Potential Attitudes Solving the Problems of Banking Stability

Liběna Černohorská
University of Pardubice, Faculty of Economics and Administration
Studentská 84, Pardubice 532 10, Czech Republic
Phone: +420 466 036 452, e-mail: libena.cernohorska@upce.cz

Jan Černohorský
University of Pardubice, Faculty of Economics and Administration
Studentská 84, Pardubice 532 10, Czech Republic
Phone: +420 466 036 452, e-mail: jan.cernohorsky@upce.cz

Abstract

The aim of this paper is to introduce the evaluation of the Czech banking sector and banking stability based on discriminant analysis and cluster. The model is devised on the basis of financial indicators analysis of selected banking institutions based on the Czech Republic in the period from 1995 until 2005. The banks were divided into two groups – the group of operating banks and the group of bankrupted banks. This division was done according to the real development of the Czech banking sector based on data provided by the Czech National Bank. All banks providing services in the Czech Republic in the period of 1995-2005 were analysed in the model except for building societies (due to their different activities compared to commercial banks) and foreign banks’ subsidiaries (strongly influenced by their foreign owners). Data for calculation of financial indicators were taken from bank’s financial statements.

Journal of Economic Literature Classification numbers: C52, G21

Keywords: bank, stability, financial indicators, discriminant analysis, cluster analysis

1. Introduction

The banking sector significantly influences economic subjects and its stability is therefore crucial for each economy. The Czech banking sector has seen a sharp development from velvet revolution since 1989. For example, big banks funded manager’s leveraged buy-outs and accepted company shares, usually over-priced, as collateral for their loans. In related note, small banks were sometimes founded for financing allied companies or even for financing bank’s managers. For these reasons, connection among Czech banks and enterprises was becoming stronger and stronger. Consequently, if a company went bust as a result of acting bank managers, banks posted lower recovery rates from the loans because of valueless collaterals in their portfolios.
Clearly, such conditions did not support company’s restructurisation and resulted in losses in bank’s books (Tetřevová 2004, 179). Therefore, plenty of banks went under in the Czech Republic in 1990s and hence the stability of the banking sector was destabilised and the trust of customers in banks dropped (for example, collapses of Agrobanka, Union Banka, IPB etc.). It is indisputable that the stabilised banking sector has been built in the Czech Republic in a relatively short period. Despite some pitfalls, the progress towards a higher stability has been made mainly due to new IT technologies, higher qualified stuff and know-how brought by foreign investors.

The article deals with creating a bank stability model based on the discriminatory analysis made on data obtained by the development of Czech banking sector in the period 1995-2005.1

2. The Development of the Czech Banking Sector

In contrast to many other accession countries of Central and Eastern Europe (CEE), the Czech Republic experienced a shorter and less severe transition recession in the first half of the 1990s. Unemployment was in the period 1990-1995 surprisingly low, but in last five years it was under 10% (see Table 1). Stabilisation policies (the fixing and devaluation of the exchange rate, tight fiscal and monetary policies, and initial wage discipline) led to a fast reduction in inflation to single-digit levels and, thus, to internal as well as external stability. The liberalisation of prices, wages and trade, along with the fast launching of mass privatisation of state property were seen as major achievements in getting the country on a path to prosperity.

Table 1. Key Economic Figures in the Czech Republic

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP per capita (EUR at PPP)</td>
<td>10 774</td>
<td>11 586</td>
<td>11 828</td>
<td>11 961</td>
<td>12 700</td>
<td>12 490</td>
<td>14 100</td>
<td>14 920</td>
<td>15 400</td>
<td>16 800</td>
</tr>
<tr>
<td>Real GDP (% yoy)</td>
<td>-</td>
<td>4,0</td>
<td>-0,7</td>
<td>-0,8</td>
<td>0,5</td>
<td>3,3</td>
<td>2,6</td>
<td>1,5</td>
<td>3,1</td>
<td>3,5</td>
</tr>
<tr>
<td>Unemployment rate (avg, %)</td>
<td>2,9</td>
<td>3,5</td>
<td>5,2</td>
<td>7,5</td>
<td>8,6</td>
<td>9,0</td>
<td>8,6</td>
<td>8,2</td>
<td>9,9</td>
<td>10,3</td>
</tr>
<tr>
<td>Consumer prices (avb, %)</td>
<td>9,1</td>
<td>8,8</td>
<td>8,5</td>
<td>10,7</td>
<td>2,1</td>
<td>3,9</td>
<td>4,7</td>
<td>1,8</td>
<td>0,1</td>
<td>3,3</td>
</tr>
<tr>
<td>Public debt (% of GDP)</td>
<td>14,6</td>
<td>12,5</td>
<td>13,1</td>
<td>15,0</td>
<td>14,5</td>
<td>16,7</td>
<td>18,6</td>
<td>19,5</td>
<td>23,0</td>
<td>27,3</td>
</tr>
<tr>
<td>Exchange rate CZK/EUR (avg)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>36,9</td>
<td>35,6</td>
<td>34,1</td>
<td>30,8</td>
<td>31,8</td>
<td>32,1</td>
</tr>
</tbody>
</table>

Note: Exchange rate CZK/EUR is calculated from 1999.

Source: Czech National Bank

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1 The Altman criteria for Czech banks cannot be used under original conditions, because these criteria were used for the U.S. environment that differs from the Czech one.
A number of observers have noted that what appeared like a smooth transition from socialism to capitalism was in fact a sign that a fundamental reorientation of the Czech economy was yet to country’s apparent success an output and macroeconomic stabilisation in the early phase of governance. That these problems were real became evident with the massive accumulation of nonperforming loans on banks’ balance sheets, bank failures, and the economic recession in the second half of the 1990s.

2.1. The Transition of the Banking Sector in the Czech Republic

In early years of transition, all post-communist countries faced similar challenges concerning banking sector reform. They had to create a two-tier banking system with the central bank ensuring macroeconomic stability (and in most cases supervising commercial banks, too) and commercial banks contributing to efficient credit allocation. They also faced similar constraints that made this task quite difficult:

- no managerial and supervisory know-how,
- no market history of potential lenders,
- greater uncertainty regarding the outcome of entrepreneurial projects,
- inherited bad loans,
- no adequate legal framework and regulation, including a general framework for creditor protection, such as effective bankruptcy law and enforceability of collateral.

These problems aggravated the information asymmetries that are inherently present in the financial sector. The lack of entrepreneurial history and heightened uncertainty during the transition make the information asymmetries greater, while the lack of know-how problems with the use of collateral and insufficient public regulation reduced the effectiveness of their standard solutions.

After the formation of the two-tier banking system in 1990, the large Czech banks were transformed into joint-stock companies in 1992 and partially privatised within the first wave of "voucher privatisation". The state, nevertheless, kept controlling stakes in these banks (over 50% in Česká spořitelna and ČSOB, 47.4% in IPB and 44% in Komerční banka). The large banks thus remained under state control until the late 1990s, licences were granted quite freely to newly created banks, and the market was opened to foreign bank branches in 1992. This led to a fast increase in the number of banks during the early 1990s. The liberal licensing policy was primarily motivated by a desire to increase competition in the banking sector quickly.

In order to reduce the inherited bad loan problem and to create the basic conditions for the viability of the commercial banks after their split-off from the State Bank of Czechoslovakia, a project called Consolidation Programme was undertaken in early 1990s. This included operations associated with the clean-up of the balance sheets of Komerční banka, Česká spořitelna, IP and the State Bank of Czechoslovakia of the bad loans extended before 1990, operations of strengthening the capital of the state-owned banks (KB, ČS and IP), and the clean-up of the balance sheets of other banks in the periods both before and after the division of Czechoslovakia. The net cost of this programme has been estimated at about CZK 100 billion (see Table 2).

In the period of 1994-1996, during economic boom, serious problems started to emerge in the sector of small banks, which had been established in the previous period with little own capital or experience in banking business. The CNB thus developed a comprehensive programme for consolidating small banks (Consolidation Programme II) at the end of 1995, with implementation commencing at the beginning of 1996. Banks whose capital adequacy fell under 8% were instructed to produce consolidation
programmes to ensure that of 8% would be met by 31 December 1996. The measures adopted in the individual banks can be divided into four basic groups:

- reduction in capital and introduction of conservatorship in cases where there was a chance of revitalising the bank, but where the management and main shareholders were not able to deliver this process,
- termination of the bank’s activities,
- sale of the bank with the expectation of a future merger,
- capital increase by existing shareholders or a new investor.

Of the total of 18 small banks, 15 were included in Consolidation Programme II, with radical solutions revocation of licences, introduction of conservatorship or game-over by another bank adopted in 9 of these. The gross amount of funds issued by the CNB under Consolidation Programme II, without taking repayments and other revenues into account was CZK 32.9 billion. The consolidation of the small banks sub-sector in 1996 led to a fundamental change in its structure. Banks which were insolvent were removed from the banking sector. The consolidation process did not take place without a decline in the public’s confidence in the banking sector.

Small banks were threatened with a gradual outflow of deposits, which they would not have been able to withstand. The Czech Government thus adopted a programme to enhance the stability of the banking sector (the Stabilisation Programme) as a systematic solution in October 1996. The essence of the Stabilisation Programme was the purchase of insolvent receivables from banks at their nominal values, up to a maximum of 110% of the bank’s capital and on the basis of returnability. Under the Stabilisation Programme, the drawing of a total of CZK 13.5 billion was approved.

### Table 2. Public Costs of the Bank Reform (CZK billion)

<table>
<thead>
<tr>
<th></th>
<th>Net costs</th>
<th>Expected net yields</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consolidation programme I (1991-1994)</td>
<td>104.8</td>
<td>-5.5</td>
</tr>
<tr>
<td>Consolidation programme II (1995-1996)</td>
<td>103.5</td>
<td>5.2</td>
</tr>
<tr>
<td>Stabilization programme (1996)</td>
<td>13.5</td>
<td>7.6</td>
</tr>
<tr>
<td>Preparation of privatisation (1998 – 2001)</td>
<td>84.8</td>
<td>9.8</td>
</tr>
<tr>
<td>Total</td>
<td>306.6</td>
<td>17.1</td>
</tr>
</tbody>
</table>

Source: Czech National Bank

### 2.1.1 Privatisation and Foreign Ownership

Privatisation was re-launched in 1997 and the state’s divestiture from large banks commenced in February 1998 with the sale of the state’s 36% minority stake in IPB to Nomura International.

This was the first time that foreign investors got the opportunity to acquire a substantial or majority interest in a large Czech bank. Privatisation continued in June 1998, when General Electric Capital Services (GE Capital acquired a substantial part of Agrobanka assets, which had been under forced administration since 1996). And then, in mid-1999, KBC of Belgium bought a 66% stake in ČSOB, the fourth largest Czech
In March 2000, Erste Bank of Austria acquired 52% of CS. This came after the Czech government had carved-out a good part of the bad debt and protected the new owner against the remaining credit risk on CAS’s loan portfolio through a ring-fencing agreement. Finally, in mid-2001, the process of bank privatisation was essentially completed – again after carving out bad assets – by the sale of KB to Société Générale (see Table 3).

The last state financial institution, Konsolidační banka, terminated its activities in August 2001, when its assets were transferred to the Konsolidační agentura. The state will retain its stakes only in a number of specialised banks specifically oriented towards financing government programmes in the areas of export, support for small businesses, and administration of poor quality assets.

As a result of the privatisation, the share of foreign capital in the equity of the banking sector increased markedly between 1995 and 2000. At the end of 2000, foreigners held about 55% of total equity of the Czech banking sector (see Table 2). At the same time, the share of banking sector assets under direct control of foreigners (i.e. subsidiaries of foreign banks and majority foreign shareholdings in Czech banks) was almost 72%. This share increases to about 75% when banks under indirect foreign ownership (i.e. banks that are controlled by a domestic legal entity which, in turn, is majority-owned by foreigners) are included. EU investors account for the largest proportion, with about 80% of total foreign equity capital.

The development of medium-sized banks, which are mainly foreign banks and foreign bank branches, has gradually eroded the dominance of the large banks. Between 1998 and 2000, the share of large banks in total banking sector credit declined from 74% to 64%. In the more competitive derivatives market, the share of large banks fell from 42% to 33%. Even on the deposit site, large banks have lost ground, with their market share falling from 75% to 70%.

To summarise, after an initial burst, the number of banks operating in the Czech Republic has declined, but remains relatively high for the size of the Czech economy. Bank privatisation got off to a slow start and only gained momentum towards the end of the 1990s. As in all other CEECs, except Slovenia, foreign-owned banks now dominate the market both in terms of bank capital and banking sector assets.

### Table 3. Costs and Revenues of Bank Privatisation in the Czech Republic (CZK billion)

<table>
<thead>
<tr>
<th>Bank</th>
<th>Revenues</th>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Komerční banka</td>
<td>40</td>
<td>98</td>
</tr>
<tr>
<td>ČSOB</td>
<td>40</td>
<td>57</td>
</tr>
<tr>
<td>Česká spořitelna</td>
<td>19</td>
<td>47</td>
</tr>
<tr>
<td>IPB</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>102</strong></td>
<td><strong>218</strong></td>
</tr>
</tbody>
</table>

*Notes: The IPB cost estimate excludes the expected loss of CZK 40-100 billion that the state guaranteed to pay to ČSOB after taking over the IPB business in mid-2000.*

*Source: Czech National Bank*

### 2.1.2. Profitability, Assets and Liabilities

Classified credits accounted for up to 30% of total credits in 2000. However, there has been an improvement in the quality of the balance sheet of the surviving banks as low-quality credits have been taken off banks’ balance sheets and passed on to Konsolidační...
banka or sold at a discount to other banks. It should also be emphasised that according to CNB methodology, “watch” credits are included in the category of classified credits. This is not common in many countries. The sum of the three high-risk categories (i.e. “sub-standard”, “doubtful” and “loss” credits) accounted for 19% of the total amount of credit in 2000, which compares to about 15% and 7% in Poland and Hungary, respectively. In sum, notwithstanding improvements in recent years, the poor quality of assets still represents a substantial financial burden for the Czech banking sector, which is evident from high provisioning costs of large Czech banks, amounting to over 3% of customer loans in 2000.

2.2. Explaining the Czech Experience

Following a period of optimism and large credit expansion, the Czech banking sector experienced a period of insufficient capital adequacy, non-transparent ownership structure, related lending, asset stripping and a huge bad loan problem. As a result, domestic banks suffered losses and large state banks had to be bailed out, while small and medium-sized domestic banks had to be paid special attention in restructuring programmes. At the same time, banks under foreign control behaved prudently and were profitable. The Czech case may serve as a handbook of banking sector problems caused, paradoxically, by a lack of binding constraints. A number of factors caused these adverse developments. There are the most important (Hájková 2001, 15-17):

• inherited debt and voucher privatization,
• lack of expertise in banking,
• shortcomings in the legal, regulatory and supervisory environment,
• lack of competition from financial markets,
• state influence.

2.3. The Impact of Financial Integration

Foreign investment and off-shore financing are the key factors that are driving the integration of the Czech banking sector with that of the EU. The activities of foreign banks in the Czech banking market got off to a slow start. While more than two thirds of the 26 foreign banks currently operating in the country entered in 1993-94, the scope of their activities was restricted to top-tier local corporates. And as the foreign banks offered better services and newer products, they successfully entered this market segment.

As a result of the relatively recent privatisation of large Czech banks and the slower entry of foreign banks compared to countries such as Hungary and Poland, the impact of financial integration and structural changes on banks’ activities is still emerging in the Czech Republic. Czech banks are less active in the most dynamically developing market segments.

More generally, the future efficiency and stability of the Czech banking sector will be determined by the ability of individual banks to cope with the changing competitive landscape of increasing competition in the traditional banking products from both bank and non-bank institutions. In this respect, evidence from the European banking industry in the 1990s is illustrative. In continental Europe, the contribution of non-interest income to banks’ total income has increased while the importance of (net) interest income, i.e. traditionally the mainstay of banks, has declined. In essence, because of a limited growth potential of traditional bank intermediation, European
banks are increasingly providing services with more scope for growth, notably investment banking and asset management services. Given the direct influence that European banks have wielded by acquiring a large market share and the indirect influence of the EU convergence, the trends and market structures observed in Europe provide a useful comparison benchmark.

The possible lack of finance for small and medium-sized enterprises is often a particular concern of policy makers – and not only in accession countries of Central and Eastern Europe. Contrary to concerns that market segments such as lending to SMEs and households will not be served as foreign-owned banks will focus on different business segments, foreign-owned banks in the other CEECs have increased lending to these clients as a result of growing penetration and competition in other market segments. This trend can also be expected in the Czech Republic.

3. The Selection of the Financial Indicators

The bank sector has seen fast development in the Czech Republic since 1989. During this development, some banks, for various reasons, finished their activity and some of them are working today. Therefore we can suppose that the unstable banks will show different values of financial indicators than the stable (healthy) ones.

The bank is stable if:
- it respects the rule of cautious bank entrepreneurship determined by the CNB,
- it has received any financial or other help neither from the state nor the Czech National Bank,
- the value of relevant financial indicators will be moving around the values of the group of stable banks.

The bank is unstable if:
- it was forced to finish its activity for reasons such as taking of the licence or forced control or a bank which received any help from the state,
- the value of relevant financial indicators will be moving around the value of the group of the mean value unstable banks.

3.1. Determining Financial Indicators for Defining the Bank Stability Model

When creating the bank stability model, it was necessary to choose the suitable financial indicators that are different for values of the stable and unstable banks and are uncorrelated at the same time. The financial indicators used vary both in the Czech (Babouček 1996, 23 or Ziegler 1997, 35) and foreign literature (Golin 2000, 125). Since data come from the Czech banking sector, financial indicators have been chosen regarding the Czech market features, the Czech accounting standards and information disclosure of the Czech banks.

The financial indicators were chosen according to data availability in the Czech banking sector.

The financial indicators were calculated for every bank in given years. Based on these calculations, the median\(^2\) for each financial indicator was computed in each year, separately for stable and unstable banks (see Appendix 1 and Appendix 2). This statistical indicator was chosen because of it is used by rating agencies such as Moody’s.

\(^2\) Median was chosen because it is not influenced by extreme values.
and Standard & Poor when evaluating bank performance (for instance, ROAA, the indicator of bad loan volume etc.). The values of these indicators were calculated for the last three years and then compared with the median of the classification group.

The main criteria for creating the model of bank stability were the uncorrelated indicators and values of the indicators are simultaneously different for the group of “stable banks” and the group of “unstable banks” (verified by a graph showing time series of the financial indicators).

Based on the above-mentioned criteria the following indicators were selected:

- return on average level of assets (ROAA),
- equity/liabilities,
- interest margin,
- profit margin,
- equity/total assets ratio.

### 3.2. Determining Financial Indicators for the Cluster Analysis

The first step was to select the banks. We will measure commercial banks because their substantial sight is to offer all types of commercial or investment products. The existence on a market of others types of banks is quite different.

After that we count arithmetical average of the indicator by counting the values of concrete indicator through all the banks in the particular group of banks and through all the years, which we divide with the number of values of the indicators (number 122 or 46). Then we have average value of the indicator that characterizes the existing banks in all the years or average value of the indicator that characterises all non-existing banks.

Differences between the averages were counted for existing and non-existing banks in the next step of our analysis. These differences were divided with the total average of concrete indicators for all banks for all years because we did not influence the selection of indicators by the total difference of stable or unstable banks (see Appendix 3).

We chose indicators where we presumed we can distinguish between the existing and bankrupted banks with the help of this rate.

The aim of the analysis was to choose the indicators that characterise differences between unstable and stable banks. We wanted to choose one suitable indicator from the group of all indicators to preserve the widest view on the bank as possible:

The following indicators were selected from the group of all indicators:

- return on average assets,
- profit per employee,
- quick assets/total assets,
- receivables to clients/total assets,
- provisions charge/total assets,
- market share from the point of view of given loans,
- expenses per employee,
- liabilities to banks/total liabilities.
4. The Creation of the Bank Stability Model

When applying the discriminant analysis, we calculate values $D_1, \ldots, D_k$ for the random quantity $X$. The investigated element belongs to the group that has the biggest value from values of $D_j$. Values of $\mu_j$ are usually unknown but we have used their estimates. The probability $p_j$ is usually chosen as proportionally to the range of the j-group; if these ranges are unknown, one can choose $p_j = 1/k$.

4.1. The Creation of the Model

First, for creating the bank stability model it was necessary to calculate values as follows:
- values of medians ($\bar{x}_j$) and variances ($\mu_j$) for all indicators for the stable banks in the period 1995–2005,

We calculated the determinant of the inverse covariance matrix $D_j$. The value of $D_j$ for a particular bank is calculated as follows:

$$D_1 = -0.5 \cdot \ln \left( \det \left( \sum_{i=1}^{1} \right) \right) - 0.5 \cdot (\bar{x} - \mu_1)' \cdot \sum_{i=1}^{-1} (\bar{x} - \mu_1) + \ln p_1$$

(1)

The size $D_2$ for a particular bank is:

$$D_2 = -0.5 \cdot \ln \left( \det \left( \sum_{i=2}^{2} \right) \right) - 0.5 \cdot (\bar{x} - \mu_2)' \cdot \sum_{i=2}^{-1} (\bar{x} - \mu_2) + \ln p_2$$

(2)

The final result is to set up a model that enables to forecast the classification of a particular bank into the particular group of banks (either into the first group of the stable banks or into the second group of the unstable banks) based on provided calculations. A particular bank will belong to the group of either stable or unstable banks depending on the value of $D_j$ (the bank will be placed into the group where it reaches the bigger value of $D_j$).

4.2. Verification of the Model

The bank stability model was verified through 38 banks in the Czech Republic. It was necessary to exclude the chosen banks from the group for verification. Hence the new covariance inverse and transposed matrix was created for each of 38 relevant banks. Furthermore, the number of measurement $p_j$ for every bank was adjusted.

4.3. Verification of Results by Monitoring Bank of the Model

The result of the model was verified in such a manner that for every bank the values of the testing criterion $D_1$ and $D_2$ were found.

Consequently, the bank was classified into the group of either stable or unstable banks according to the value of testing criterion $D_j$. Seventeen banks were classified as stable banks and 24 banks as unstable.
Data from the CNB were used for verification of the bank stability model. The CNB presents in the publication “The Bank Supervision 2005” the following overview of the Czech banking sector:

- banks with a valid bank licence,
- banks in the forced administration,
- banks in liquidation,
- banks in bankruptcy proceeding,
- banks as stock companies without the bank licence,
- banks in bankruptcy without liquidation,
- banks in bankruptcy with liquidation.

Based on the results a comparison between the results from the researched model and the real development of the Czech banking sector was provided.

4.4. The Evaluation the Bank Stability Model

As it appears from our research, the results from the proposed model completely correspond to the real development of the Czech banking sector. The model has classified 17 banks into the group of stable banks and 21 banks into the group of unstable banks. When comparing with real data, this classification fully matches with the real development of the Czech banking sector (see Table 4).

<table>
<thead>
<tr>
<th>Bank group</th>
<th>Total number of banks in group</th>
<th>Bank stability model</th>
<th>Real bank development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stable banks</td>
<td>17</td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>Unstable banks</td>
<td>21</td>
<td></td>
<td>21</td>
</tr>
</tbody>
</table>

Source: own calculation, www.cnb.cz

Based on the results outlined above one can claim that the bank stability model is able to predict whether the chosen bank belongs to the group of the stable or to the group of unstable banks. Since data used in the model are publicly available, the model can be used by any economic subject in its decision-making process when choosing a bank for its financial transactions.

5. Creation of Methods of Cluster Analysis

Sets of objects (groups of banks in our case) could be better divided into some inside homogeneity groups. The output is that inside the groups objects (banks) are similar and on the contrary, objects of different clusters are different from each other. We can create clusters of stable banks and clusters of unstable banks.

Starting values for every bank are average values of every indicator in the years 1995-2005 or shorter time of existence of their dates. The following step was to transform some indicators to make all indicators comparable. As a result, higher values of indicators mean negative developments while lower values indicate positive development. We used the following formula for this transformation.

\[ y_i = \max\{x_1, x_2, ..., x_n\} - x_i, \quad i = 1, ..., n \] (3)

34
We had to transform indicators to compare the modules. We used the following formula to make a standardised magnitude.

\[
x_{ik}^* = \frac{x_{ik} - \bar{x}_k}{s_k}
\]

We will use these values in the next steps. We can count distance between single objects at this moment. We calculate this by force of Euclidean distance; it could be counted by this relation

\[
d(X_i, X_j) = \sqrt{\sum_{k=1}^{n} (x_{ik} - x_{jk})^2}
\]

We can get a matrix of distances in this manner. We will make clustering of objects by the method of average distances; the distance of objects will be counted by this relation:

\[
d(S_h, S_k) = \frac{1}{n_h n_k} \sum_{x_i \in S_h} \sum_{x_j \in S_k} d(X_i, X_j)
\]

The diagram of representation of progression of clustering is a graph that represents the clusters of the banks.

We divided banks into six groups (see Appendix 4) on the principle of selected indicators and the chosen distance of 2.5. Every group contains either existing banks or bankrupt banks only. However, there was one exception – IPB bank – this bank was classified as a stable bank but went bankrupt in the year 2000. The reason could be that the IPB Bank’s financial statements were not reliable.  

It can be said that selected indicators classified well differences between the stable and unstable banks if we know that stable bank is the bank existing and unstable bank is bankrupted.

6. Conclusions

The development of the Czech banking sector in its post-transition period has been erratic. It has been marked with problems and large economic losses. These materialised most visibly in the second half of the 1990s. First, the crisis of small banks in 1996 revealed several problems in the Czech banking sector. Second, the experience in 1997-98 clearly confirmed the need for change. The economy was in recession, and growing credit problems of banks with their existing loan portfolios forced the large Czech banks, in particular, to reconsider their lending strategies and to contract domestic credit. Observers often refer to this period as a “credit crunch” since it has been characterised by a lack of capital. We would instead consider this period a healthy adjustment of previous soft lending behaviour. Perhaps the period should be renamed “lack of projects”. Overall, it is fair to conclude that it was more an undefined strategy, lack of proper risk management systems, and related-party lending that caused most of the failures of Czech banks, rather than excessive competition.

Privatisation of the banking sector is expected to result in greater efficiency, and mostly in higher stability. It is clear that the new market players do not lack either

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3 The IPB management tried to hide the bank’s financial losses through non-standard accounting procedures and therefore distorted the bank’s financial results.
sufficient capital or know-how. There is no reason, therefore, for any of the banks to be exposed to a higher risk than others.

The proposed bank stability model was verified on the selected banks doing business in the Czech Republic in the period 1995–2005. However, the verification could not be done on all the banks doing business in the Czech Republic in this period of time. The reason was data unavailability for an analysis of all needed financial indicators.

The bank stability model was created on the basis of the discriminant analysis. The discriminant analysis includes five financial indicators that help to classify a bank either into the group of the stable banks or unstable banks. The model was drawn up by using 211 measurements, thereof 145 measurements were connected to the stable banks and 66 measurements were connected to the unstable banks. The classification of a bank into the stable or unstable group fully corresponded to the facts published by the Czech National Bank.

The choice of the financial indicators was influenced by data availability. The original intention included 11 financial indicators for providing the discriminant analysis. However, we had to decrease the number of financial indicators because of an uncorrelation of financial indicators requirement. Therefore the number of indicators was cut from 11 to 5 indicators. The choice of these five financial indicators was also supported with the results of the financial analysis and through a graph describing time series of these financial indicators.

The verification of the model shows the practical usage for evaluation of the bank stability. The results verification was done for 41 banks in total, thereof 24 banks were clarified as the stable banks and 17 banks as the unstable banks. The used classification fully matches with the real development of the Czech banking sector.

We made some hypothesis while defining differences between stable and unstable banks. These hypotheses proved true with the support of cluster analysis. It can say with respect to some conditions which influence information capability of used method. The number of banks is not too large (38 banks), time series of indicators are 1 – 8 year long (depending on the period data are available for the bank). Another reason is that the Czech banking sector went through a complicated evolution during economic transformation. In addition, some banks classified as stable banks faced considerable problems such as a high ratio of non-performing loans, low efficiency, low profitability etc. The state even had to help big banks to hold its position on the market. Another factor is buying banks by new owners and their financial recovering – it means before this operation the bank had financial problems and was unstable and after this operation the bank is stable. The next aspect is credibility of accounting statements – we cannot suppose with 100% probability that all of the data published in balance sheets and profit and loss accounts are true and correspond to accounting principles.

Nevertheless, let’s hope that this paper gets a follow-up research in the field of banks’ stability.

References


### Appendix 1. The Financial Indicators for the Stable Banks in the Period 1995 – 2005 (median, in %)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ROAA</td>
<td>0,69</td>
<td>0,79</td>
<td>0,52</td>
<td>0,33</td>
<td>0,02</td>
<td>0,13</td>
<td>0,58</td>
<td>0,66</td>
<td>1,60</td>
<td>1,55</td>
<td>1,72</td>
</tr>
<tr>
<td>Equity/Liabilities</td>
<td>18,35</td>
<td>18,41</td>
<td>37,10</td>
<td>34,93</td>
<td>19,92</td>
<td>8,35</td>
<td>18,31</td>
<td>11,26</td>
<td>20,68</td>
<td>19,32</td>
<td>20,50</td>
</tr>
<tr>
<td>Profit margin</td>
<td>5,07</td>
<td>8,18</td>
<td>4,80</td>
<td>2,84</td>
<td>0,23</td>
<td>8,24</td>
<td>6,71</td>
<td>12,31</td>
<td>21,56</td>
<td>21,63</td>
<td>21,88</td>
</tr>
<tr>
<td>Interest margin</td>
<td>3,54</td>
<td>2,89</td>
<td>2,00</td>
<td>2,52</td>
<td>3,47</td>
<td>5,31</td>
<td>2,34</td>
<td>1,97</td>
<td>4,05</td>
<td>3,96</td>
<td>4,12</td>
</tr>
<tr>
<td>Equity/Total assets</td>
<td>8,65</td>
<td>8,42</td>
<td>9,30</td>
<td>10,35</td>
<td>8,30</td>
<td>5,83</td>
<td>7,18</td>
<td>6,72</td>
<td>2,05</td>
<td>1,99</td>
<td>2,03</td>
</tr>
</tbody>
</table>

*Source*: own calculation

### Appendix 2. The Values of Selected Financial Indicators for the Unstable Banks in the Period 1995 – 2000 (median, in %)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ROAA</td>
<td>-2,02</td>
<td>-1,30</td>
<td>-0,91</td>
<td>-0,35</td>
<td>0,00</td>
<td>0,13</td>
</tr>
<tr>
<td>Equity/Liabilities</td>
<td>9,76</td>
<td>11,28</td>
<td>8,73</td>
<td>7,30</td>
<td>8,62</td>
<td>8,35</td>
</tr>
<tr>
<td>Profit margin</td>
<td>-16,69</td>
<td>-7,26</td>
<td>-4,23</td>
<td>-4,38</td>
<td>0,00</td>
<td>8,24</td>
</tr>
<tr>
<td>Interest margin</td>
<td>4,69</td>
<td>4,06</td>
<td>4,84</td>
<td>5,48</td>
<td>3,79</td>
<td>5,31</td>
</tr>
<tr>
<td>Equity/Total assets</td>
<td>5,66</td>
<td>7,39</td>
<td>5,50</td>
<td>4,91</td>
<td>6,41</td>
<td>5,83</td>
</tr>
</tbody>
</table>

*Source*: own calculation
## Appendix 3. The Selection of Suitable Financial Indicators for the Cluster Analysis

<table>
<thead>
<tr>
<th></th>
<th>Profitability and productivity</th>
<th>Liquidity</th>
<th>Assets quality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ROAA</td>
<td>ROAE</td>
<td>Basic deposits/ total assets</td>
</tr>
<tr>
<td>Average (stable)</td>
<td>-0.0039</td>
<td>-0.0083</td>
<td>0.3691</td>
</tr>
<tr>
<td>Average (unstable)</td>
<td>-0.0644</td>
<td>0.1959</td>
<td>0.4828</td>
</tr>
<tr>
<td>Average for all banks</td>
<td>-0.0192</td>
<td>0.0433</td>
<td>0.3978</td>
</tr>
<tr>
<td>Difference existing - stable</td>
<td>0.0605</td>
<td>-0.2043</td>
<td>-0.1137</td>
</tr>
<tr>
<td>(difference/average all) x 100</td>
<td>315.6%</td>
<td>471.9%</td>
<td>743.7%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Market share</th>
<th>Income and expense</th>
<th>Activity</th>
<th>Structure of liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Market share – balance sheet size</td>
<td>Market share - loans</td>
<td>Market share - deposits</td>
<td>Incomes/ total assets</td>
</tr>
<tr>
<td>Average (stable)</td>
<td>0.0416</td>
<td>0.0703</td>
<td>0.0666</td>
<td>0.1300</td>
</tr>
<tr>
<td>Average (unstable)</td>
<td>0.0189</td>
<td>0.0279</td>
<td>0.0321</td>
<td>0.6641</td>
</tr>
<tr>
<td>Average for all banks</td>
<td>0.0359</td>
<td>0.0596</td>
<td>0.0579</td>
<td>0.2650</td>
</tr>
<tr>
<td>Difference existing - unstable</td>
<td>0.0227</td>
<td>0.0424</td>
<td>0.0346</td>
<td>-0.5341</td>
</tr>
<tr>
<td>(difference/average all) x 100</td>
<td>63.4%</td>
<td>71.1%</td>
<td>59.7%</td>
<td>201.6%</td>
</tr>
</tbody>
</table>

Source: own calculation
Appendix 4. Tree Diagram for 38 Banks

Tree Diagram for 38 Cases
Unweighted pair-group average
Euclidean distances

Source: own calculation