ANALYSIS AND FORECASTING OF THE DEVELOPMENT OF BANKING: THE ESTONIAN CASE

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ABSTRACT

The main purpose of the paper is to test the possibilities of treating a bank as an enterprise that produces services and for which the same laws are valid (at least in Estonia) as for other enterprises. As Estonia is a small country, the banks here can be considered small or medium-sized, despite the high profitability of their enterprises.
Banks and other financial institutions compose a unique set of business firms whose assets and liabilities, regulatory restrictions, economic functions and operation make them an important subject of research. Banks' performance monitoring, analysis and control deserve special attention in respect to their operation and performance results from the viewpoint of varioust audiences such as investors/owners, regulators, customers, and management.

This paper presents two econometric models the prognostication ability of which is very good. In addition, whether the development of the Estonianbanking agrees with R. Solow´s theory of balanced growth is considered.
Keywords:banking analysis, econometric models.

INTRODUCTION

The first commercial bank (Tartu Commercial Bank), on the territory of the former Soviet Union, was established in Estonia in 1988. This bank went bankrupt and was liquidated in 1992–1993. As there was a great demand for banking services by the emerging private sector, the maximum number of commercial banks operating simultaneously in the small Estonian banking market was 42 in 1992. Some of them were liquidated during the banking crises in 1992–1994 and in 1998–1999, and some of them were merged into larger commercial banks.

Up until 1997, the development of the Estonian banking sector was characterized by a rapid nominal growth of total assets and loan portfolios. The year 1997 is also the beginning of a new stage in the development of the Estonian financial sector, especially in international context, which is confirmed by investment grade credit ratings assigned to Estonia.

In 1998, a wave of mergers and restructuring took place in the Estonian banking sector. After the completion of these mergers, Scandinavian banks started to show greater interest in the Estonian banking market. We may say that the Estonian banking sector became healthier when Swedish banks and other Nordic investors joined the circle of bank owners, improving the future outlook of the banking system; (e.g. by supporting and helping in the case of crises). Estonia has experienced two serious banking crises during the about 12-year period of its banking sector development and restructuring: the first crisis in 1992-1994; and the second in 1998-1999. The first banking crisis occurred during the difficult period when drastic economic reconstruction was starting, production was reducing dramatically, and the country was beginning to experience a period of hyperinflation. A characteristic feature of the first banking crisis in Estonia was that it was caused by internal reasons, and was overcome with Estonia's own resources and management skills. The main causes of this banking crisis were severe problems in the entire economy, poor bank management and lack of professional skills, weak supervision both from the side of the central bank and owners. The depositors' losses in the banking crisis were large, the money supply decreased, many loans were depreciated, and the trustworthiness of the banking system fell significantly. As for the second crisis of 1998-1999, in retrospect it is possible to notice some signs of the crisis:

(1) Estonian banks took extraordinarily high financial risks through investment companies and their subsidiary companies to get large profits via speculating in the securities market. Rapid fall in prices on the share market in autumn 1997 significantly reduced banks' profits, and at the end of 1997 and in 1998, almost all banks operated in losses. Commercial banks absorbed heavily into non-banking business. For example, the Land Bank of Estonia, which later crashed, owned several banks that held a very high negative level of gap (interest rate sensitive liabilities exceeded significantly rate-sensitive assets) for earning excessive profits in the environment where interest rates steadily decreased during the previous years, and they were not able to adjust subordinate establishments and related companies, which dealt with leasing and investing, and with anything else but banking (i.e.,hotels, processing agricultural products, broadcasting etc.). Also other banks were absorbed in risky non-banking business;
(2) The decision to expand to the Eastern market (Russia and other Baltic States), where the interest rates and potential for profitability seemed to be higher, was also too risky and premature, especially in the framework of the Russian crisis in 1998;
(3) There were various disputes and conflicts of interests between the owners and management, which led to wrong decisions (mismanagement). Good examples can be drawn from the Land Bank of Estonia and the Estonian Investment Bank. For example, the shareholders of the Investment Bank intended to sell the bank to the German Schleswig-Holstein Bank in autumn 1997, but the top executives threatened to hand in a collective resignation, and so the bank was sold to them;
(4) Sometimes there were inadvisable relations between the bank management and political powers, and there was corresponding political pressure. A typical "political" bank was the Land Bank of Estonia where almost all financial risks were ignored and later the Government lost its deposits in the bank amounting to more than 800 million Estonian crowns, EEK (i.e., more than 50 million euros).

The authors are of the opinion that the currency board arrangement helped in Estonia to resolve banking crises rapidly and mostly effectively without remarkable rehabilitation costs. The main instruments for anticipating banking crises are the tightening of prudential requirements and strengthening of banking supervision. Recent changes in the operational framework for monetary policy and banks' prudential ratios in Estonia were aimed at enhancing financial stability and increasing the liquidity buffers of the financial system. In short-term, the priority focused on restoring foreign investors' confidence in Estonian economic viability.

The structure of the Estonian banking sector has changed fundamentally during the last decade. Today, the banking system is highly concentrated and two Swedish-owned banks dominate in the market. The consolidation process continued throughout the second banking crisis in 1998-1999, resulting in fundamental reorganizations. We can notice all three worldwide trends in the financial consolidation process in the Estonian market: domestic consolidation, foreign entry and cross-border consolidation; and the formation of financial conglomerates and bank assurances.

1. THEORETICAL BACKGROUND

One can ask what is the production or product of a bank? In our opinion, the product of the bank is the amount of the services, the volume of which can be measured by the total income of the bank, which is the measure of the amount of production.

We selected the total income of the banks (y) as the output variable (dependent variable) and used profit earning assets (x_1), equity (x_2), liabilities (x_3) and fixed assets (x_4) as factors (independent variables).

The time series were treated as consisting of three components:

$$y(t) = f(t) + h(t) + e_t \quad (1)$$

where $y(t)$ represents the actual time series;

$f(t)$ represents the linear trend in the time series;

$h(t)$ represents the harmonious component in the time series;
e_t represents residuals.

The harmonious component is determined by Fourier's series:

(2) $$h(t) = a_0 + \sum_{j=1}^{k} (a_j \cos a + b_j \sin a), \qquad a = j\frac{t2p}{T}$$

where j represents the number of harmonious components,
t represents time,
T represents length of the time series (the number of periods).

We chose the power function as the type of the model.

(3) $$y = ax^a z^b, \quad a + b = 1.$$

To estimate the parameters a and a with the method of least squares, it was necessary to first find logarithms of the primary data. Then, according to the rules of analysing time series, we checked forthe existence of a trend and harmonious component in the time series of the logarithms of the selected parameters.

We followed R. Solow's approach and assumed that the chosen factors can be regrouped so that two groups would be formed: profit earning current assets, $x = x_1 + x_2 + x_3$; and profit earning fixed assets, $z = x_4$.

(4) $$y = ax^a z^{1-a}.$$

Now we assume that part of the total income will be invested into profit earning current assets:

(5) $$I = sy = dx/dt$$

and that the fixed assets will remain unchanged for a certain period of time.

(6) $$z(t) = z_0, \; dz/dt = 0.$$

Now

(7) $$\frac{dx}{dt} = sy = sf(x, z) = sf(x, z_0).$$

Now let the ratio of current assets to fixed assets $k = x/z$; then

(8) $$x(t) = k(t) z_0.$$

Differentiating (8) on the basis of time, we obtain

(9) $$\frac{dz}{dt} = \frac{dk}{dt} z_0$$

and

(10) $$\frac{dk}{dt} z_0 = sf(x, z_0),$$

from which

(11) $$\frac{dk}{dt} z_0 = sz_0 f\left(\frac{x}{z_0}, 1\right)$$

and denoting $f\left(\frac{x}{z_0}, 1\right) = f(k)$,

we get

(12) $$\frac{dk}{dt} = sf(k).$$

Equation (12) shows that all investments are directed toward increasing the amount of profit earning current assets.
In the case of the power function

(13) $$\frac{dk}{dt} = sak^a.$$

By integrating (13) we get

$$\int k^{-a} dk = \int asdt$$

from which

(14) $$\frac{1}{1-a} k^{1-a} = ast + A.$$

To determine the constant A, we assume that $k(t) = k_0$, if $t = 0$.

$$A = \frac{1}{1-a} k_0^{1-a},$$

$$k^{1-a} = ast(1-a) + k_0^{1-a},$$

(15) $$k(t) = \left[ast(1-a) + sak^{1-a}\right]\frac{1}{1-a}.$$

The increment of the total income is found as follows:

(16) $$\frac{dy}{dt} = \frac{d}{dt}\left[ax^a z_0^{1-a}\right] = \left[aax^{a-1} z_0^{1-a}\right]\frac{dx}{dt} = aa\frac{x^a}{x} z_0^{1-a}\frac{dx}{dt} = ay\frac{1}{x}\frac{dx}{dt},$$

(17) $$\frac{1}{y}\frac{dy}{dt} = a\frac{1}{x}\frac{dx}{dt} = a\frac{sy}{x} = asb,$$

where $b = y/x$ is the productivity of profit earning assets, the rate of increment of which is

(18) $$\frac{1}{b}\frac{db}{dt} = \frac{x}{y}\frac{d}{dt}\left(\frac{y}{x}\right) = \frac{x}{y}\frac{1}{x}\frac{dy}{dt} - \frac{x}{y} y\frac{1}{x^2}\frac{dx}{dt} = \frac{1}{y}\frac{dy}{dt} - \frac{1}{x}\frac{dx}{dt} = (a-1)sb.$$

The rate of increment of the productivity of fixed assets is

(19) $$\frac{1}{v}\frac{dv}{dt}=\frac{1}{v}\frac{d}{dt}\left(\frac{y}{z_0}\right)=\frac{1}{v}\frac{1}{z_0}\frac{dy}{dt}=\frac{z_0}{y}\frac{1}{z_0}\frac{dy}{dt}=\frac{1}{y}\frac{dy}{dt}=a\,sb.$$

Let us now examine the situation where the increase of fixed assets is linear:

(20) $$z(t)=a_0+a_1t\,.$$

Now the amount of the profit earning current assets is

(21) $$x(t)=k(t)z(t)=k(t)(a_0+a_1t)$$

and its increment is

(22) $$\frac{dx}{dt}=\frac{dk}{dt}(a_0+a_1t)+a_1k(t).$$

Assuming the existence of the function

(23) $$y=f(x,z)=f(x,a_0+a_1t),$$

we can write:

(24) $$\frac{dk}{dt}(a_0+a_1t)+a_1k_t=sf\left(x,a_0+a_1t\right),$$

from which

(25) $$\left(a_0+a_1t\right)\left(\frac{dk}{dt}+k_t\frac{a_1}{a_0+a_1t}\right)=s\left(a_0+a_1t\right)f\left(\frac{x}{a_0+a_1t},1\right)$$

or

(26) $$\frac{dk}{dt}=sf(k)-k\frac{a_1}{a_0+a_1t},$$

where $a_1/\left(a_0+a_1t\right)=n=\frac{1}{z}\frac{dz}{dt}$ is the increment rate of fixed assets.
The condition of equilibrium is here

(27) $$\frac{1}{x}\frac{dx}{dt}=\frac{1}{z}\frac{dz}{dt},$$

from which $m=s/n$, where m represents the ratio of current assets and total income.
As

(28) $$m=\frac{x}{y}=\frac{x}{zf(k)}=\frac{k}{f(k)},$$

then, in the case of equilibrium

(29) $$\frac{s}{n} = \frac{k}{f(k)}.$$

In the case of the Cobb-Douglas function

(30) $$\frac{dk}{dt} + nk = sak^{a}.$$

Equation (30) is a first-order non-linear non-homogeneous differential equation the solution of which is the function

(31) $$k(t) = \left[\left(k_0^{1-a} - \frac{as}{n}\right)e^{-n(1-a)t} + \frac{as}{n}\right]^{\frac{1}{1-a}}.$$

It can be seen from equation (31) that if $t \to \infty$, then $e^{-n(1-a)t} \to 0$ and the ratio of current assets and fixed assets will move towards the equilibrium state $\left(\frac{as}{n}\right)^{\frac{1}{1-a}}$.

2. ECONOMETRIC MODELS

Let us first construct two-factor power function (6 functions), of which the best was the function with the minimum standard error

(32) $$\begin{aligned}\ln y = {} & -1{,}9775 - 0{,}0245t + 0{,}5106\ln x_2 + 0{,}4894x_3 + \\ & + 0{,}1102\cos a - 0{,}0575\sin a - 0{,}0569\cos 3a + 0{,}1052\sin 3a;\end{aligned}$$

(33) $$y = 0{,}1384x_2^{0{,}5106}x_3^{0{,}4894}\exp\left[\begin{aligned}& 0{,}1127\cos a - 0{,}0414\sin a - \\ & - 0{,}1265\cos 3a - 0{,}0520\sin 3a - 0{,}0245t\end{aligned}\right].$$

$R = 0{,}848.$

The suitability of function (33) can be seen in Figure 1.

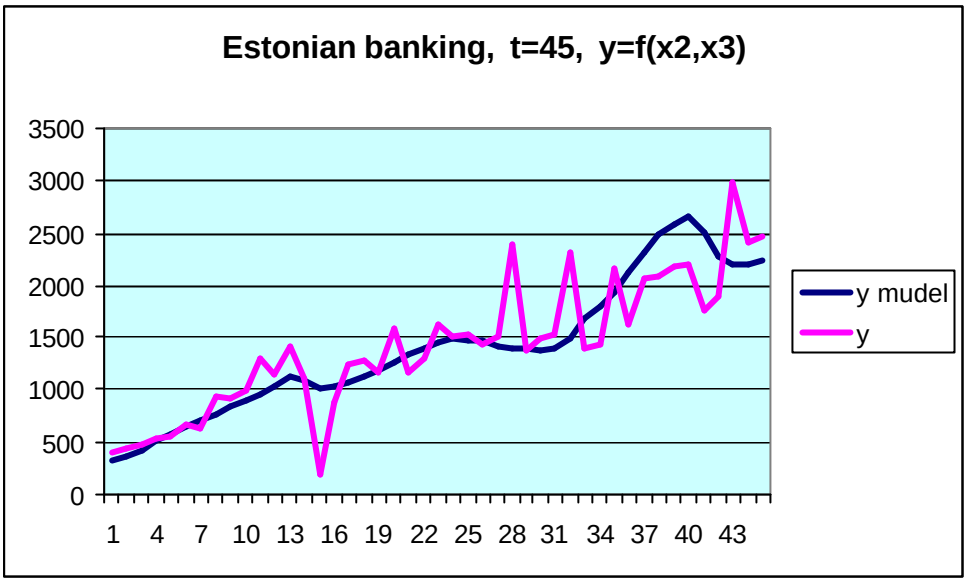

Figure 1. Suitability of the model $y = f(x_2, x_3)$.
Source: Authors' calculations

Then we found the parameters of the function $y = f(k)$. As a result we obtained the function

(34) $$y = 4{,}5k^{0{,}76}, \quad R = 0{,}836.$$

The suitability of this model is demonstrated by Figure 2.

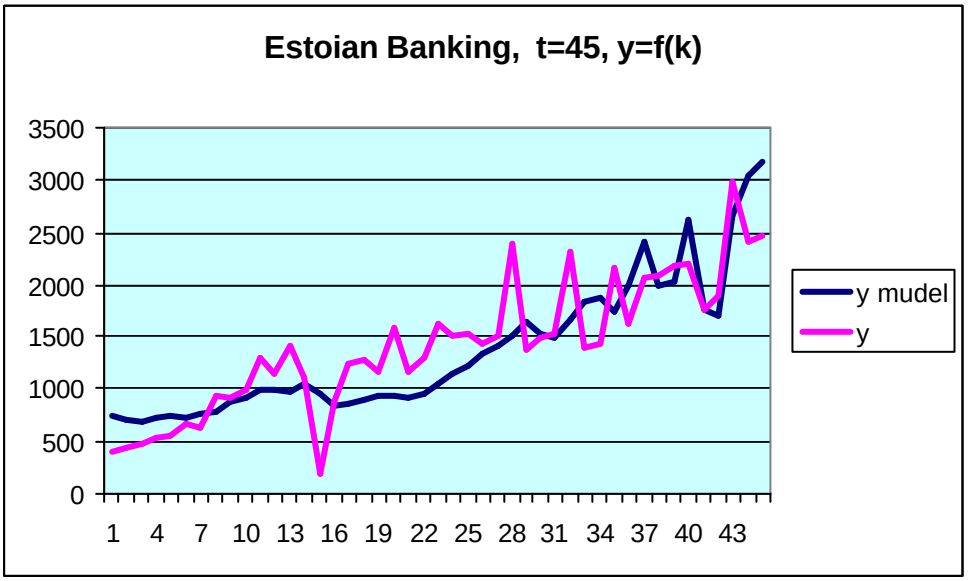

Figure 2. Suitability of the model $y = f(k)$.
Source: authors' calculations

Now we have received two models that are well-suited for the characterizing of the development of Estonian banking. Let us now examine the forecasting ability of the models, assuming that, in the future, the development will proceed in the same way it has so far.

According to model (33) we get the forecast $y(46) = 2933{,}9$; actually $y(46) = 2743{,}3$. Thus, the actual total income of Estonian banking is higher than the forecast value by 6.5%.

If we use model (34), the forecast will be $y(46) = 2616{,}0$, which is smaller than the actual figure by 4.6%. These discrepancies cannot be regarded as too large.

We are of the opinion that both these econometric models are quite suitable for analysing ad forecasting the development of the Estonian banking system.

Let us now examine the development of Estonian banking from the perspective of the theory of balanced growth. It can be seen from Equation (31) that the state of equilibrium can be calculated using the following formula:

$$y^{bal} = \left(\frac{as}{n} \right)^{\frac{1}{1-a}}.$$

By using Equation (34) and taking $s = 0{,}1$, we get the value of the equilibrium state equal to 8799.77 million Estonian kroon. Actually, the level of the Estonian banking was 106.36 million Estonian kroon. This means that Estonian banks had too little current assets per one unit of fixed assets or that they had too much fixed assets per one unit of current assets. This suggests that the development of Estonian banking has not been rational. On the other hand, the history of Estonian banking is short, and these banks had to procure buildings, the necessary technology, know-how etc., despite having limited resources of current assets.

CONCLUSIONS

1. Econometric models can be used to analyse and prognosticate banking parameters; power functions give the best results.
2. Different functions give somewhat different results, but these differences are not large.
3. Analysis of the dynamics of Estonian banking from the perspective of the theory of balanced growth revealed that Estonian banking is far from a state of equilibrium. To some extent this is due to the short history of Estonian banking; besides, these banks had to start from scratch. Undoubtedly, the fact that the banking market and the volume of turnover are very small has had its effect on the lack of balance.

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