Quantifying the Cyclicality of Regulatory Capital – First Evidence from Austria

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With the financial crisis spreading to the real economy, the discussion about potential procyclical implications of Basel II received a surge of attention. While existing research approaches the topic either from a theoretical perspective or from an empirical perspective that draws on simulated data, we are first in studying the cyclicality of risk weights on the basis of realized data. Furthermore, we are able to differentiate not only between Basel I and Basel II, but also between the Standardized Approach (StA) and the internal ratings-based (IRB) approach. We argue that without knowledge of these approaches' presumably distinct cyclicality of risk weights, any measure to dampen procyclicality is premature. For this purpose, we first study which banks opt for implementation of the IRB approach and then set up a panel model to quantify the cyclicality of capital requirements. While we find no evidence of cyclicality in portfolios subject to the Basel II StA, we find economically substantial and statistically significant effects in IRB portfolios.

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1 Introduction and Motivation

In the face of the ongoing crisis, interest in the discussion about potential procyclical implications of the current regime of financial regulation, Basel II, has increased. In a nutshell, it is argued that in economically bad times higher regulatory capital requirements induce banks to reduce their lending activities, thus hampering aggregate demand (and vice versa in good times).

In the respective literature this procyclical effect is referred to as the "bank capital channel" (see Drumond, 2008, for a synthesis). In this study we empirically analyze the link between economic conditions and increases in regulatory capital requirements – we refer to this link as "cyclicality of capital requirements." At least from an empirical point of view, potential procyclicality effects – a further economic downturn stemming from reduced lending activities due to the cyclicality of capital requirements – are exceptionally complex to identify. Even if one controls for all relevant factors that affect bank lending and takes banks' capital constraints into account, bank lending might be procyclical even without capital requirements. So it remains unclear how to distinguish between (additional) procyclicality induced by cyclical capital requirements and reduced lending due to decreased demand or lending opportunities.

As Kashyap and Stein (2004) point out, capital constraints are more binding in a recession. That is, the scarcity of bank capital relative to positive net present value lending opportunities is more severe in such an economic environment. From a bank's perspective, two effects lead to more binding capital constraints in times of crisis:

1. Banks suffer losses, and these losses directly reduce equity. One can refer to this as "contraction in the numerator," as the capital base relative to risk-weighted assets shrinks due to a smaller capital base.
2. The risk underlying banks' assets increases; under the assumption of a regulatory system that maps risk

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via an increasing function into risk weights, capital requirements also rise in economically difficult times. Basel II clearly aims at providing such a function; in fact this function constitutes the key change compared to Basel I (Drumond, 2008).

To complete the picture, we add one further factor:

3. Capital constraints are more binding during a crisis because the possibility of raising new capital erodes under such circumstances. Although it seems that the difficulty of raising new capital was neglected before the crisis,[2] its presence as well as its high correlation with the two effects mentioned above are now generally acknowledged. Many banks' assumption of unchanged funding sources in times of crisis proved to be terribly wrong.

To sum it up, the two effects lead to tighter capital constraints for banks and therefore to reduced lending,[3] which in turn has a negative impact on the real economy.

In fact, (1) is somehow a *natural* outcome of the crisis, while (2) is regulatorily induced. Therefore, studies on the procyclicality of regulatory systems focus on the second effect.

The issue of an economic cycle-amplifying effect due to volatile capital requirements has been much debated in financial literature. On the theoretical side, we find papers by Catarineu-Rabell et al. (2005), Heid (2007) and recently Pederzoli et al. (2008), who model the effects of business cycle fluctuations on capital requirements. Empirical studies on the other hand generally use data on rating migrations to simulate the effects of a downturn on regulatory capital requirements. Among those we find e.g. the works of Kashyap and Stein (2004), Gordy and Howells (2006) and Repullo et al. (2009).[4] Although the hypothesis that Basel II induces additional cyclicality of capital requirements is generally supported, a high level of uncertainty remains. There are two main reasons for this: One is that all of the studies mentioned base their research on simulated data rather than observed outcomes of capital requirements.[5] Lowe (2002) states that due to structural changes, the effects of Basel II cannot be assessed adequately under the regime of Basel I, which can be seen as a version of the Lucas Critique. The wide range of results of empirical studies reflects the sensitivity of critical assumptions about the construction of simulated data. Reviewing the literature on this topic, one finds differing assumptions about management reactions, rating migration, rerating frequency, severeness of the downturn, etc.

The second reason for the high level of uncertainty is that there is very little or no evidence on how the cyclicality of capital requirements differs between

[2] *E.g. Aguiar and Drumond (2007) address this effect via a varying liquidity premium on equity, Markovic (2006) via the introduction of the adjustment cost channel, the default risk channel and the capital loss channel. Nevertheless, the fact that the possibility to raise new capital is not included in theoretical models has rather been seen as a drawback than a feature of the model.*

[3] *See Blum and Hellwig (1995) for a simple Aggregate Demand-Aggregate Supply model on how capital requirements affect aggregate demand. Aliaga-Diaz (2005) incorporates capital requirements into a Dynamic Stochastic General Equilibrium (DSGE) model. Drumond (2008) provides an extensive literature review of this link from a theoretical perspective. Peek and Rosengren (1995) and Jackson et al. (1999) present empirical support.*

[4] *See Kashyap and Stein (2004) and Lowe (2002) for an overview.*

[5] *This is because most studies were conducted prior to or at an early stage of implementation of Basel II. However, there is research studying the determinants of capital ratios subject to Basel I that makes use of realized data. See Francis and Osborne (2009) and the references therein.*

regulatory regimes, i.e. Basel I, Basel II StA and Basel II IRB.[6] In fact, many empirical studies focus solely on IRB and therefore do not allow a comparison. While it seems obvious that Basel II takes more sensitive risk weights into account than Basel I, irrespective of the approach, the comparison of StA and IRB is not clear from an ex ante perspective. Furthermore, we argue that without knowledge of these approaches' presumably distinct cyclicality, any measure to dampen procyclicality suggested by the literature is premature.

The contribution of our study is therefore twofold. First, we examine the cyclicality of capital requirements based on realized, not simulated data. Our observation period covers an entire business cycle from the year 2000 to 2009, thus including the recent crisis. Second, we provide first evidence on the question so far unanswered in existing literature of whether risk weights show more cyclicality under the StA or under IRB. To measure the extent to which Basel II contributes to cyclicality, we set up a panel model. The regulatory reporting system, which provides us with detailed and frequent information on the Austrian banking sector, serves as a data source. Drawing on this source, we hope to find answers to the question of how capital requirements evolve in crisis periods, and to differentiate between Basel I, Basel II StA and Basel II IRB.

The remainder of the paper is structured as follows. Section 2 examines IRB more closely, focusing on banks' and regulators' motivation for introducing this regulatory approach. Section 3 presents the modeling approach to quantify cyclical effects, whose results are presented in section 4. Section 5 concludes with an outlook on how the cyclicality of capital requirements can be embedded in the economic and political discussion about procyclicality. In particular, we highlight some areas of future research.

2 IRB Implementation

In this section we give a brief overview of IRB to better understand its role in the cyclical behavior of regulatory capital requirements and to address the question of which banks are able and willing to switch to IRB.

From a bank's perspective, the benefit of an IRB approach lies mainly in reduced capital requirements, as intended by the BIS.[7] Furthermore, the possibility of calculating own risk weights for certain bank assets without relying on the fixed Basel II tabularized weights can be seen as a major incentive. Banks subject to IRB are required to estimate their risk parameters based on a time series of at least five years. However, under certain circumstances, this time period may temporarily be reduced to two years.[8] In any case, this time span allows probability of default (PD) and loss given default (LGD) estimations to be conducted over the horizon of an economic boom phase during which estimates may be favorable with regard to minimizing risk weights.

On the cost side, the design and implementation of an IRB approach requires a certain amount of resources and know-how that only larger banks are likely to have at their disposal. Moreover, to counteract any incentives for banks to minimize their risk-

[6] *See http://www.oenb.at/en/presse_pub/period_pub/baselII/basel_ii.jsp for a comprehensive overview of Basel II, including a detailed description of the differences between Basel II StA and Basel II IRB.*

[7] *Compare the Quantitative Impact Study (BIS, 2006).*

[8] *See EU Directive 2006/48/EC Annex VII, Part 4, points 66 and 71.*

weighted assets excessively, banks are only allowed to implement a certified model subject to regulatory supervision. From the regulator's view, the reduced capital requirements are compensated for by a higher risk sensitivity, leading to more sophisticated coverage and a deeper awareness of the risks a bank is exposed to.

To econometrically analyze the decision-making process, we conduct a series of probit regressions that try to incorporate the above arguments. A few theoretical papers (i.e. Ruthenberg and Landskroner, 2008, as well as Hakenes and Schnabel, 2006) use bank size as a proxy for the ability to carry out large initial investments in risk management technologies that are necessary to comply with the regulatory requirements for such models. Aside from bank size (measured in total assets), variables that indicate the portfolio composition are used as explanatory variables.

In our models we find that bank size has a significant positive effect on the probability of adopting the IRB approach. On the benefits side, we could not clearly identify significant variables related to portfolio structure and quality. However, we believe that these inconclusive results are possibly related to the fact that IRB banks have not yet implemented the IRB for their entire portfolio.

3 Model Specification and Data

Following the argumentation of the previous section, we now turn to the modeling of the panel model to assess cyclical capital requirements[9] in banks. The capital requirements of bank i at time t, $CR_{i,t}$, can be expressed as

$$\mathrm{CR}_{i,t} = f(rr_{i,t}, ee_t, bank\ size_{i,t}, other\ factors_{i,t}). \quad (1)$$

Under $rr_{i,t}$, "regulatory regime," we identify whether bank i is subject to Basel I or Basel II, uses the IRB approach to determine its regulatory capital requirement, etc., at time t, while under the term ee_t, "economic environment," we identify general financial or macroeconomic conditions at time t. As the latter are assumed to be identical for all banks at a given time t, there is no subscript i. In this study the focus lies on

$$E\left(\frac{\partial CR_{i,t}}{\partial ee_t}\middle| rr_{i,t} = X\right). \quad (2)$$

E denotes the mathematical expectation parameter. Clearly, the hypothesis is that the relation between capital requirements and economic environment is subject to the regulatory regime a bank has to follow.

3.1 Data Description

In order to determine the dependence of capital requirements on economic conditions, we set up a panel model. In the next step, we present the data input needed to model function (1). We use quarterly data from all banks active in the Austrian market between March 2000 and March 2009. To the authors' knowledge, so far there has been no attempt to answer the discussed questions with a dataset of comparable size. The number of data points available totals 26,604.[10] The bulk of the data stems from the Austrian reporting system which obliges banks to regularly

[9] *For the remainder of the work, "capital requirements" will exclusively refer to regulatory capital requirements of credit risk.*

[10] *This is less than 850 banks times 4 quarters times 9 years (i.e. 30,600) as not every bank reports non zero numbers for the whole period. In such cases the respective data points have been eliminated.*

report certain data, especially solvency-related data. Consequently, information on banks' regulatory capital requirements *(CR)* and on their respective regulatory regime are available on a monthly basis. Clearly, *CR* is the dependent variable, while we use data on the regulatory regime to construct (1) a dummy variable equal to one if the bank reports under the Basel II regulation,[11] and (2) a variable which measures the share of the risk-weighted assets a bank calculates using the *IRB* approach.[12] These time series will be denoted $B2D_{i,t}$ and $IRB_{i,t}$ for the remainder of the study.

A priori, many variables would be suited to quantifying economic conditions, e.g. gross domestic product, unemployment, credit spreads, asset price indices, interest rates, to name just a few. Fortunately, we can draw on intensive literature concerning this selection process in Austria. Kalirai and Scheicher (2002) and Boss (2002) study the influence of several macroeconomic factors on provisions for credit losses or respectively on the probability of default in the Austrian financial sector. Reviewing these studies, certain factors are found to have a high explanatory power of the relevant exogenous variable in both studies.[13] Among these are asset price indices, exports, GDP, nominal short-term interest rates and industrial production.

Following these findings, we use Austrian real exports and Austrian real GDP to summarize economic conditions.[14] Thus, EE_t refers to either exports or GDP. With respect to bank size, we use total assets, denoted $TA_{i,t}$.

3.2 Estimation

Having presented the data, we now turn to details of the model specification. As changes in economic conditions or in the size of a bank obviously affect its capital requirements in relative terms, the variables enter the model in logarithms. Furthermore, in order to capture $\partial CR_{i,t} / \partial ee_t$ conditional on the regulatory regime (see equation (2)), dependences are modeled by including interaction terms.

Hence, equation (1) is modeled via

$$\begin{aligned}\log CR_{i,t} = {} & \alpha_{0,i} + \alpha_1 \log TA_{i,t} + \alpha_2 B2D_{i,t} \\ & + \alpha_3 IRB_{i,t} + \sum_{j=0}^{p} \beta_j \log EE_{t-j} \\ & + \sum_{j=0}^{p} \gamma_j (\log EE_{t-j} \times B2D_{i,t}) \\ & + \sum_{j=0}^{p} \eta_j (\log EE_{t-j} \times IRB_{i,t}) + u_{i,t}.\end{aligned} \tag{3}$$

As already stated, $TA_{i,t}$ denotes total assets and is therefore a measure of bank size, $B2D_{i,t}$ is a dummy variable indicating the switch to Basel II, $IRB_{i,t}$ the share of risk-weighted assets calculated by *IRB* and EE_{t-1} either real GDP or real exports. $u_{i,t}$ represents the usual error term, thus including "other factors." We set $p:=2$ in order to additionally incorporate the dependence on lagged explanatory variables.

Problematically, equation (3) contains two issues that must be dealt with when estimated. First, individual time-constant effects, $\alpha_{0,i}$, are unobserved, and estimating them would lead to a severe reduction in degrees of freedom. Second, several variables in equation (3) are likely to contain unit roots, which would render an estimation inconsistent. To examine the matter

[11] *Not applicable to any bank before January 2007 and to all banks after January 2008.*

[12] *Therefore, IRB equals zero for all banks using the IRB approach.*

[13] *In the case of Kalirai and Scheicher (2002), it is the sum of writeoffs and in the case of Boss (2002) sector-wide average PDs.*

[14] *We also calculate the respective estimations for nominal terms.*

more closely, we apply the *panel unit root test* suggested by Hanck[15] and find strong evidence for unit roots, especially in the time series *CR* and *TA* as well as in the time series for economic environment.

However, both issues can easily be dealt with by first differencing over time. This yields

$$\begin{aligned}\Delta \log CR_{i,t} &= \alpha_1 \Delta \log TA_{i,t} \\ &+ \alpha_2 \Delta B2D_{i,t} + \alpha_3 \Delta IRB_{i,t} \\ &+ \sum_{j=0}^{p} \beta_j \, \Delta \log EE_{t-j} \\ &+ \sum_{j=0}^{p} \gamma_j (\Delta \log EE_{t-j} \times B2D_{i,t}) \\ &+ \sum_{j=0}^{p} \eta_j (\Delta \log EE_{t-j} \times IRB_{i,t}) + \Delta u_{i,t}.\end{aligned} \tag{4}$$

Note that the individual time-constant effects have disappeared. Furthermore, we find no evidence of unit roots in the differenced time series. In our case, first differencing has additional appeal compared to fixed-effects or random-effects estimation. Applying a test suggested by Wooldridge (2002, see section 10.6.3), we cannot reject the hypothesis of serial correlated errors in the model specified in levels, but find strong evidence against serial correlated errors in differences.

The parameters β_j's measure the influence of the economic environment on capital requirements under Basel I. Under this regime, there was little or no risk sensitivity. Therefore, we expect these parameters to be indistinguishable from zero. In the subsequent sections the parameters of highest interest will be γ_j's and η_j's, as they measure the procyclicality of capital requirements under Basel II and IRB, respectively. A negative sign of these parameters would mean that in times of deteriorating economic conditions, capital requirements increase (on average) while the opposite would hold true for an upswing.

As the main distinctive criterion between Basel I and its successor Basel II is that the latter aims at increasing the sensitivity of capital requirements to the risk of banks' assets (Drumond, 2008), one could expect the *long-run propensity* of additional cyclicality of Basel II, $\overline{\gamma} := \sum_{j=0}^{p} \gamma_j$, to be negative. This would indicate a more pronounced cyclical movement of capital requirements than under Basel I. However, as already stated, most literature on procyclicality focuses on IRB, not on the StA.

In fact, the StA assigns risk weights to all instruments that carry credit risk. These risk weights are either fixed (if no external rating exists) or subject to a mapping process of international rating agencies, which, according to Cantor (2004), run *through-the-cycle* (TTC) models.[16]

Consulting existing literature on that matter, we find mixed results. Amato and Furfine (2003) and Catarineu-Rabell et al. (2005) find little or no cyclicality in TTC models, while Bangia et al. (2002), who use migration matrices of Standard & Poor's, find substantial dependence of rating migrations on the business cycle. As a consequence of the mixed results, it is not clear ex ante whether the long-run propensity of Basel II StA is in fact negative. Likewise, the question concerning the long-run propensity of Basel II IRB is far from clear-cut. Although the simulation studies of Gordy and Howells (2006) and Kashyap and Stein (2004)

[15] *This panel test is based on the Simes' multiple test. See Hanck (2009) for details.*

[16] *As discussed in Cantor and Mann (2003) and Fons (2002), agency ratings are stable because they are intended to measure the default risk over long investment horizons.*

indicate a pronounced movement of capital requirements under IRB, reality could still show distinct behavior due to management actions, rating model specifications, etc. As a matter of fact, using IRB offers more flexibility in calculating risk weights and therefore the possibility to avoid increasing capital requirements. Furthermore, IRB models are also generally allowed to be TTC.[17] Therefore, we must conclude that ex ante there is again no agreed opinion whether the long-run propensity of IRB, $\overline{\eta} := \sum_{j=0}^{p} \eta_j$, will in fact be negative, indicating additional cyclicality of IRB compared to StA and Basel I.

Estimating equation (4) provides us with the parameters γ_j and η_j, which may be used to calculate the long-run propensities of interest, $\overline{\gamma}$ and $\overline{\eta}$, as they are defined as the sum of the individual parameters. However, equation (4) does not provide us with estimates of their uncertainty, i.e. their standard errors, as the long-run propensities are not directly estimated. Therefore, we rewrite the model specified in equation (4) using the definitions of $\overline{\gamma}$ and $\overline{\eta}$ from above and adding $\overline{\beta} := \sum_{j=0}^{p} \beta_j$ to get

$$\begin{aligned}\Delta \log CR_{i,t} &= \alpha_1 \Delta \log TA_{i,t} + \alpha_2 \Delta B2D_{i,t} \\ &+ \alpha_3 \Delta IRB_{i,t} + \overline{\beta} \Delta \log EE_t \\ &+ \sum_{j=0}^{p} \beta_j \Delta \log EE_{t-j} + \overline{\gamma}(\Delta \log EE_{t-j} \\ &\times B2D_{i,t}) + \sum_{j=0}^{p} \gamma_j (\Delta \log EE_{t-j} \times B2D_{i,t} \\ &- \Delta \log EE_t \times B2D_{i,t}) + \overline{\eta}(\Delta \log EE_t \\ &\times IRB_{i,t}) + \sum_{j=0}^{p} \eta_j (\Delta \log EE_{t-j} \\ &\times IRB_{i,t} - \Delta \log EE_t \times IRB_{i,t}) + \Delta u_{i,t}.\end{aligned} \tag{5}$$

Thus, we can calculate usual standard errors of the long-run propensities, as they are directly estimated.

4 Results

In this section we turn to the results of the estimation of equation (5). We present the estimates in tables 1 and 2 together with White's robust estimates of standard errors and respective p-values. Table 1 shows the outcome using real exports to indicate the economic environment while table 2 uses real GDP. The corresponding tables for nominal exports and GDP can be found in the appendix.

Our main interest lies in the parameters $\overline{\beta}$, $\overline{\gamma}$ and $\overline{\eta}$, representing the cyclical effects of Basel I, Basel II StA and IRB. A negative sign of these coefficients indicates cyclicality, meaning that once economic conditions worsen and exports or GDP move down, capital requirements go up and vice versa. Hence, the estimates of parameter $\overline{\beta}$ indicate that there was no cyclicality under Basel I. This result is in line with expectations (see section 3 for a discussion thereof), as Basel I had no integrated risk sensitivity. The fact that the coefficient has a positive sign may stem from banks' investing in riskier customer segments in good times. However, considering the small size of the estimate of $\overline{\beta}$, the economic importance of this effect is rather low. More surprisingly, we find no evidence of cyclicality under Basel II StA, either. Depending on the specification of the model, we find either a negative or a positive sign of the estimate of $\overline{\gamma}$. Moreover, the estimate is not significant regardless of the way in which current economic conditions are modeled. In

[17] *As the IRB banks in our sample do not differ in the degree of* through-the-cycle *versus* point in time (PIT), *we cannot make a distinction here. Generally, the models are said to be neither clear TTC nor PIT, but rather a mixed approach.*

Table 1

Estimation Using Real Exports to Indicate the Current Economic Environment

Coefficients		Estimates	Standard error	P-values
Basic effects				
α_1	Elasticity of total assets	0.749280	0.051782	0.000000
α_2	Elasticity of Basel II introduction	−0.122964	0.013648	0.000000
α_3	Effect of IRB implementation	−0.209455	0.210095	0.318797
Long-run business cycle elasticities				
$\overline{\beta}$	Underlying – Basel I	0.052185	0.015655	0.000859
$\overline{\gamma}$	(Additional) of Basel II	−0.024417	0.157141	0.876522
$\overline{\eta}$	(Additional) of IRB	−1.669019	0.279067	0.000000

Source: OeNB calculations.

Table 2

Estimation Using Real GDP to Indicate the Current Economic Environment

Coefficients		Estimates	Standard error	P-values
Basic effects				
α_1	Elasticity of total assets	0.751603	0.050840	0.000000
α_2	Elasticity of Basel II introduction	−0.136265	0.011876	0.000000
α_3	Effect of IRB implementation	−0.275248	0.203722	0.176676
Long-run business cycle elasticities				
$\overline{\beta}$	Underlying – Basel I	0.020535	0.005983	0.000599
$\overline{\gamma}$	(Additional) of Basel II	0.121632	0.103403	0.239490
$\overline{\eta}$	(Additional) of IRB	−1.572507	0.197363	0.000000

Source: OeNB calculations.

accordance with these findings we conclude that under Basel II StA there seem to be only little or no cyclical effects.

Interestingly, the case of IRB is very different. Here, the cyclicality of capital requirements under IRB (measured by $\overline{\eta}$) is large and statistically different from zero under usual significance levels. This finding is in line with prior empirical research as in Kashyap and Stein (2004), Gordy and Howells (2006) and Repullo et al. (2009). The estimated parameter of around –1.5 indicates that a fall of exports or GDP of 1% translates on average into an increase of 1.5% in regulatory capital requirements of IRB portfolios.

The reported parameters of introducing Basel II and IRB, α_2 and α_3, as well as the elasticity of total assets, α_1, are as expected. The introduction of Basel II and IRB lowers regulatory capital requirements of credit risk while total assets clearly have an increasing effect.

Including either GDP or exports to feed current economic conditions into the model (see tables 1 and 2), we find that most parameters are robust to this change. Additionally, regarding the use of nominal terms instead of real terms (see tables 3 and 4), we find that the estimates are in line with the one derived using real variables.

5 Conclusions

Building on these results, we conclude that the cyclicality of capital requirements is a major issue for IRB banks but appears to be less important for StA banks. However, one should bear in mind that the cyclical behavior of capi-

tal requirements as analyzed in this study is *after* management action. Therefore, possible cyclical movements of capital requirements under Basel II StA might trigger countermeasures on the part of management that might not show up in the regression.

As the cyclicality of capital requirements is the basis for potential procyclicality, it is important to distinguish between IRB and StA in policy analysis. Numerous suggestions for adequate measures to address procyclicality have been made in the respective literature (see Drumond, 2008, section 4.3 for an overview). Although the discussion of these proposals would go beyond the scope of this text, our empirical study provides a quantitative foundation for the ongoing discussion. For the next step in the procyclicality discussion, further research on the empirical influence of cyclicality requirements on future lending activities and economic growth is necessary.

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Appendix

Table 3

Estimation Using Nominal Exports to Indicate the Current Economic Environment

Coefficients		Estimates	Standard error	P-values
Basic effects				
α_1	Elasticity of total assets	0.748007	0.051674	0.000000
α_2	Elasticity of Basel II introduction	−0.130055	0.012441	0.000000
α_3	Effect of IRB implementation	−0.230273	0.207561	0.267259
Long-run business cycle elasticities				
$\overline{\beta}$	Underlying – Basel I	0.170104	0.045620	0.000193
$\overline{\gamma}$	(Additional) of Basel II	0.166658	0.271407	0.539185
$\overline{\eta}$	(Additional) of IRB	−2.591295	0.395711	0.000000

Source: OeNB calculations.

Table 4

Estimation Using Nominal GDP to Indicate the Current Economic Environment

Coefficients		Estimates	Standard error	P-values
Basic effects				
α_1	Elasticity of total assets	0.749526	0.051911	0.000000
α_2	Elasticity of Basel II introduction	−0.122294	0.013137	0.000000
α_3	Effect of IRB implementation	−0.220497	0.211959	0.298220
Long-run business cycle elasticities				
$\overline{\beta}$	Underlying – Basel I	0.050780	0.018181	0.005226
$\overline{\gamma}$	(Additional) of Basel II	−0.037176	0.069250	0.591381
$\overline{\eta}$	(Additional) of IRB	−2.369288	0.321060	0.000000

Source: OeNB calculations.