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## Measuring the Quality of Eligible Collateral

Philipp Lehmbecker and Martin Missong

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*Philipp Lehmbecker and Martin Missong*

*Dr. Philipp Lehmbecker*  
University of Bremen  
Faculty 07: Business Studies and Economics  
Empirical Economics and Applied Statistics  
Wilhelm-Herbst-Str. 5  
D-28359 Bremen  
e-mail: [lehmbecker@uni-bremen.de](mailto:lehmbecker@uni-bremen.de)

*Prof. Dr. Martin Missong*  
University of Bremen  
Faculty 07: Business Studies and Economics  
Empirical Economics and Applied Statistics  
Wilhelm-Herbst-Str. 5  
D-28359 Bremen  
e-mail: [missong@uni-bremen.de](mailto:missong@uni-bremen.de)

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Prof. Dr. Albrecht F. Michler,  
Heinrich-Heine-University of Duesseldorf, Department of Economics, Universitaetsstr. 1,  
Build. 23.32.01.63, D-40225 Duesseldorf, Germany  
Tel.: ++49(0)-211-81-15372  
Fax: ++49(0)-211-81-10434  
E-mail: [helpdesk@rome-net.org](mailto:helpdesk@rome-net.org)  
[michler@uni-duesseldorf.de](mailto:michler@uni-duesseldorf.de)

## **Abstract**

Recently, the U. S. subprime crisis has shown that a weak collateralization of credits may have massive economic implications, entailing severe perturbations of the international financial system. We focus on central bank lending and try to pin down the quantitative impact of the collateralization of central banks' credits. A questionnaire on national monetary frameworks was used to collect data from central banks. Drawing on these data we derive an index of the quality of eligible assets measuring the minimum requirements for the issue of money by the respective central bank. We provide data for 62 countries and we show that this index has the potential to affect monetary stability as measured by national inflation rates. The existence of a correlation between inflation and the quality of eligible collateral would strongly support fundamental claims of property economics, an economic theory based on a clear cut distinction between property and possession. Property economics emphasizes the role of collateralized lending in explaining the process of money creation and, more generally, the emergence of any economic activity.

**JEL-Classification: E42, B59, C43**

**Keywords:** Monetary economics, monetary theory, inflation, collateral, central banks, property, property economics, central bank independence, index construction

# 1 Introduction

Institutional aspects of monetary policy became a prominent topic of central banking research in the 1980s. Following the seminal works of Nobel laureates Kydland and Prescott, central bank independence and a transparent monetary policy were regarded as best suited to achieve and safeguard monetary stability.<sup>1</sup> The empirical literature, however, failed in establishing a solid ground for this consensus. Berger *et al.* (2001) survey the literature on central bank independence and reveal that the generation of new data for testing hypotheses is rather an exception in the empirical literature. Given that the current debate relies upon data for 1950 to 1990, economists essentially are in need of new data to break down an imminent deadlock in central banking research.

From a theoretical perspective, the theory of property economics, as developed by Heinsohn and Steiger, sheds light on potential determinants of monetary stability not addressed as yet in the central banking context, namely property rights and the collateralization of credits.<sup>2</sup> However, some of the implications of property economics for central banking relate to a growing strand of literature on central bank capital and central bank losses, as has been detailed by Lehmbecker (2008a).

Property Economics strictly differentiates between property, which is a bundle of rights, comprising inter alia the options of selling and leasing, and possession, which is the right to physically use a good.<sup>3</sup> Once property rights are effectively protected by a legal system, money can be created by means of a credit contract between two proprietors. The creditor issues money by handing out documents to a debtor. Each of these documents represents a claim to a part of the creditor's property. The debtor receives the issued money if he pledges a part of his property to collateralise the loan and promises to repay the loan plus interest. The collateral serves as insurance for the creditor, as her money could be presented for redemption out of her property if the debtor defaults. In that case, the pledged property of the debtor becomes property of the creditor. According to this theory, both the creditor and the debtor have to be proprietors, and both of them experience a limitation of disposition over their property during the contract term. In particular, they lose the opportunities of selling or pledging their burdened property. However, both of them benefit from the credit contract: The creditor receives interest as a compensation for burdening his property,<sup>4</sup> and the debtor is still allowed to physically use (possess) his pledged assets.

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<sup>1</sup> Cf. Kydland and Prescott (1977), Barro and Gordon (1983), Cukierman and Meltzer (1986) and Geraats (2002).

<sup>2</sup> Cf. Heinsohn and Steiger (2000; 2005; 2006; 2007).

<sup>3</sup> New Institutional Economics calls this right to physically use a good a property right, and refrains from using the term possession. Cf. Alchian (1992), Demsetz (1967; 1998) and Steiger (2006). Note that confusing both terms conceals the inherent legal distinction between both of these concepts. See, for instance, the German Bürgerliches Gesetzbuch (2002) on "Eigentum" (property) and "Besitz" (possession).

<sup>4</sup> The proprietor's freedom of disposition over his property is coined "property premium" by Heinsohn and Steiger (2000; 2006). Hence, property economics explains interest as a compensation for the (temporal) loss of the creditor's property premium.

Lehmbecker (2008a,b) points out the implications of property economics for the institutional aspects of central banking and monetary stability. In a two-tiered banking system, money is issued by the central bank via credits to its counterparties, the commercial banks. An arbitrarily growing money base is prevented by the central bank requiring commercial banks to pledge good securities to collateralise any credit.<sup>5</sup> Applying the reasoning of property economics, Lehmbecker argues that central banks' standards for assets eligible as collateral determine whether a currency can achieve price stability. Whenever assets not valued in a transparent market, but for instance the debtor's self issued certificates of debt (IOU notes) are accepted as eligible collateral, a decrease in the value of money seems to be inescapable. A central bank accepting collateral of poor quality runs the risk of having to use own funds to absorb excess liquidity and - in the worst case - of experiencing central bank losses, in case of a defaulting commercial bank. Consequently, financial independence as opposed to political independence turns out to be crucial for safeguarding price stability, see Lehmbecker (2008a), pp 57-66. As sketched above money is backed by both parties property: the creditor's assets and the debtor's pledged assets. Hence, the value of money is tied closely to the value of collateral.

## 2 Constructing an Index on Central Banks' Quality of Eligible Collateral: IQEC

A central bank's institutional framework has to be regarded as the basic requirement safeguarding central bankers' ability to focus on monetary policy. The quality of eligible collateral forms part of such an institutional framework as it does not form part of what is commonly described as monetary policy but rather resembles issues that are treated in central bank laws like limits on credit to government. Therefore, this survey on the quality of eligible collateral pertains to the literature on central banks' institutional frameworks and their effects on inflation. This literature has proposed and empirically tested several potential determinants of average inflation like central bank independence and transparency.<sup>6</sup> This survey's methodology thus broadly follows the one employed in the empirical literature on central banks' institutional frameworks. Continuing this line of research without changes in methodology guarantees a certain consistency of empirical methods and, more importantly, allows for assessing property economics' explanatory power with regard to cross-country differences in average inflation.

This section presents a new dataset on the quality of eligible collateral. The quality of eligible assets was operationalised, taking into account current guidelines (frameworks) on eligible collateral of the Eurosystem, the Bank of Japan and the Swiss National Bank (SNB).<sup>7</sup> These central banks have been chosen as a kind of benchmark due to the

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<sup>5</sup> Repo operations, i.e. operations with repurchase agreements, make up the bulk of today's liquidity providing operations. These repo operations are nothing else than collateralised credits. Cf. Bank of Japan (2003), p. 1.

<sup>6</sup> Cf. the surveys by Berger *et al.* (2001) and Geraats (2002) on central bank independence and transparency respectively.

<sup>7</sup> Cf. Bank of Japan (2003), ECB (2005) chapter 6, "Eligible Assets", and SNB (2004).

detaildness with which these central banks discuss their collateral frameworks. Qualitative data on standards for eligible collateral from central banks' terms and conditions are the only data available, since virtually no quantitative data on type and volume of pledged assets are published so far.<sup>8</sup> These qualitative data, however, are far better than one might think at first sight, since nobody apart from central banks has any other information than what can be found in central banks' terms and conditions as well as laws. In addition the words written there cannot be understood in any other way than that these state, what a central bank actually practices in everyday operations, i.e. what kind of assets it will not accept as collateral.

The approach adopted here to construct an index of the quality of eligible collateral (IQEC) at central banks resembles the procedures applied to construct the indices in Cukierman *et al.* (1992) and Das *et al.* (2004). The latter construct indices of regulatory governance and financial system stability to assess whether the former possesses any influence on the latter. The creation of an IQEC is aspired for two reasons. Firstly, to avoid the problem of multicollinearity since, due to possibly close interrelations among framework elements, a high correlation between answers to different questions has to be assumed. Chortareas *et al.* (2002) argue in a similar fashion on why to use an index or a scale instead of single variables. Secondly, to obtain a high validity in operationalising the independent variable, IQEC, since the interaction of several indicators in one index usually raises the validity of an operationalisation relative to the case in which only one indicator is employed.

To measure the quality of eligible collateral, a questionnaire was designed. There are three reasons to employ a questionnaire: i) Not all relevant texts are gratuitously available as access to texts is hindered either in terms of public accessibility, i.e. texts are not downloadable, or in terms of an efficient use of resources as texts are usually written in the language of the country, which would often necessitate translations. Therefore, this survey represents not only a form of expert interview but offers also the best cost-efficiency. ii) What the relevant texts are, is a priori unknown as it could be laws, terms and conditions or special guidelines; iii) Finally, in order to achieve a satisfactory sample size a questionnaire is superior to a content analysis of central bank laws and guidelines regarding efficiency and viability given the project's time constraints of six months for the actual collection of data.

## 2.1 Data Collection

The survey by Fry *et al.* (2000) for the Bank of England represents the broadest collection of data on central bank frameworks so far and can be regarded as a benchmark for this strand of literature. The questionnaire employed by Fry *et al.* was used as draft for this survey's form. If and to what extent the art of questionnaire design<sup>9</sup> was applied can be

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<sup>8</sup> The sole exception is the Bank of Japan that publishes statistics on eligible collateral since 2002.

<sup>9</sup> Cf. Stier (1996).

studied online.<sup>10</sup> In 2004 a pre-test for this survey's questionnaire design was conducted that provided valuable information on how to eliminate potential deficiencies and ambiguities.<sup>11</sup>

The data collection for the survey was conducted over six months between end of January 2006 and July 2006. During this time central banks were contacted via email and asked to complete the online questionnaire. There are at least 178 central banks in the world today that issue currency.<sup>12</sup> The homepage of the Bank for International Settlements (BIS) contains a list of 148 central banks (as of November 2006) that possess an Internet representation.<sup>13</sup> These 148 central banks are taken as this survey's population. 62 central banks returned the filled forms, implying a response rate of about 42%, see Table 2 in the appendix. Developed countries are well represented in this sample (26). The same holds true for western and eastern European countries (19 and 9 respectively) as well as for North America (3), South America (10), the Caribbean (10)<sup>14</sup> and the Middle East (4) while only seven Asian, two from the Pacific region and five African countries are represented in this sample.

Constructing an index of the quality of eligible collateral was not the only purpose of the questionnaire. Answers should also reveal trends in monetary frameworks' adjustments and shed some light on central banks' deficits, see Lehmbecker (2008a). In this paper, however, we focus on the derivation of an index of the quality of eligible collateral covering the period 1998 to 2003. Therefore, we sketch the evaluation of the questionnaire and refer the reader to Lehmbecker (2008a) for an in-depth analysis of the distribution of answers. The complete questionnaire is displayed in the appendix.

## 2.2 Questionnaire Design and Choice of Relevant Items

Part 1 of the questionnaire refers to general information concerning the central bank's monetary framework. Seven out of ten collateral frameworks have been changed at most twice since 1990. Given the immense effort necessary to replace an existing collateral framework with a new one it seems improbable that frequent framework changes bring about significant alterations.<sup>15</sup> Thus, we can assume that collateral frameworks are usually valid for many years. Consequently, a collateral framework has generally the potential to influence the level of inflation. This is true even though the number of new frameworks introduced during the 1990s is likely to be rather high and thus exaggerating the normal number of framework changes due to transformations taking place in former communist

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<sup>10</sup> The questionnaire and the survey's homepage is available under <http://www.wiwi.uni-bremen.de/empwifo/umfrage/questionnaire.htm>. Important considerations in this regard are the communication of respectability and the motivation to participate.

<sup>11</sup> Cf. Stier (1996) p. 205 ff. on the advantages of pre-tests. See Lehmbecker (2004; 2005) for details on the previous questionnaire.

<sup>12</sup> The European Central Bank is not considered here because it does not issue currency. Cf. Spethmann & Steiger (2005).

<sup>13</sup> The list can be found under <http://www.bis.org/cbanks.htm>.

<sup>14</sup> This includes the eight members of the Eastern Caribbean Central Bank.

<sup>15</sup> See ECB (2004) on the revision of the Eurosystem's collateral framework.

states that had to develop proper monetary systems. Given the “institutional stickiness” of monetary frameworks, we conclude that the causal direction in fact runs from frameworks to inflation.<sup>16</sup>

The quality of eligible assets is addressed in part 2. Question 2.1 is a binary variable, asking whether collateral is exceptionally dispensed with (e.g. in case of short-term liquidity shortages). 92% of the central banks in the sample do not provide liquidity – even in emergency situations, i.e. acting as LOLR – unless the counterparty pledges sufficient collateral. Question 2.2 asks whether the central bank provides advances (non-collateralized lending) to the government. As including these answers in the quality index would hamper a theoretical distinction between the concept of central bank independence on the one hand and of the quality of eligible collateral on the other, we decided to leave this item out of the index formula. The next two questions ask whether assets are accepted as collateral from institutions that are the issuers (2.3) or that have close ties with the issuers (2.4) of those assets. As the latter concept proves to be the broader one, we include merely answers to 2.4 in the index calculation. 87% of the central banks negate this question. Question 2.5 asks for the assessment procedure used to evaluate assets accepted as collateral. Due to a high item-nonresponse rate (about 40%) we do not use this item in the further analysis. Finally, question 2.6 gives information on the minimum share of the credit that has to be collateralized. The minimum sufficient cover is for more than nine out of ten central banks at least 100%. Less than 10% of central banks are demanding a minimum sufficient cover of less than 100%.

Part 3 of the questionnaire deals with the required creditworthiness of the issuer (3.1) and of the central banks counterparties (3.2). It turns out that merely 9% of the central banks are using rating agencies assessments to define minimum creditworthiness for their counterparties.<sup>17</sup> Hence, we use the answers to question 3.1 as a single indicator of creditworthiness in the index formula. The minimum creditworthiness of issuers of assets acceptable as collateral corresponds for two out of three central banks to rating agencies’ assessments. If issuer’s minimum creditworthiness can be expressed as such a rating, more than three out of four central banks demand an issuer’s creditworthiness that can be said to be essentially risk free (ratings Aaa to A).

Central banks capital and reserves are reviewed in part 4 of the questionnaire. The effectiveness of central banks’ collateral frameworks with regard to the avoidance of bad debts and ultimately central bank losses is the subject matter of question 4.1. 50% of central banks did not record any bad debts during the last 15 years. Those central banks, however, that recorded bad debts mostly did so in several years of the respective periods. An interpretation of these statistics in the sense that there is a tendency to suffer newly recorded bad debts each year is nonetheless invalid. Bad debts seem to be rather a one-off that stays in a central bank balance sheet as a potential threat to central bank’s capital until

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<sup>16</sup> This argument holds true in particular if we focus on a relatively short period, as is done in this analysis.

<sup>17</sup> Apparently the creditworthiness of central banks’ counterparties depends – at least for central banks themselves – more on an assessment of a commercial bank’s creditworthiness by the banking supervision, which is often part of a central bank’s mandate.



a settlement has been reached. The magnitude of bad debts – in case these are recorded – can only be neglected by less than a third of the concerned central banks. For another third of these central banks the level of bad debts is well in the range of two digit percentages of total credits granted. Such a magnitude of bad debts is even higher than that, which commercial banks usually have to expect.

Question 4.2 asks for the balance sheet details in the period 1990-2003. From these entries, the amount of banknotes in circulation as a percentage of total assets can be calculated. Only slightly more than 10% of central banks have or had a balance sheet burdened with such an amount of other activities items that the percentage of currency fell below 10% of total liabilities. To put this in perspective the Federal Reserve System's combined balance sheet displays a percentage of currency of about 90% of total liabilities. Of course the question needs to be asked whether central bank balance sheets that display less than 10% currency as percentage of total liabilities contain only items, which represent genuine central bank activities.<sup>18</sup>

Following this argumentation, items 4.1 and 4.2 are included in the set of variables relevant for index calculation, as both of them prove to be indicators for quality of eligible collateral. Question 4.3 asks for the amount of profits transferred to government each year. This item is not of immediate concern for the quality of eligible assets. Finally, part 5 deals with communication items. In particular, central banks' are asked for relevant publications concerning their guidelines on eligible collateral.

## 2.3 Measuring Item Responses and Treatment of Missing Values

Table 1 integrates the 6 items that were selected as the basis for calculating an index of the quality of eligible collateral. 2.1 and 2.4 enter the index as binary 0/1-variables. As answers to 2.6 (minimum sufficient cover) were formulated as share brackets, we decided to measure these answers on an equidistant scale ranging from 1 to 5. The same reasoning was applied to transform answers on item 3.1 (minimum degree of creditworthiness) into a quantitative measure, the scale goes from 1 to 8. Both 4.1 and 4.2 ask for percentage values, stated shares enter the index without any prior transformation. Table 1 lists the items to be incorporated in the index calculation.

19 central banks did not report the percentage of bad debt in their portfolios (question 4.1). Roughly three quarter of the remaining central banks (31 out of 43) stated that none of their credits were suffering. Hence, we chose to fill the missing answers by the value 0. Concerning quality measurement, this is a conservative method of imputation, as an underestimation of the quality of credits and, thus, the quality of collateral is ruled out by this particular approach. Missing values were also observed for questions 2.6 and 3.1: Two central banks did not give information on the minimum sufficient cover and four

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<sup>18</sup> A similar measure labelled *clean balance sheet indicator* has been employed by Gros (2004) who shows that some correlation exists between average inflation and his indicator. The size of the sample used and the data collected by Gros, however, are rather small and are taken as corroboration of his argument that an overblown central bank balance sheet might represent a threat for central bank independence.

central banks did not specify the minimum degree of creditworthiness of the issuers of eligible assets. We replaced these missing values with the mode of corresponding answers.

**Table 1: Questions, answers and assigned numerical values**

| <b>Question</b> | <b>Answers</b>   | <b>Assigned values</b> |
|-----------------|--|------------------------|
| <b>2.1</b>      | Does your central bank provide liquidity if the receiving institution is not pledging sufficient collateral to secure the credit, e.g. for short-term liquidity shortages?   |                        |
|                 | No ( <i>collateral is never dispensed with</i> )<br>Yes ( <i>collateral is exceptionally dispensed with</i> )  | <b>0</b><br><b>1</b>   |
| <b>2.4</b>      | Does your central bank accept assets as collateral from institutions that have close ties with the issuers of those assets?  |                        |
|                 | No ( <i>assets issued by linked institutions can not be pledged</i> )<br>Yes ( <i>such assets are accepted as collateral</i> )   | <b>0</b><br><b>1</b>   |
| <b>2.6</b>      | What is the minimum percentage eligible collateral has to satisfy relative to an amount of credit? That is, what is the minimum sufficient cover?  |                        |
|                 | minimum sufficient cover of more than 100 percent  | <b>1</b>               |
|                 | minimum sufficient cover of 100 percent  | <b>2</b>               |
|                 | minimum sufficient cover of 50 percent or more   | <b>3</b>               |
|                 | minimum sufficient cover of less than 50 percent<br>no backing by collateral needed  | <b>4</b><br><b>5</b>   |
| <b>3.1</b>      | Which is the minimum degree of creditworthiness that issuers of assets eligible as collateral at your central bank have to satisfy?  |                        |
|                 | Aaa (most creditworthy)  | <b>1</b>               |
|                 | Aa (highly creditworthy)   | <b>2</b>               |
|                 | A (creditworthy)   | <b>3</b>               |
|                 | Baa (less creditworthy but investment-grade)   | <b>4</b>               |
|                 | Ba (low-risk speculative)  | <b>5</b>               |
|                 | B (moderate-risk speculative)  | <b>6</b>               |
|                 | C (high-risk speculative)<br>None  | <b>7</b><br><b>8</b>   |
| <b>4.1</b>      | What was the amount of bad debts as percentage of the total amount of credits granted by your central bank in each year?   |                        |
|                 | no classification/quantitative variable  |                        |
| <b>4.2</b>      | Please complete the following balance sheets for your central bank.<br>( <i>What was the amount of “non-banknotes assets” as percentage of total assets in each year? – This is one minus the amount of banknotes in circulation as percentage of total assets</i> ) |                        |
|                 | no classification/quantitative variable  |                        |

## 2.4 Standardization of Item Values and Choice of Index Weights

To be able to aggregate items measured on different scales these have to be made comparable. Two methods of rescaling are common in the construction of socio-economic indices:

- **Rescaling ranges:** Given both an upper and a lower bound of item values,  $x_u$  and  $x_l$  respectively, transforming the observations by subtracting the lower limit and dividing this difference by the value range results in transformed values  $(x-x_l)/(x_u-x_l)$  ranging from 0 to 1 by construction.<sup>19</sup> Hence, aggregating the transformed items leads to an index with the same span of values.
- **Rescaling moments:** Instead of standardizing value ranges, the first two moments of the response distributions can be unified. Usually, z-scores are used for this purpose: Mean adjusted item responses are divided by their empirical standard deviation. The resulting scores possess zero mean and a unitary variance.

Note that in case of rescaling the item range, the choice of the upper and lower bounds  $x_u$  and  $x_l$  implicitly determines the relative weight the item obtains when combining the rescaled variables to produce a single index.<sup>20</sup> In particular, binary responses have a strong impact on the resulting index values: As either zero or one is observed, any observation lies on the border of the (rescaled) item range. Whether or not this is a sensible or desirable feature depends on the respective application. In the application at hand, it seems reasonable to allow for a strong impact of the “fundamental” binary items 2.1 and 2.4 on the resulting index. This may be seen as an argument for using rescaled ranges when constructing an index on the quality of eligible assets.

Whenever item responses are combined to produce a single index, index weights have to be assigned to the individual components. Provided that items are selected in a way that each component measures a distinct feature of the phenomenon the index is constructed for, as is the case in our study, any departure from equal weights seems to be arbitrary.<sup>21</sup> Hence, an equally weighted index seems to be a natural choice to combine the items listed in Table 1 to an index on the quality of eligible collateral. This is the method proposed in Lehmecker (2008a). However, following the argumentation in the preceding paragraph it is reasonable to slightly increase the weight assigned to both of the quantitative variables as measured by items 4.1 and 4.2. Hence, the IQEC index used in Lehmecker (2008a) is defined as follows:

|      |                   |  |
|------|-------------------|--|
| IQEC | Components:       | Items 2.1, 2.4, 2.6, 3.1, 4.1, 4.2, rescaled ranges (0 to 1) |
|      | Weighting scheme: | 0.15, 0.15, 0.15, 0.15, 0.2, 0.2                             |

Frequently, data-driven selection procedures are suggested as an alternative to choosing index weights based on a priori reasoning. Here, factor analysis turns out to be a

<sup>19</sup> A popular example for this class of indices is the Human Development Index HDI constructed by the United Nations Development Program. See Cahill & Sanchez (2001) for a concise discussion, referring also to principal components analysis.

<sup>20</sup> See Noorbakhsh (1998) for a discussion.

<sup>21</sup> Berger *et al.* (2001), p. 16-23, discuss different methods of aggregating components of indices.

convenient tool: Exploiting the empirical correlations of individual item responses, factor analysis reduces the information of the multivariate data set to a smaller set of (uncorrelated) latent factors. Using the principal components method of factor analysis, the first extracted factor by construction explains most of the variance of the whole dataset, and the succeeding factors explain less and less variance. Hence, the first principal component may be interpreted as an index of the underlying variables, with weights of individual items determined merely by statistical reasoning.<sup>22</sup> Obviously, principal components analysis proves to be an appropriate procedure for index construction, whenever the first principal component explains a substantial share of the underlying data set's variance.<sup>23</sup>

Usually, principal component analysis is based on the z-scores of the underlying variables. Drawing on this rescaling method for the six items listed above, the estimated first component is 1.65, which means that merely 27.4% of total variance is explained by this factor.<sup>24</sup> This comes as no surprise, since the individual items aim at measuring rather different facets of the quality of eligible assets. Hence, extracting common factors by analyzing correlations between item responses turns out to be a very ambitious task. However, we continue to calculate an index based on principal component analysis, IQEC<sup>PC</sup>, for comparison purposes. The weighting scheme of the 'principal component index' is given by the first eigenvector of the correlation matrix and reads as follows:

|                    |                   |   |
|--------------------|-------------------|---|
| IQEC <sup>PC</sup> | Components:       | Items 2.1, 2.4, 2.6, 3.1, 4.1, 4.2, rescaled moments (z-scores) |
|                    | Weighting scheme: | 0.536, -0.021, 0.260, 0.516, 0.469, 0.398                       |

Note that in principal components analysis, index weights are normalized so that their squared values sum to unity.<sup>25</sup> Principal components analysis assigns weights of comparable size to questions 2.1, 3.1, 4.1 and 4.2, whereas item 2.6 enters the index with reduced weight. Virtually no weight is given to question 2.4. This is counterintuitive and corroborates the statement that using principal components turns out to be an inferior method of index construction in the application at hand: The zero 'principal components' weight for item 2.4 reflects very low correlations with the remaining items for the period 1998 to 2003. Nonetheless, it clearly would be inappropriate to ignore the fact that a central bank accepts assets as collateral from institutions that have close ties with the issuers of those assets when measuring the quality of eligible collateral.

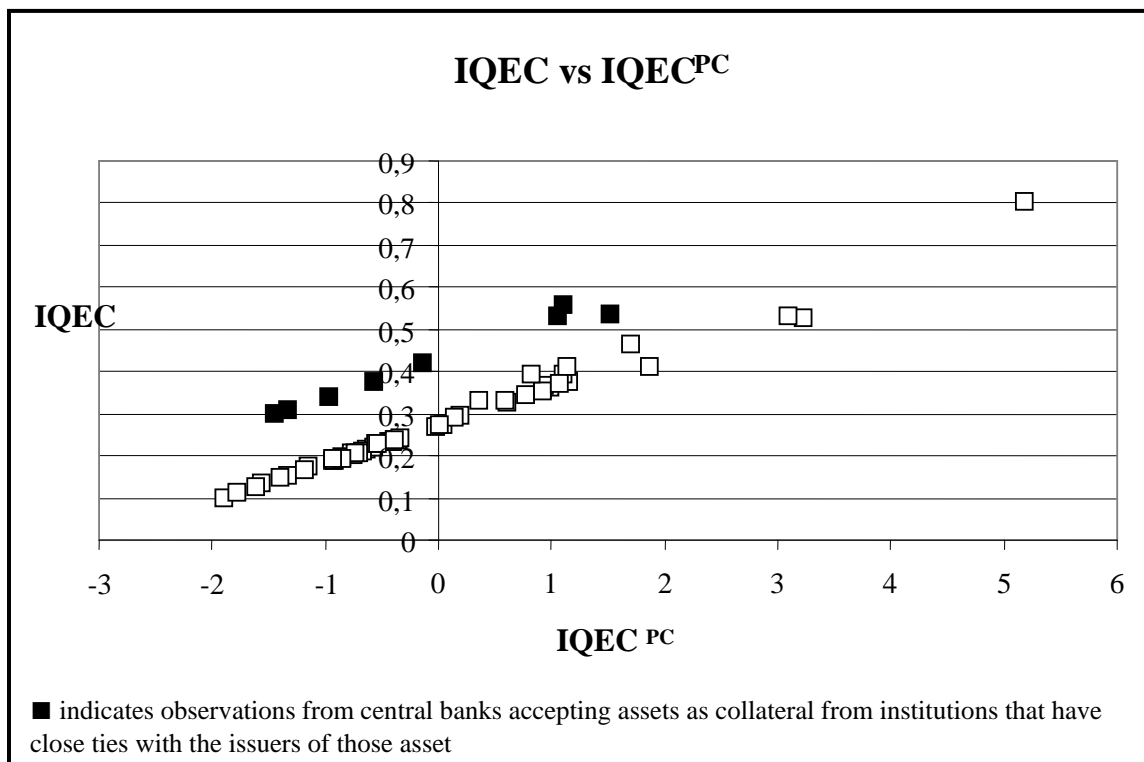
<sup>22</sup> A detailed discussion of applied index construction using the principal components method is given in Yvas & Kumaranayake (2006).

<sup>23</sup> Formally, the principal component refers to the first eigenvalue of the data set's correlation matrix. The (relative) contribution to the explanation of total variance is given by the individual eigenvalue's share in the total sum of eigenvalues.

<sup>24</sup> Estimated eigenvalues are 1.646, 1.158, 1.116, 0.924, 0.632, 0.523. Variance shares are obtained by dividing these values by 6 (number of underlying variables) and read as follows: 0.274, 0.193, 0.186, 0.154, 0.105, 0.087.

<sup>25</sup> For convenience, these index values may be rescaled once more, for example to obtain an index with zero mean.

Figure 1 shows a scatter plot of IQEC against  $IQEC^{PC}$ . The 8 central banks accepting collateral from institutions that have close ties with the issuers can be identified easily from this diagram. Obviously, the particular treatment of item 2.4 seems to be the only distinctive feature of both indices. Ignoring the ‘allowing for close ties’ observations leads to a correlation coefficient of 0.993 for the index values in the reduced sample (54 countries). This can be interpreted as ample evidence for the IQEC’s robustness with respect to both the rescaling method and the particular weighting scheme (apart from the unreasonable zero weight for item 2.4 as suggested by the principal components analysis).<sup>26</sup>



**Figure 1: Scatter plot for IQEC versus  $IQEC^{PC}$**

IQEC values for the sample of 62 countries are listed in Table 2 in the Appendix. Note that by construction a high index value indicates a poor quality of collateral.

## 2.4 Correlation Analysis

According to the theory of Property Economics, the quality of eligible collateral proves to be the main determinant of monetary stability. Hence, we examine this issue in a leadoff correlation analysis. In Figure 2 IQEC values are plotted against the rate of consumer price inflation (CPI)<sup>27</sup> during the period 1998-2003. The correlation coefficient  $r = 0,494$

<sup>26</sup> See Lehmecker (2008a) for further robustness checks concerning alternative weighting schemes for the individual index components.

<sup>27</sup> Data are taken from the World Bank’s (2006) development indicators.

has the expected sign as a lower index value indicates a better quality of collateral and proves to be highly significant ( $p < 0,001$ ).

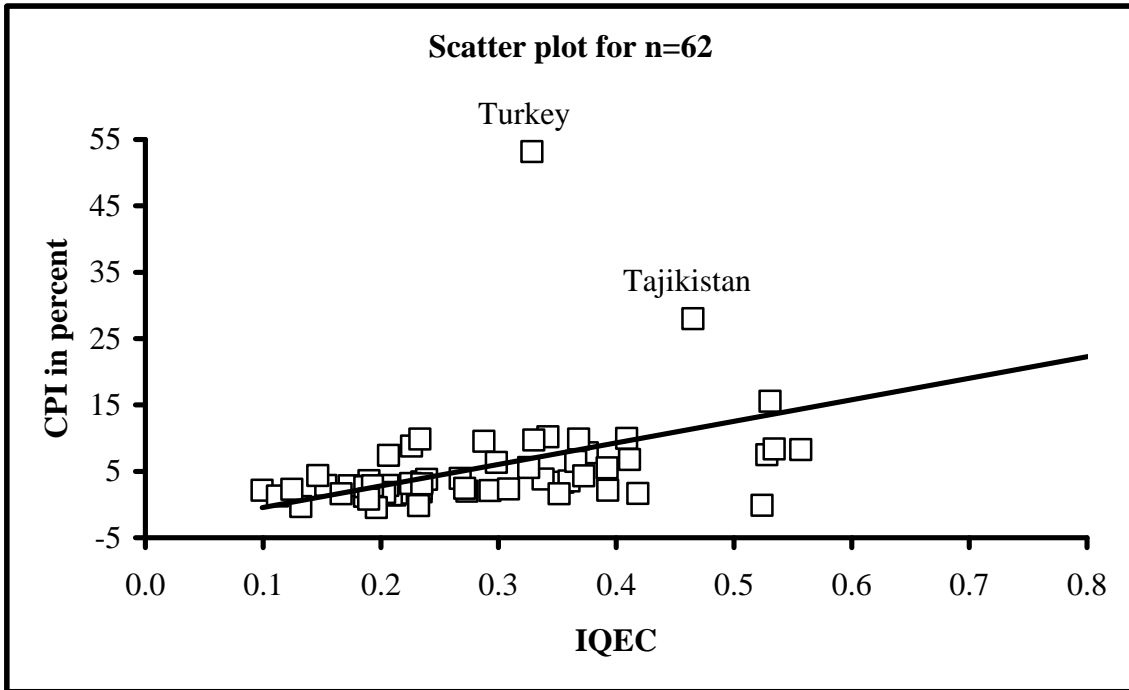


Figure 2: Scatter plot for IQEC versus CPI, full sample

Note that the sample includes three high-inflation countries: Romania, Tajikistan and Turkey feature pronounced above average inflation. These observations might possess an inadmissibly strong effect on the correlations presented above. However, exclusion of the three outliers from the sample leaves both the correlation coefficient and the significance level almost unchanged:  $r = 0.526$ , with  $p < 0.001$ . The related scatter plot is displayed in Figure 3.

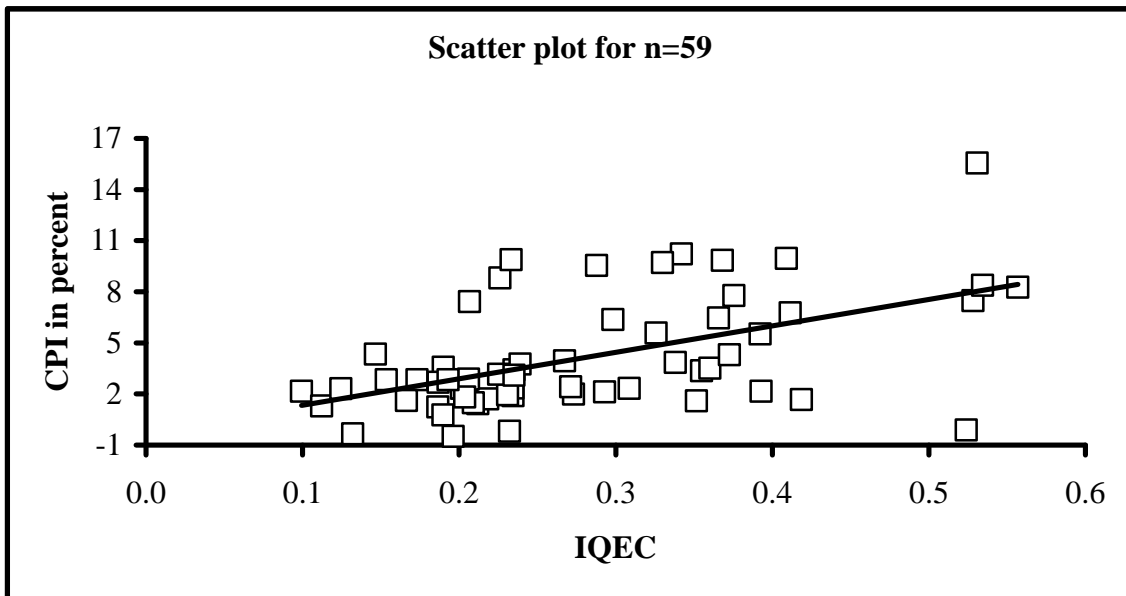


Figure 3: Scatter plot for IQEC versus CPI, reduced sample (Romania, Tajikistan and Turkey excluded)

This can be interpreted as first empirical evidence of the claim that the concept of the quality of eligible collateral possesses in fact explanatory power with regard to differences in inflation. Whether this assertion can be corroborated by multivariate regression analyses (including several control variables) is examined in a companion paper.<sup>28</sup>

### 3 Summary

We derived an index measuring central banks' standards on the quality of assets eligible for collateralising central banks' loans to commercial banks – IQEC. These data could be used to generate new empirical findings. Such findings might, in turn, provide valuable policy advice for less-developed and transition countries directions towards a more stable economic development. In particular, we found a significant correlation between index values and monetary stability as measured by inflation rates in a sample of 62 countries. This result is in line with the theory of property economics. An in-depth discussion of the theoretical foundations and a thorough (multivariate) empirical analysis is delegated to a companion paper. In this contribution, we focused on the index construction, and we provided IQEC-values for the sample of 62 countries. We hope that these data will prove to be of value in further empirical studies addressing the impact of institutional frameworks on central banks' efficiency.

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<sup>28</sup> Cf. Lehmbecker (2008b).

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## Appendix

**Table 2: Index values**

| <b>Country</b> | <b>IQEC</b> | <b>Country</b>    | <b>IQEC</b> |
|----------------|-------------|-------------------|-------------|
| Australia      | 0.15        | Latvia            | 0.17        |
| Austria        | 0.21        | Luxembourg        | 0.27        |
| Bahamas        | 0.23        | Macedonia         | 0.29        |
| Belgium        | 0.22        | Malta             | 0.19        |
| Bolivia        | 0.35        | Mauritius         | 0.33        |
| Botswana       | 0.38        | Mexico            | 0.29        |
| Brazil         | 0.53        | Mongolia          | 0.41        |
| Canada         | 0.10        | Mozambique        | 0.37        |
| Cape Verde     | 0.39        | Netherlands       | 0.21        |
| Chile          | 0.36        | New Zealand       | 0.20        |
| China          | 0.52        | Nicaragua         | 0.53        |
| Colombia       | 0.41        | Norway            | 0.27        |
| Croatia        | 0.19        | Oman              | 0.23        |
| Czech Rep.     | 0.34        | Paraguay          | 0.23        |
| Denmark        | 0.23        | Peru              | 0.23        |
| ECCB           | 0.42        | Philippines       | 0.39        |
| Estonia        | 0.15        | Portugal          | 0.23        |
| Finland        | 0.23        | Romania           | 0.80        |
| France         | 0.21        | Saudi Arabia      | 0.20        |
| Germany        | 0.19        | Slovenia          | 0.21        |
| Greece         | 0.24        | South Africa      | 0.30        |
| Guatemala      | 0.37        | Spain             | 0.19        |
| Honduras       | 0.34        | Sweden            | 0.17        |
| Hungary        | 0.23        | Switzerland       | 0.19        |
| Iceland        | 0.27        | Tajikistan        | 0.47        |
| Iran           | 0.53        | Thailand          | 0.31        |
| Ireland        | 0.24        | Trinidad & Tobago | 0.37        |
| Italy          | 0.20        | Turkey            | 0.33        |
| Japan          | 0.13        | United Kingdom    | 0.11        |
| Jordan         | 0.35        | United States     | 0.12        |
| Kazakhstan     | 0.56        | Uruguay           | 0.33        |

**Table 2: Countries and respective IQEC values**

## Questionnaire on Eligible Collateral

The following questions are organized under five headings. The major part of the questions will ask for information regarding the current framework of your central bank as well as the framework of 1990 or an alternative year, on which you can provide information, possibly close to 1990. The answering of the questions should not take more than 30 minutes. Any additional information and comments are welcome. If you have questions, please feel free to contact us: lehmbecker@uni-bremen.de.

### 1 Basic information

1.1 If you were to categorise your monetary policy framework as one of the following, would you describe your framework as: (Please tick)

| Targeted variable   | Current framework        | Framework of 1990 or other 19□□ |
|---|--------------------------|---------------------------------|
| Money targeting   | <input type="checkbox"/> | <input type="checkbox"/>        |
| Inflation targeting   | <input type="checkbox"/> | <input type="checkbox"/>        |
| Discretionary   | <input type="checkbox"/> | <input type="checkbox"/>        |
| Exchange rate targeting                                       | <input type="checkbox"/> | <input type="checkbox"/>        |
| Balance of payments targeting                                 | <input type="checkbox"/> | <input type="checkbox"/>        |
| Other (please specify)  | <input type="checkbox"/> | <input type="checkbox"/>        |
| Cannot be summarised as targeting one variable                | <input type="checkbox"/> | <input type="checkbox"/>        |
| Please provide details for current framework:                 |                          |                                 |
| Please provide details for framework of 1990 or another year: |                          |                                 |

Please note: If you do not have information on the framework of 1990, please provide information for an alternative year close to 1990 and state for which year you provide information.

1.2 Since when are the current terms and conditions of your central bank on eligible collateral for monetary policy operations valid? (Please enter year)

1.3 How many times have the guidelines on eligible collateral been changed since 1990?

**2 Quality of eligible assets**

2.1 Does your central bank provide liquidity if the receiving institution is not pledging sufficient collateral to secure the credit, e.g. for short-term liquidity shortages? (Please tick)

|  |  |
|--|--|
| Current framework:   | Framework of 1990 or other<br>19□□                         |
| Yes <input type="checkbox"/> / No <input type="checkbox"/> | Yes <input type="checkbox"/> / No <input type="checkbox"/> |

2.2 Does your central bank provide advances (non-collateralized lending) to the government? (Please tick)

|  |  |
|--|--|
| Current framework:   | Framework of 1990 or other<br>19□□                         |
| Yes <input type="checkbox"/> / No <input type="checkbox"/> | Yes <input type="checkbox"/> / No <input type="checkbox"/> |

2.3 Does your central bank accept assets as collateral from institutions that are the issuers of those assets? That is, do issuers of assets that would be accepted as collateral have the right to pledge these assets as collateral? (Please tick)

|  |  |
|--|--|
| Current framework:   | Framework of 1990 or other<br>19□□                         |
| Yes <input type="checkbox"/> / No <input type="checkbox"/> | Yes <input type="checkbox"/> / No <input type="checkbox"/> |

2.4 Does your central bank accept assets as collateral from institutions that have close ties with the issuers of those assets? (Please tick)

|  |  |
|--|--|
| Current framework:   | Framework of 1990 or other<br>19□□                         |
| Yes <input type="checkbox"/> / No <input type="checkbox"/> | Yes <input type="checkbox"/> / No <input type="checkbox"/> |

2.5 Which assessment procedure or assessment criteria are used to evaluate those assets accepted as collateral? (Please tick)

| Assessment procedure / criteria to evaluate accepted collateral | Current framework                                   | Framework of 1990 or other<br>19□□                  |
|---|---|---|
| Evaluation always with lowest value                             | <input type="checkbox"/>                            | <input type="checkbox"/>                            |
| Evaluation with market value                                    | <input type="checkbox"/>                            | <input type="checkbox"/>                            |
| Evaluation with market value and evaluation haircuts            | <input type="checkbox"/><br>minimum haircut<br>□□ % | <input type="checkbox"/><br>minimum haircut<br>□□ % |

Measuring the Quality of Eligible Collateral

|  |                         |                         |
|--|-------------------------|-------------------------|
|  | maximum haircut<br>□□ % | maximum haircut<br>□□ % |
| If other procedure / criteria under current framework, please specify:                 |                         |                         |
| If other procedure / criteria under framework of 1990 or another year, please specify: |                         |                         |

2.6 What is the minimum percentage eligible collateral has to satisfy relative to an amount of credit? That is, what is the minimum sufficient cover? (Please tick)

| Minimum sufficient cover               | Current framework        | Framework of 1990 or other 19□□ |
|--|--------------------------|---------------------------------|
| No backing by collateral needed        | <input type="checkbox"/> | <input type="checkbox"/>        |
| Less than 50% of the amount of credit  | <input type="checkbox"/> | <input type="checkbox"/>        |
| 50% or more of the amount of credit    | <input type="checkbox"/> | <input type="checkbox"/>        |
| 100% of the amount of credit           | <input type="checkbox"/> | <input type="checkbox"/>        |
| More than 100% of the amount of credit | <input type="checkbox"/> | <input type="checkbox"/>        |

### 3 Creditworthiness

3.1 Which is the minimum degree of creditworthiness that issuers of assets eligible as collateral at your central bank have to satisfy?

| Issuer's degree of creditworthiness          |         | Current framework        | Framework of 1990 or other 19□□ |
|--|---------|--------------------------|---------------------------------|
| Standard & Poor's                            | Moody's |                          |                                 |
| AAA / most creditworthy                      | Aaa     | <input type="checkbox"/> | <input type="checkbox"/>        |
| AA / highly creditworthy                     | Aa      | <input type="checkbox"/> | <input type="checkbox"/>        |
| A / creditworthy                             | A       | <input type="checkbox"/> | <input type="checkbox"/>        |
| BBB / less creditworthy but investment-grade | Baa     | <input type="checkbox"/> | <input type="checkbox"/>        |
| BB / low-risk speculative                    | Ba      | <input type="checkbox"/> | <input type="checkbox"/>        |
| B / moderate-risk speculative                | B       | <input type="checkbox"/> | <input type="checkbox"/>        |
| C / high-risk speculative                    | C       | <input type="checkbox"/> | <input type="checkbox"/>        |
| None   |         | <input type="checkbox"/> | <input type="checkbox"/>        |

3.2 Which is the minimum degree of creditworthiness that eligible counterparties that pledge collateral to your central bank have to satisfy?

Measuring the Quality of Eligible Collateral

| Counterparty's degree of creditworthiness    |         | Current framework        | Framework of 1990 or other 19□□ |
|--|---------|--------------------------|---------------------------------|
| Standard & Poor's                            | Moody's |                          |                                 |
| AAA / most creditworthy                      | Aaa     | <input type="checkbox"/> | <input type="checkbox"/>        |
| AA / highly creditworthy                     | Aa      | <input type="checkbox"/> | <input type="checkbox"/>        |
| A / creditworthy                             | A       | <input type="checkbox"/> | <input type="checkbox"/>        |
| BBB / less creditworthy but investment-grade | Baa     | <input type="checkbox"/> | <input type="checkbox"/>        |
| BB / low-risk speculative                    | Ba      | <input type="checkbox"/> | <input type="checkbox"/>        |
| B / moderate-risk speculative                | B       | <input type="checkbox"/> | <input type="checkbox"/>        |
| C / high-risk speculative                    | C       | <input type="checkbox"/> | <input type="checkbox"/>        |
| None   |         | <input type="checkbox"/> | <input type="checkbox"/>        |

#### 4 Capital and reserves

4.1 What was the amount of bad debts as percentage of the total amount of credits granted by your central bank in each year?

| Bad debts as percentage of credits granted |      |      |      |      |
|--|------|------|------|------|
| 2003                                       | 2002 | 2001 | 2000 | 1999 |
|  |      |      |      |      |
| 1998                                       | 1997 | 1996 | 1995 | 1994 |
|  |      |      |      |      |
| 1993                                       | 1992 | 1991 | 1990 |      |
|  |      |      |      |      |

4.2 Please complete the following balance sheets for your central bank.

Please feel free to choose a convenient unit of measurement and use this unit for all of the balance sheet entries.

Measuring the Quality of Eligible Collateral

| <b>Balance sheets for the years 2003 to 1990</b>   |      |      |                                  |      |      |
|--|------|------|----------------------------------|------|------|
| Assets   | 2003 | 2002 | Liabilities                      | 2003 | 2002 |
| Gold and gold receivables  |      |      | Banknotes in circulation         |      |      |
| Foreign assets   |      |      | Liabilities in domestic currency |      |      |
| Claims on government   |      |      | Liabilities in foreign currency  |      |      |
| Claims on domestic banks   |      |      | Provisions for possible losses   |      |      |
| Other assets   |      |      | Other liabilities                |      |      |
| Total assets   |      |      | Revaluation accounts             |      |      |
|  |      |      | Capital and reserves             |      |      |
|  |      |      | <b>Total liabilities</b>         |      |      |
| Loss for the year  |      |      | Profit for the year              |      |      |
| Major reason(s) for loss   |      |      | Major reason(s) for profit       |      |      |
| <p><b>Please note:</b> If your central bank provides the information asked for in this table, i.e data on balance sheets and profits and losses for the years 1990 to 2003, on its homepage and in English language, please provide the corresponding link(s) here:<br/>Otherwise, please complete the following tables as well.</p> |      |      |                                  |      |      |



Measuring the Quality of Eligible Collateral

| <b>Balance sheets for the years 2001 to 1999</b> |             |             |             |                                  |             |             |             |
|--|-------------|-------------|-------------|----------------------------------|-------------|-------------|-------------|
| <b>Assets</b>                                    | <b>2001</b> | <b>2000</b> | <b>1999</b> | <b>Liabilities</b>               | <b>2001</b> | <b>2000</b> | <b>1999</b> |
| Gold and gold receivables                        |             |             |             | Banknotes in circulation         |             |             |             |
| Foreign assets                                   |             |             |             | Liabilities in domestic currency |             |             |             |
| Claims on government                             |             |             |             | Liabilities in foreign currency  |             |             |             |
| Claims on domestic banks                         |             |             |             | Provisions for possible losses   |             |             |             |
| Other assets                                     |             |             |             | Other liabilities                |             |             |             |
| Total assets                                     |             |             |             | Revaluation accounts             |             |             |             |
|  |             |             |             | Capital and reserves             |             |             |             |
|  |             |             |             | <b>Total liabilities</b>         |             |             |             |
| Loss for the year                                |             |             |             | Profit for the year              |             |             |             |
| Major reason(s) for loss                         |             |             |             | Major reason(s) for profit       |             |             |             |

Measuring the Quality of Eligible Collateral

| <b>Balance sheets for the years 1998 to 1996</b> |             |             |             |                                  |             |             |             |
|--|-------------|-------------|-------------|----------------------------------|-------------|-------------|-------------|
| <b>Assets</b>                                    | <b>1998</b> | <b>1997</b> | <b>1996</b> | <b>Liabilities</b>               | <b>1998</b> | <b>1997</b> | <b>1996</b> |
| Gold and gold receivables                        |             |             |             | Banknotes in circulation         |             |             |             |
| Foreign assets                                   |             |             |             | Liabilities in domestic currency |             |             |             |
| Claims on government                             |             |             |             | Liabilities in foreign currency  |             |             |             |
| Claims on domestic banks                         |             |             |             | Provisions for possible losses   |             |             |             |
| Other assets                                     |             |             |             | Other liabilities                |             |             |             |
| Total assets                                     |             |             |             | Revaluation accounts             |             |             |             |
|  |             |             |             | Capital and reserves             |             |             |             |
|  |             |             |             | <b>Total liabilities</b>         |             |             |             |
| Loss for the year                                |             |             |             | Profit for the year              |             |             |             |
| Major reason(s) for loss                         |             |             |             | Major reason(s) for profit       |             |             |             |

Measuring the Quality of Eligible Collateral

| <b>Balance sheets for the years 1995 to 1993</b> |             |             |             |                                  |             |             |             |
|--|-------------|-------------|-------------|----------------------------------|-------------|-------------|-------------|
| <b>Assets</b>                                    | <b>1995</b> | <b>1994</b> | <b>1993</b> | <b>Liabilities</b>               | <b>1995</b> | <b>1994</b> | <b>1993</b> |
| Gold and gold receivables                        |             |             |             | Banknotes in circulation         |             |             |             |
| Foreign assets                                   |             |             |             | Liabilities in domestic currency |             |             |             |
| Claims on government                             |             |             |             | Liabilities in foreign currency  |             |             |             |
| Claims on domestic banks                         |             |             |             | Provisions for possible losses   |             |             |             |
| Other assets                                     |             |             |             | Other liabilities                |             |             |             |
| Total assets                                     |             |             |             | Revaluation accounts             |             |             |             |
|  |             |             |             | Capital and reserves             |             |             |             |
|  |             |             |             | <b>Total liabilities</b>         |             |             |             |
| Loss for the year                                |             |             |             | Profit for the year              |             |             |             |
| Major reason(s) for loss                         |             |             |             | Major reason(s) for profit       |             |             |             |

Measuring the Quality of Eligible Collateral

| <b>Balance sheets for the years 1992 to 1990</b> |             |             |             |                                  |             |             |             |
|--|-------------|-------------|-------------|----------------------------------|-------------|-------------|-------------|
| <b>Assets</b>                                    | <b>1992</b> | <b>1991</b> | <b>1990</b> | <b>Liabilities</b>               | <b>1992</b> | <b>1991</b> | <b>1990</b> |
| Gold and gold receivables                        |             |             |             | Banknotes in circulation         |             |             |             |
| Foreign assets                                   |             |             |             | Liabilities in domestic currency |             |             |             |
| Claims on government                             |             |             |             | Liabilities in foreign currency  |             |             |             |
| Claims on domestic banks                         |             |             |             | Provisions for possible losses   |             |             |             |
| Other assets                                     |             |             |             | Other liabilities                |             |             |             |
| Total assets                                     |             |             |             | Revaluation accounts             |             |             |             |
|  |             |             |             | Capital and reserves             |             |             |             |
|  |             |             |             | <b>Total liabilities</b>         |             |             |             |
| Loss for the year                                |             |             |             | Profit for the year              |             |             |             |
| Major reason(s) for loss                         |             |             |             | Major reason(s) for profit       |             |             |             |

4.3 In each of the following years, what was the amount of profits transferred to government (Please indicate transfers received from government with a minus)?

| Profits transferred to government |      |      |      |      |
|-----------------------------------|------|------|------|------|
| 2003                              | 2002 | 2001 | 2000 | 1999 |
|                                   |      |      |      |      |
| 1998                              | 1997 | 1996 | 1995 | 1994 |
|                                   |      |      |      |      |
| 1993                              | 1992 | 1991 | 1990 |      |
|                                   |      |      |      |      |

## 5 Publications and address

5.1 Which publication/act/law contains the relevant guidelines on eligible collateral?

5.2 Please provide your central bank's official title.

5.3 Please provide your email address if you are interested in the results of our survey.

Fax: + 49 421 218 4336

Email: lehmbecker@uni-bremen.de

We thank you very much for your time and effort.

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