

The Effects of Bank Capital on Bank Credit Creation

Panel Evidence from Austria

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I. Introduction

Minimum capital holding takes center stage in modern financial markets regulation and supervision. Bank capital is viewed as the most effective regulatory means to keep banks in solvent and stable conditions by ensuring that banks have enough capital to support their risk bearing. To be more specific, minimum capital holdings are aimed to promote sound and proper banking and to secure a level playing field in the international market place.

In June 1988, the members of the Basel Committee on Banking Supervision reached an agreement to set a common regulatory target for bank capital of internationally operating banks in 12 industrialized countries. This agreement became known as Basel Accord I or Basel I. The capital target as set in Basel I requires that a bank hold capital of at least 8 percent of its risk-weighted assets. In Basel I, credit risks are accounted for by four risk buckets each with a different weight to reflect the degree of credit risk. However, the undifferentiated and coarse measurement of credit risks and the rapid pace of financial innovation have gradually undermined the effectiveness of Basel I. Thanks to the broad-brushed-type risk differentiation, banks can boost their profits in many of their business sectors by accepting higher risks without the need to increase their capital (capital arbitrage). Yet, the effectiveness of Basel I was most seriously reduced by the explosive growth of bank transactions the risk of which are inadequately or not at all covered by the existing regime (on this point see, e. g., *Hahn* (2003)). Consequently, soon after Basel I became the established foundation for supervision of bank capi-

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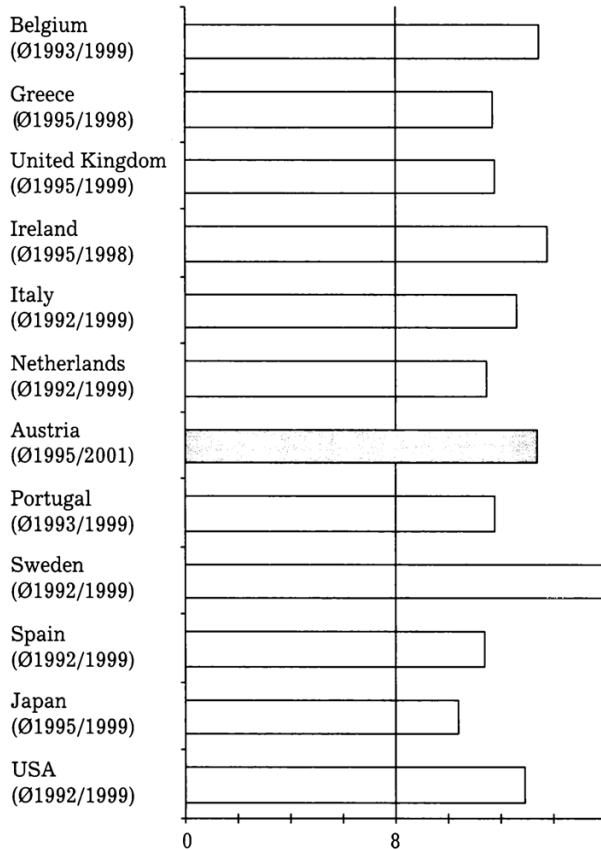
tal in many countries, the Basel Committee on Banking Supervision has joined forces to launch a thorough overhaul of Basel I (the first consultative paper on the New Basel Capital Accord, in short Basel II, was presented in June 1999). The new proposal is aimed at eliminating the weaknesses of its predecessor and at reducing the gap between the capital required by supervisory regulations and that required by managerial prudence, by providing modern and improved methods of risk measurement.

So imperfectly Basel I is it nevertheless has, in conjunction with the ongoing discussion on Basel II, significantly raised the risk awareness in the banking community. With increasing numbers of countries accepting the requirements of Basel I in the 1990s (i. e., Austria joined Basel I in 1994), banks markedly improved their capital adequacy, most of which even expanded their capital holding well beyond the minimum capital requirement of 8 percent of risk-weighted assets (Figure 1).

Though risk-based capital holding as promoted by Basel I may improve soundness and stability in banking, it also may have a serious macroeconomic downside. According to the liquidity creation framework by *Diamond/Rajan* (2001, 2000) there is a trade-off between risk-based bank capital and credit creation. This paper is aimed to test empirically this hypothesis by assessing the impact of bank capital holding, as a percentage of risk-weighted assets according to Basel I, on credit creation in Austria for the period from 1996 to 2000. In so doing, we apply a panel-econometric approach similar to the one used in *Honda* (2002). The work is designed as follows: Section II. discusses the role of bank capital within the “liquidity creation” view of banking. In Section III. the panel data models for assessing the impact of bank capital on credit creation by Austrian banks are introduced and the estimates are presented. Bank size receives special attention through estimating respective panel data models for small, medium and large banks. Section IV. concludes.

II. Bank Capital and Credit Creation

Minimum capital requirements form the backbone of contemporary banking regulation. However, holding capital does not come without a cost. First, there is the apprehension that more overall financial stability is traded off for less liquidity (and efficiency) creation by banks subject to minimum capital holding, and, second, it is anything but clear that capital requirements do, under all circumstances, induce the banks to



S: OECD, 2002.

Figure 1: Capital Charges According to Basel I as Percent of Risk-weighted Assets

optimize their risk-taking. For example, *Blum* (1999) explores the inter-temporal implications of risk-based capital adequacy requirements in banking and finds theoretical evidence that a bank may value an additional unit of equity tomorrow more with the bank capital binding than without a minimum capital requirement at all. This particularly holds when raising equity is costly, and when the only way available to increase equity tomorrow is to increase risk today.

In the following, we rather concentrate on exploring the relation between bank capital, consisting of both regulatory and voluntary capital

holding as a percentage of risk-weighted assets according to Basel I, and bank credit creation. To fully understand the determinants of this relation, one first has to understand the essential functions banks perform. This approach has been chosen by *Diamond/Rajan* (2000, 2001). Their theory of bank capital rests on the view that the source of illiquidity of assets, be they real or financial, is all the same: human capital too closely tied to the respective asset providing rent opportunities. As to real assets such as a new investment project, the entrepreneur herself is assumed to be the one and only who gets the best out of the project. Since the entrepreneur can withdraw from the project in the future and thus can demand a rent not to do so, an outside financier cannot fully extract the cash flows generated by the project. This causes illiquidity due to the fact that such a project cannot be financed to the full extent of the cash flows expected.

The same line of reasoning applies as to comprehend why a financial asset such as a loan to a real investment project is illiquid. A lender with the most credible liquidation threat will extort the most in terms of future payments, with any other outside financier who lends against repayment recovering less. A lender's liquidation threat is most credible when the lender knows best how to redeploy the project's assets most profitably. The lender can acquire this specific knowledge through building a relationship with the borrowing entrepreneur. This is best done by joining the entrepreneur's project at a very early stage. Of course, relationship-based lending generates a financial asset, that is, a loan, which is as illiquid as the loan financed project itself due to the relationship lender's lack of commitment to recover the full value of the loan without collecting a rent for so doing.

As a result, to create liquidity in a context like this the relationship lender has to be financed by demand deposits. Such a relationship lender is usually called a bank. Since deposits are fixed claims with a sequential service constraint (i. e., deposits are claims with a first-come-first-served right to the bank's cash flows until the bank runs out of money) the bank cannot credibly hold up the depositors by threatening to extort a rent for giving back the full value of the deposits issued. Trying to extort a rent would be answered by the depositors with running on the bank rather than entering into renegotiations. Thus, the collective action problem among depositors is a credible commitment to run on the bank whenever the depositors believe their money claims are in jeopardy. This drives the banker's rent to zero because behaving other-

wise would disintermediate her immediately. This is strong enough a threat making the banker pass through all collections directly to depositors (*Diamond/Rajan* (2000)).

As a result, in the context of certainty the banker provides the social optimum of liquidity for both the depositors and the entrepreneurs when she is all-deposit refinanced. In a world of uncertainty, however, bank runs can be triggered by reasons other than opportunistic behavior, such as shocks to asset values. In this context issuing softer claims than deposits may help the banker survive times likely to be prone to runs due to increased uncertainty or systemic shock exposure.

A claim which is (much) softer than deposits in terms of renegotiations is capital. Capital issued as equity is a long-term claim with no other right but to liquidate the equity-financed project any time. Since the relationship banker is assumed to recover the most of the loan provided, replacing the banker (that is, liquidating the project) is costly rendering the capital holders' commitment not to renegotiate implausible. Thus, capital holders are not exposed to a collective action problem allowing the banker to capture some rents in the future. This, however, has a downside today in that the banker is not able to raise as much money as she would be able to raise if she were all-deposit-refunded. That is to say, issuing capital instead of deposits in order to increase shock absorption reduces the banker's capability of creating liquidity relative to the case where she issues deposits only. In other words, the flow of credit provided by the banker is curtailed relative to a situation with all-deposit refinancing.

From the viewpoint taken in this paper, the liquidity creation framework as put forward by *Diamond/Rajan* (2001, 2000) provides a solid rationale for credit supply cuts due to bank capital holding. The liquidity creation theory makes a strong case in favor of an all-deposit refunded banking system on grounds of its providing liquidity at the social optimum whereas the issuance of capital aimed at making the banks safer incurs a social cost in terms of lower credit and constraint liquidity creation. The negative relationship between bank capital and credit creation as proposed by the liquidity creation theory is the hypothesis to be tested econometrically in the following section.

III. The Panel Data Model

In this section we design a model to empirically test the proposition whether there is a negative relation between bank capital holding and credit creation by banks. For this purpose, we use a sample consisting of a balanced panel of annual report data from 1996 to 2000 for 750 Austrian universal banks (unfortunately, access to quarterly or monthly data was not made possible). That is, for each variable there are 3,750 observations. The bank data used for the estimates have been provided by the electronic data service of the Oesterreichische Nationalbank (OeNB). The Data Appendix gives the details on variables and data sources used.

In following *Honda* (2002), we construct a panel model designed to identify the impact of bank capital holding as a percentage of risk-weighted assets according to Basel I on credit creation by trying to disentangle the impacts of various supply-side and demand-side variables likely to affect bank credit creation. Though distinguishing between supply-side and demand-side variables requires a disequilibrium model, the approach chosen allows, to some degree, to interpret the estimates as evidence for a demand-driven or supply-driven loan volume growth¹. To begin with, the aggregate output gap is used to capture the general business condition or systemic shocks, respectively. Further, a performance index of mutual real estate funds (IATX) is used to capture the impact of collateralization on bank credit creation. Most bank lending in Austria is protected through wholesale collateralization, with real estate as the prime candidate to be chosen as bond (*Hahn* (2002)). Rising real estate prices indicate that the agency costs of borrowers fall allowing the banks to provide a larger amount of collateralized loan, *ceteris paribus*. Since the aggregate output gap and the performance index of the mutual real estate funds are exposed to the same macroeconomic shocks these variables enter the equation separately. We use these variables lagged by one period to give credit to the fact that both borrowers and lenders often need time to adjust to macroeconomic shocks. By including the total assets of each bank we try to account for the differences in the loan demand structure among the Austrian banks of different size. In order to control for idiosyncratic shocks of each bank we enclose individual bank dummy variables. In addition, we use the nominal interest rate for commercial loans as an indicator for capturing shocks to loan pricing.

¹ I owe an anonymous referee this line of argumentation.

Controlling for these shocks add up to the following panel model:

$$(1) \quad \frac{\Delta L_{i,t}}{A_{i,t-1}} = \beta_0 + \sum_{j=1}^{749} \mu_j + \beta_1 K_{i,t} + \beta_2 \log A_{i,t-1} + \beta_3 Y_{t-1} + \beta_4 R_t + \varepsilon_{i,t}$$

$$i = 1, 2, \dots, 750; t = 1, 2, \dots, 5$$

As suggested by *Honda* (2002), the left-hand side variable of equation (1) with $\Delta L_{i,t}$ picturing loan creation by bank i at time t is normalized by the total assets of each bank at the beginning of the period, $A_{i,t-1}$. The variable $K_{i,t}$ represents the actual bank capital as a percentage of risk-weighted assets according to Basel I. This capital ratio contains the relevant information to capture the impact of bank capital holding on credit creation. Since the actual capital ratios of all banks under study exceed the minimum capital requirement in the years covered actual capital holding also captures the information contained in the gap between voluntary and regulatory capital. Y_{t-1} stands either for the aggregate output gap or for the log of the collateral value of real estate at the beginning of the period, respectively. R_t indicates the nominal interest rate for commercial loans at time t . The μ_j denote the bank-specific effects and $\beta_0, \beta_1, \beta_2, \beta_3$ and β_4 the coefficients to estimate. The term $\varepsilon_{i,t}$ is the remainder stochastic disturbance factor.

IV. Empirical Evidence

The model as given by equation (1) suggests that the fixed effects panel estimator be used as estimation procedure. This is supported by the standard diagnostics. For all models estimated the results highly support the fixed effects model estimates against the plain OLS and the random effects model estimates, respectively. To be more specific, testing for fixed effects shows that the null $H_0: \mu_j = 0$, for $j = 1, 2, \dots, 749, j = 1, 2, \dots, 749$, is rejected at the 1-percent significance level in all models. Further, under the alternative of the random effects model the Hausman test statistics are very large altogether suggesting that the null hypothesis of the random effects model be rejected at the 1-percent significance level. The fixed effects estimates of equation (1) for the 750 Austrian banks are reported in Table 1.

The estimates corroborate (that is to say, do not reject) the hypothesis that bank capital holding has a negative impact on bank credit creation as suggested by the liquidity creation theory. The coefficient estimate of

Table 1
Estimates of Credit Creation by the Fixed Effects Models
Left-hand Side Variables are Changes in Credit Divided by the Total Value
of Assets at the Beginning of the Corresponding Period

Explanatory variables	Model with aggregate output gap	Model with collateral value of real estate
Output gap	0.0099** (4.77)	
Real estate value		0.4027** (6.15)
Total assets	-0.4808** (-17.35)	-0.5244** (-17.56)
Actual capital ratio	-0.0022** (-4.85)	-0.0017** (-7.70)
Commercial loan rate	-0.0164** (-7.03)	-0.0136** (-5.57)
R ²	0.37	0.37
Adjusted R ²	0.21	0.21
Number of observations	3,750	3,750

** ... denotes significant at the 1-percent level against a one-sided alternative. Numbers in parentheses denote *t-values*.

actual capital holding is both negative and highly significant, even if its magnitude is low. This result holds in either model reported. The difference of the respective coefficient estimates between the model with the aggregate output gap as the measure of general business conditions and the model with the collateral value of real estate is insignificant. The same applies to the remaining coefficient estimates. In both models, all coefficients are highly significant, with signs indicating that the set of variables considered may capture demand-driven as well as supply-driven forces. While the real estate value exerts the expected positive influence, the positive effect of the output gap is contrary to the expectation of declining credit demand when the output gap rises. Since the output gap measures the difference between potential and actual output, its positive impact on credit growth may be due to a rise in potential output rather than a decline in actual output. The negative impact of total assets may result from a higher loan demand reduction at larger banks or from a supply-side strategy change from commercial banking to

investment banking by larger banks in a period of rising share prices. The negative effect of the commercial loan rate indicates that credit creation is driven by demand rather than supply. There seems to be no credit rationing, since loan demand declines with rising interest rates. In this context, an interesting facet is the consideration that capital sensitivity might change with size. The point is that larger banks which usually deal with a more risky credit (or overall portfolio) structure are more likely to be capital constraint than smaller banks. However, as shown by the descriptive statistics in Table 2, this was not the case for the banks in our sample. Large banks hold higher voluntary capital beyond the regulatory minimum of 8 percent of risk-weighted assets, compared to small and medium-sized banks. This may again be explained by a larger decline of loan demand by their customers or by their lower willingness to lend due to a retreat from commercial banking. Though differences in credit demand and/or overall portfolio structure have been controlled for by considering the role of total assets of each bank, we additionally account for bank size directly by re-estimating the model on the basis of panel data sets consisting of banks of approximately the same size. This is achieved by building a balanced panel for small Austrian banks, medium Austrian banks and large Austrian banks, respectively. For the respective definitions we refer to the Data Appendix. The results obtained by directly controlling for bank size are displayed in Table 3.

The results show that the negative impact of capital holding on credit creation is significantly higher for the larger banks than for the smaller ones. The respective magnitude is more than three times as high for large banks with coefficient estimates of around -0.0080 as for small and medium banks. While the negative sign in all three subsamples is in line with the liquidity theory of bank capital, its higher magnitude for large banks may be explained by a reverse causality: a decline in loan demand or in the willingness to lend implies less credit expansion and hence higher capital ratios. Further the estimates suggest that the general business conditions as measured by the aggregate output gap or the collateral value of real estate have no significant influence on credit supply provided by small banks. This result squares well with the fact that lending behavior of small banks is much more relationship-guided than that of large banks (for empirical evidence about the effects of relationship lending on credit supply, see, e. g., *Elsas/Krahnen* (1998); *Harhoff/Körting* (1998); *Lehmann/Neuberger* (2001)).

Table 2
Descriptive Statistics – Actual Capital Ratio
Bank Capital as Percentage of Risk-weighted Assets According to Basel I
1995 Through 2001

	Mean	Median	Standard deviation	Minimum	Maximum
Small banks	11.7	10.7	3.8	8.0	29.5
Medium banks	12.7	11.9	3.5	8.0	27.5
Large banks	13.4	12.8	3.1	8.4	26.4

S: OeNB.

Table 3
Fixed Effects Model Estimates of Credit Creation by Small,
Medium and Large Banks
Left-hand Side Variables are Changes in Credit Divided by the
Total Value of Assets at the Beginning of the Corresponding Period

Explanatory variables	Model with aggregate output gap for			Model with collateral value of real estate for		
	small banks	medium banks	large banks	small banks	medium banks	large banks
Output gap	-0.0010 (-0.42)	0.0175** (5.04)	0.0238** (2.68)			
Real estate value				-0.0613 (-0.81)	0.5883** (6.12)	1.0092** (4.20)
Total assets	-0.3042** (-7.48)	-0.5483** (-12.52)	-0.6571** (-7.54)	-0.2909** (-6.56)	-0.6110** (-12.95)	-0.7713** (-8.36)
Actual capital ratio	-0.0023** (-5.40)	-0.0029** (-2.26)	-0.0079* (-2.31)	-0.0024** (-5.22)	-0.0026** (-2.01)	-0.0084* (-2.49)
Commercial loan rate	-0.0142** (-5.45)	-0.0178** (-4.39)	-0.0227* (-2.19)	-0.0153** (-5.07)	-0.0109** (-2.46)	-0.0083 (-0.75)
R ²	0.37	0.39	0.31	0.37	0.39	0.33
Adjusted R ²	0.22	0.23	0.13	0.22	0.24	0.16
Number of observations	1,945	1,525	280	1,945	1,525	280

** ... denotes significant at the 1-percent level against a one-sided alternative, * ... denotes significant at the 5-percent level against a one-sided alternative. Numbers in parentheses denote *t-values*.

V. Concluding Remarks

This paper shows that bank capital holding has a negative impact on bank credit creation in Austria. This is consistent with the theory of bank capital provided by *Diamond/Rajan* (2000, 2001), according to which an increase in bank capital should reduce liquidity and credit creation by banks. In addition, the paper provides evidence that the negative effect of capital holdings (as a percentage of risk-weighted assets according to Basel I) on credit creation is increasing with bank size. This may be explained by the same theory, but also by reverse causality: large banks hold more capital beyond the regulatory minimum, which reduces their credit creation, or their higher capital holdings are caused by a decline in credit demand or willingness to lend.

While sharpening the risk awareness of the banking industry as a whole the newly proposed capital requirement framework by the Basel Committee on Banking Supervision (Basel II) is particularly aimed at targeting the larger banks by trying to bring their regulatory capital-to-asset ratio closer in line with the perceived risk of their individual portfolios. In so doing, Basel II tends to put the measurement of these banks' actual risk exposure on a firmer conceptual footing by providing a more accurate gauge of risk aimed at narrowing the gap between regulatory and economic capital holding. The New Basel Accord has many upsides indeed, but if the sophisticated risk measurement methods proposed will suffice to compensate for the social costs of a curtailed liquidity and credit creation due to bank capital holding is still not clear yet.

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Data Appendix: Variables and Sources

Variable	Definition	Original source
Credit creation (mn. EUR) Banks	Changes in credits to non-banks	OeNB, Annual Reports Statistics of Austrian
Output gap (percent)		OECD Economic Outlook
Real estate value (index)	Austrian Real Estate Securities Index	Vienna Stock Exchange
Total assets (log) Banks		OeNB, Annual Reports Statistics of Austrian
Actual capital ratio (percent) Banks	Equity Ratio Pursuant to § 23 Austrian Banking Act 1993	OeNB, Annual Reports Statistics of Austrian
Commercial loan rate (percent)		OeNB
Small banks	Banks within the interval ranging from the minimum to the median of total assets of the entire sample	
Medium banks	Banks within the interval ranging from the median to the mean plus 1 standard deviation of total assets of the entire sample	
Large banks	Banks within the interval ranging from the mean plus 1 standard deviation to the maximum of total assets of the entire sample	

Summary

The Effects of Bank Capital on Bank Credit Creation Panel Evidence from Austria

This paper is aimed to assess the impact of risk-weighted bank capital on credit growth in Austria for the period from 1996 to 2000 by using a panel-econometric approach. For this purpose, we use a sample consisting of a balanced panel of annual report data from 1996 to 2000 for 750 Austrian universal banks. To disentangle the impact of bank capital from other effects we control for impacts caused by supply-side and demand-side variables such as the commercial loan rate, aggregate output gap and the collateral value of real estate, respectively. The esti-

mates show that bank capital holding as a percentage of risk-weighted assets according to Basel I has a negative impact on bank credit creation in Austria. Thus the paper provides evidence that risk-based bank capital may work as a binding constraint on liquidity and bank credit creation. This is a remarkable result against the backdrop of the ongoing overhaul of the Basel Accord. (JEL C23, E51, G21, N20)

Zusammenfassung

Auswirkung von Bankeigenkapital auf das Kreditangebot Panel-ökonometrische Evidenz für Österreich

Dieser Artikel untersucht die quantitativen Auswirkungen von risiko-gewichtetem Bankeigenkapital auf das Wachstum von Bankenkrediten in Österreich. Die Untersuchungsperiode umfasst die Jahre 1996 bis 2000. Die panel-ökonometrische Analyse erfolgt auf der Grundlage von Jahresbilanzdaten von 750 österreichischen Universalbanken. Das Regressionsmodell berücksichtigt verschiedene angebots- und nachfrageseitige Einflussfaktoren, um die Wirkung von Bankeigenkapital auf das Kreditangebot von anderen Bestimmungsgrößen zu isolieren. Die analytischen Ergebnisse stützen die Hypothese, dass risikogewichtetes Eigenkapital einen (quantitativ geringen) negativen Einfluss auf das Kreditwachstum ausübt. Dieses Ergebnis ist im Einklang mit der „liquidity creation“-Theorie von Diamond/Rajan (2000, 2001).

Résumé

Les effets des fonds propres bancaires sur la création de crédit Evidance économétrique par panel pour l'Autriche

L'article analyse quel est l'impact quantitatif des fonds propres bancaires pondérés par le risque sur la croissance du crédit bancaire en Autriche. La période considérée s'étend de 1996 à 2000. L'analyse économétrique par panel se base sur les données des bilans annuels de 750 banques universelles autrichiennes. Le modèle de régression prend en compte différents facteurs qui influencent l'offre et la demande afin d'isoler l'effet des fonds propres bancaires sur l'offre de crédit par rapport à d'autres variables. Les résultats analytiques soutiennent l'hypothèse que les fonds propres bancaires pondérés par le risque exercent une influence négative (quantitativement faible) sur la croissance du crédit. Ce résultat rejoint la théorie de la création de liquidité de Diamond-Rajan (2000, 2001).