%)	Net benefit(%)
7%	0.238	1.102	0.864	23.136	22.898
8%	0.318	1.590	1.272	33.389	33.071
9%	0.377	1.691	1.314	35.521	35.144
10%	0.426	1.710	1.284	35.910	35.484
11%	0.468	1.713	1.245	35.975	35.507
12%	0.505	1.714	1.209	35.997	35.492
13%	0.539	1.714	1.175	35.997	35.458
14%	0.57	1.714	1.144	35.997	35.427
15%	0.598	1.714	1.116	35.997	35.399

Table 15: Economic impact of higher liquidity requirements

		Temporary GDP loss		Permanent GDP loss	
NSFR	Expected cost(%)	Expected benefit(%)	Net benefit(%)	Expected benefit(%)	Net benefit(%)
0.96	0.318	0.210	-0.108	4.410	4.092
0.97	0.327	0.350	0.023	7.349	7.022
0.98	0.336	0.477	0.141	10.008	9.672
0.99	0.344	0.593	0.249	12.443	12.099
1	0.352	0.699	0.347	14.670	14.318

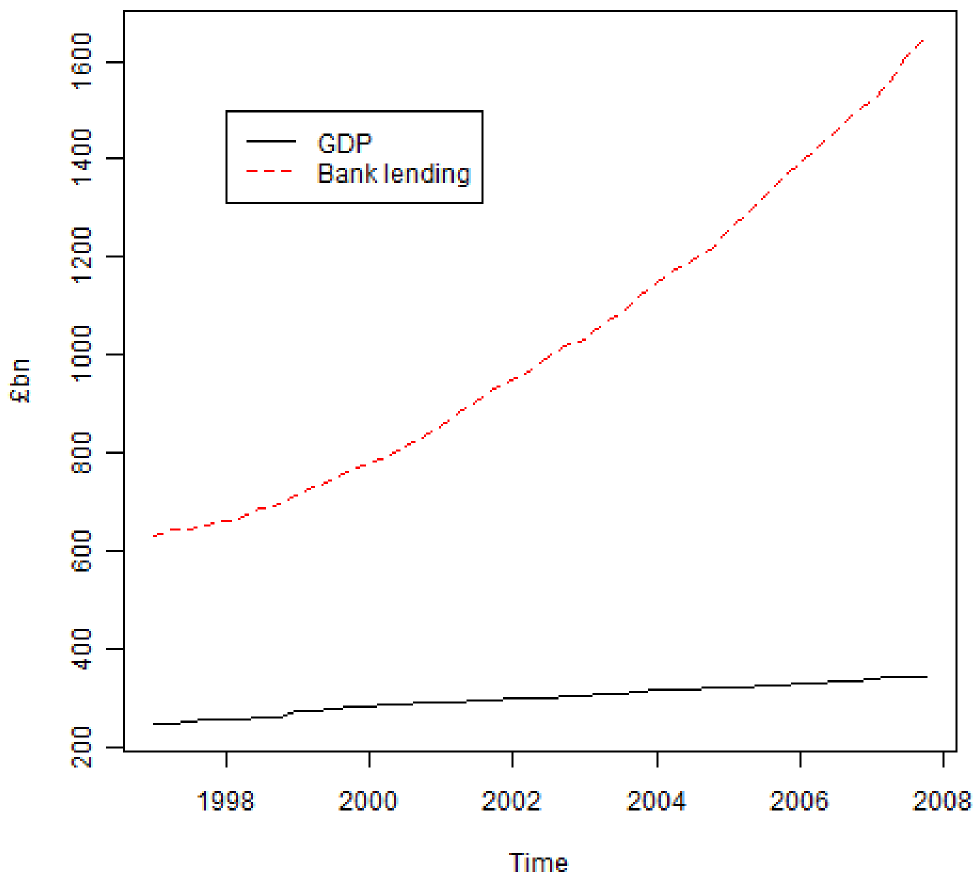
Figures

Figure 1: Real UK GDP, 1997-2010



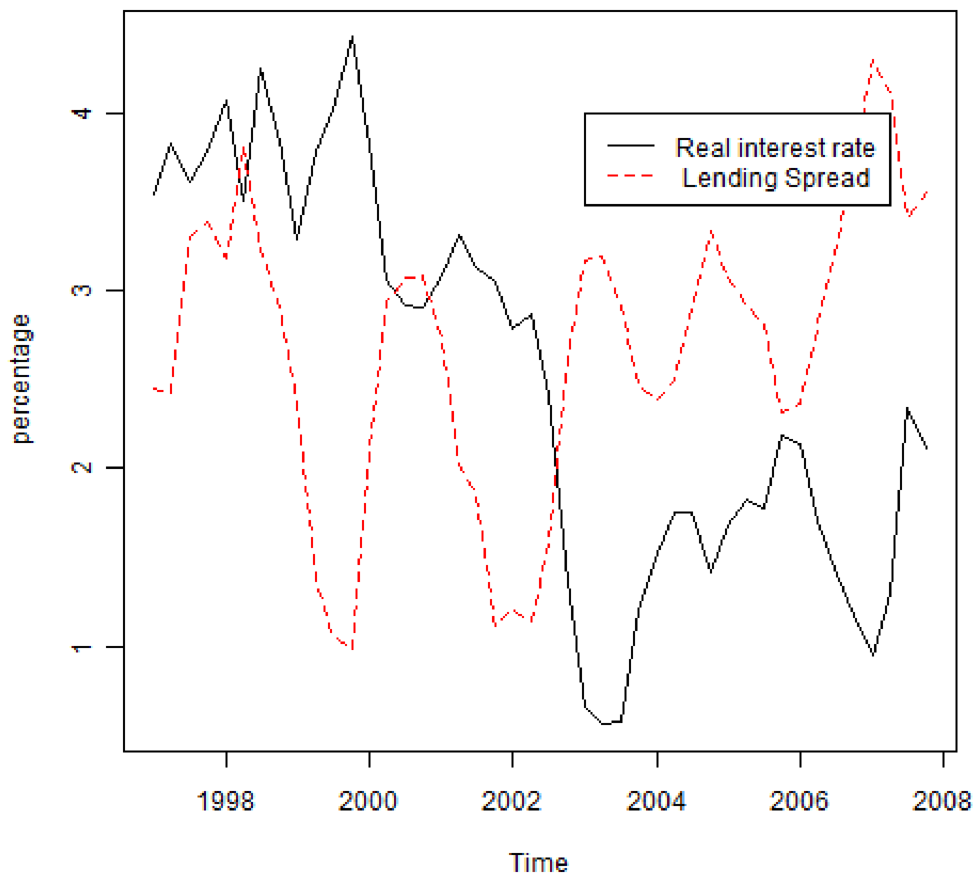
Note: The trend of real GDP is estimated by regressing the real GDP on a constant and a linear time trend.

Figure 2: Bank lending and GDP, 1997-2007



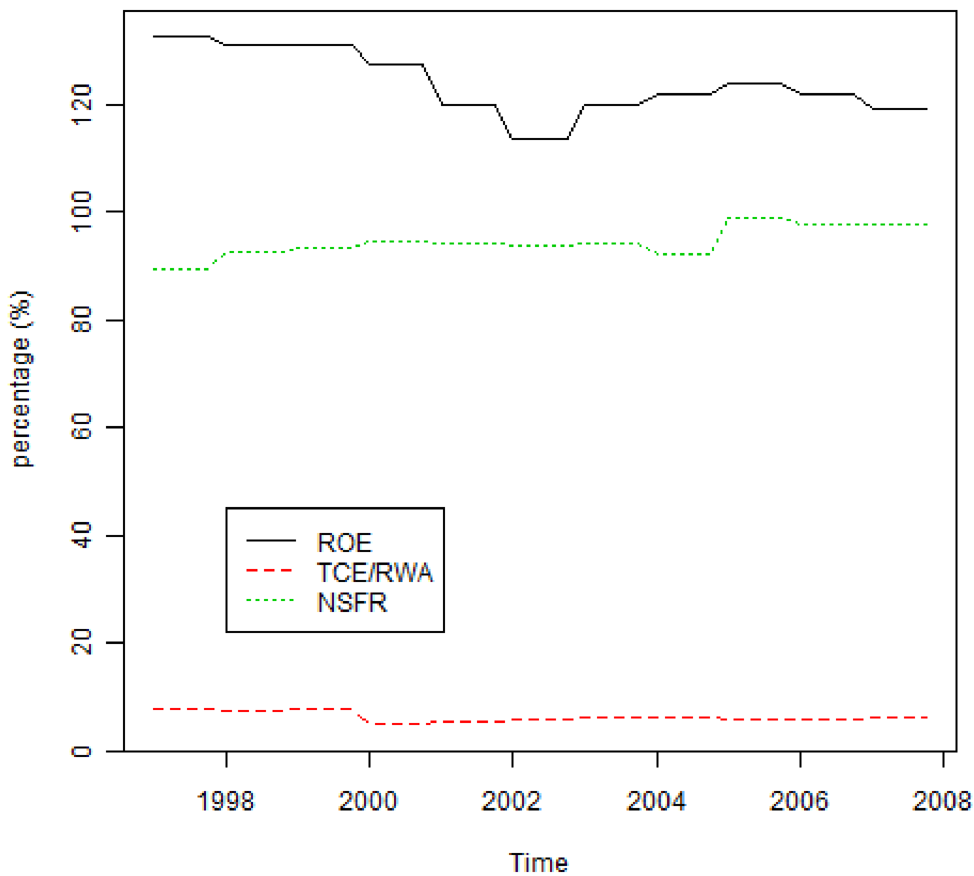
Note: GDP is gross domestic product (output measure) at constant prices. The real bank lending series includes lending to both banking and non-bank financial firms.

Figure 3: Short term real interest rates and lending spreads, 1997-2007



Note: The short term real interest rate is given by the 3-month interbank rate minus CPI inflation. The spread is the difference between the lending rate and the 3-month interbank rate.

Figure 4: Bank profitability, the capital ratio and the liquidity ratio, 1997-2007



Note: The return on equity of UK banks is in real terms; and the tangible common equity capital ratio and net stable funding ratio are calculated using data from Bankscope as well as banks' annual reports.

Figure 5: Crisis Prediction