

## IDENTIFICATION OF INDICATORS' APPLICABILITY TO SETTLE BORROWERS' PROBABILITY OF DEFAULT

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**Abstract.** Borrowers default risk is one of the most relevant types of risk in commercial banking and its assessment is important to secure business profitability and avoid huge losses during economic turbulences. This leads to necessity to investigate topics related to assessment of borrowers' default probability and applicability of factors, which would enable to capture the newest trends of borrowers' markets. Leading economic indicators (in addition to financial and other economic indicators) are often suggested as forward-looking in scientific literature. However, there is still a discussion going on applicability of financial ratios and economic indicators. As the problem is relevant in theoretical view as well as for practitioners, this article aims to identify applicability of leading economic indicators for the estimation of default probability. Further, the qualitative criteria for factor selection were identified and used when using detailing, grouping and SWOT analysis methods. Based on current scientific literature analysis, this paper concludes that although leading economic indicators are able to capture forward-looking signals, they should be used with careful analysis of its drawbacks and in combination with financial factors in order to avoid overshooting effects. The limitation of the article is the analysis of factors based on rather theoretical analysis than estimation of quantitative criteria. This suggests that every time using leading economic indicators requires using empirical study of particular indicators' set.

*Keywords:* Borrowers' default probability; financial ratios; economic indicators; commercial banks.

*Type of the paper:* Theoretical paper

*JEL Classification:* G21, C52

### Introduction

Default risk is one of the biggest and relevant risks to which most commercial banks are exposed to, and its constant assessment as part of risk management is essential not only to insure competitive returns for shareholders but also to be resilient to potential losses resulted because of financial turbulences. Taking into account the importance of default-related ratios, management of commercial banks as well as supervisory authorities underline necessity to review periodically these assessment tools to catch up to newest methods and economic tendencies. Development of modern informational technologies and increasing availability of information determines these trends.

Leading economic indicators are suggested as useful factors to capture newest economic trends for default modelling in recent scientific literature. Financial or other types of economic indicators, so called lagging and coinciding, may show only the past performance of borrowers resulting slower reaction to real economy environment changes. Therefore, increasing the number of empirical evidences on leading economic indicators is observed in scientific literature. However, default probability financial ratios and lagging or coinciding economic indicators are most commonly used and rarely include leading economic indicators in analysed researches. This fact and existing need of commercial banks and supervisory authorities form a demand of particular theoretical comparisons, evidences and practical solutions for default modelling. In other words, theoretical researches, empirical tests and combination of these two required in order to use the leading economic indicators.

Researchers pay attention to the following important problems of default risk assessment. What are the most appropriate factors for estimations of default risk? What models of default risk assessment are commonly used and what is their applicability? What models of risk assessment are most commonly used and which of the factors are considered as most appropriate in estimation of default risk in credit

portfolio? What are common problems in default risk assessment and what could be solutions for them? Worth noting, it is still being debated which factors might be most appropriate for the assessment of borrowers default risk. As the problem is relevant in theoretical view as well as for practitioners, this article aims to identify applicability of leading economic indicators in estimations of default probability.

The articles structure is as follows. Analysis of theoretical background of financial and economic indicators, identification of qualitative criteria for factor selection, comparison of factors' applicability, benefits and drawbacks. Research methods used in the article are detailing, grouping, SWOT and comparison methods. The hypothesis is that considering qualitative criteria identified in scientific literature, leading economic indicators have enough empirical evidences to be used as forward looking factors in borrowers' default probability models. Using relevant methods, this paper concludes that although leading economic indicators are applicable to capture forward-looking signals in such estimations, however, they should be used with careful analysis of methodologies and in combination with financial factors in order to avoid overshooting effects.

## Literature Review

### *Nature of default probability modelling*

Default risk is considered as financial risk in overall classification of risks, that is, consequences of the risk are relatively easier to assess in monetary terms (European Banking Authority 2015). To understand the nature of default risk more thoroughly, it is important to understand sources of this risk, which can be divided into two broad categories – quantitative and qualitative (Špicas, Nekrošiūtė 2012). Qualitative sources are those that involve more subjective assessment, for example, business, political and legal environment, reputation, competitiveness of the product and risk management. Whilst quantitative are more objectively estimated, such as collateral, trends of business sectors and default risk of borrowers. This article deals with financial quantitative default risk assessment.

Commercial banks could not know whether their capital is adequate to outweigh possible losses in the future without comprehensive assessment of default risk. This risk defined as actual threat from counterparty's insolvency, which can negatively affect business and result undesirable consequences for commercial bank value. Probability of default is major ratio in overall pyramid of assessment ratios of credit risk. In general, default risk assessment starts from disbursement of the credit to the client when commercial bank is overtaking the risk (probability not to get back lend money, interests and other fees) and continues until the moment when liabilities (including interests and fees) are repaid. Therefore, worth noting in the overall credit risk assessment process probability of default ratio considered as the most important exogenous variable in internal rating based approach. In order to improve some parts of default risk modelling, this article focuses in the analysis of factor selection.

Generally, the development of default probability methodologies in commercial banks is challenging and should not only take into account historical information of borrowers but also include implied assessment of market tendencies, which relate to dynamic environment in real economy and capital markets. The assessment of this ratio usually starts from the definition of default probability. By developing the definition, we have to consider factors, which may result insolvency of the borrower and models to use. Default probability generally considered as theoretical and not directly observed and implies from default frequency. According to international standards, it is important to take into account two criteria to define it: first, historical information of default factors in particular borrowers' group; and second, information implying on the future, that is, important information of client group that may signal default of the borrower (Comptroller of the Currency Administrator of National Banks 2015). This double criterion helps to avoid some false signals of default, which may erupt because of changed historical information or too volatile implied signals on the trends. The choice of these criteria also depends on the purpose of the model – whether the purpose is to assess borrower or loan (Dzidzevičiūtė 2010). Finally, there should be assumed on what indication the default will rely. The early probability of default models were developed mainly in the reference to bankruptcy (Cibulskienė *et al.* 2014). However, gradually models using indication of default became more popular amongst

scientists and practitioners because of the increasing number of evidences that definitions with bankruptcy indication have lower discriminant power.

One of the most commonly used approaches to evaluate probability of default is rating based assessment that estimates probability in accordance to financial and other borrower-related data. In general, development of this approach is considered as relatively complex process, which requires correct choice of tools as well as forming comprehensive database (Dzidzevičiūtė 2010). Furthermore, it can be subdivided into eight stages: definition of project in order to describe goals and feasibility, definition of doubtful and non-performing borrowers, choosing particular period for analysis, division of borrowers into groups, formation of sample size and analysis of potential variables, choice of statistical methods, estimation of factor coefficients and execution of back testing of overall assessment approach.

To include factors into such assessments, four methods may be potentially used: linear probabilistic, logistic, probit and linear discriminant analysis. These methods may also include neural networks and decision-making tree. Logistic method is usually considered as one of the most valuable with relatively easier interpretation power in scientific literature. The general idea of the approach is having any type of independent variables, dependent variable will be determined by one of two possible events – default or not default, that is, zero value or 1. Usage of this type of models is based on sufficient number of empirical evidences (Mileris, Boguslauskas 2011). However, the requirement to have relatively high level of sample size is considered as the main drawback. Therefore, its two features limit usage of logistic method – dependent variable is binomial and adequate database is required. This suggests us that factor selection is important stage of default probability estimation and is determined by availability of sufficient data and standardisation. Consequently, the definition should be carefully considered and criteria should be set for factor selection in order to model default probabilities.

### ***Criteria for factor selection***

Factors have to help to achieve defined models' goals. For this reason, qualitative criteria of best model selection as well as quantitative in selection of variables should be taken into account (Mader *et al.* 2007). Though sometimes the criteria may seem relatively simplistic, it can be hard to define them knowing their importance in overall process. Besides, this is what scientists and practitioners seek in definitions of their methods. Worth mentioning that though the criteria considered as important element, they are rare topic in the scientific literature. The research of Mader *et al.* (2007) finds that the criteria are often hard to meet and few of them are usually conflicting. For the criteria definition, the authors suggest to link areas related to organisation including the areas of information technology, requirements for analysis and design of modelling.

The factor analysis can be defined as a multivariate statistical procedure that has several uses: to reduce a number of variables into a smaller set of factors, to identify interconnectedness of variables and financial phenomenon and to validate reasoning behind choices. In accordance to study of Brett *et al.* (2012), the financial ratios and economic indicators' analysis may use several steps of exploratory factor analysis protocol, which provides researchers with starting reference point in developing clear decision criteria. According to analysed researches for modelling probability of default, the most important groups of criteria for factor selection may be identified as follows:

- Availability of data;
- Scientific evidences;
- Forward looking;
- Interpretation power.

*Availability of data.* For modelling purposes, it is important to clearly define the factors in order to have interpretable and consistent results. For instance, appropriate models and factors used in the assessment of default risk may vary a lot. This is because objects of modelling may vary in their nature as well. Therefore, information availability sometimes becomes essential determinant of the modelling process. Most of the models aim to have parsimonious tools, and according to Occam's razor-based theories, such as Akaike Information Criterion and the Bayesian Information Criterion

(Vrieze 2012), this principle is particularly relevant to modelling: amongst models with roughly equal predictive power, the simplest one is the most desirable. Hence, the number of states and variables should be concise and, ideally, the models should use stable, clearly defined and well-understood factors to achieve its goals. However, publicly available methodologies and researches on particular factors could limit this.

Another common issue related to factors is availability to obtain sample size. There should be enough qualitative historical data in order to test and validate modelling results (Hogarty *et al.* 2005). However, optimal sample size for the statistical analysis is still debating question. Although many researchers have been suggesting various optimal sample sizes, all of them agree that ability to obtain as numerous sample size as possible is important criteria for the factor. Accessibility to publicly available databases and data sets could determine this ability.

*Scientific evidences.* Scientific substantiation supported by empirical evidence and interpretation under scientific method is an important element, which serves to either support or counter a hypothesis (Theobald 2012). Therefore, having evidences and methods in decision-making process is very important. Relevant properties of factors should be adequately based as well. Assumptions have to be often made in the development of models in order to allow using a certain modelling technique. Therefore, the factors should be weighted enough in terms of scientific evidences and behaviour in order to avoid errors in further stages of modelling and overall credit risk assessment. Another aspect is determinability of adequate scientific evidences level to validate usage of factors. Although this is intuitive concept, some scientists argue that scientific evidence itself is subjective. However, most of scientists would agree that the validity of any inference should not be based on just a few observations or contradictions but on the totality of the evidence (Martis 2006). In this article, we simplistically describe whether there are at least several researches proving necessary evidences. The more evidences could be gathered, the more arguments are to select the factor.

*Forward looking.* Each model has a specified purpose and contributes to the realisation of that purpose. Possible purposes may include (Evans, Lindner 2012)

- Analysis of past events;
- Verification of specific properties;
- Implying on future from currently available information, that is, models can be divided into descriptive, prescriptive and predictive.

As the purpose of the default probability modelling is considered as predictive, the factors should also contribute to this purpose. Additionally, such models and factors should be extensible and reusable, that is, methods and factors has long-term value if their predictive features are sustainable. Number of scientific researches, which compare forward-looking features of different factors, can determine this feature. In reference to Organisation for Economic Co-operation and Development (2012), economic indicators can also be divided into lagging, coinciding and leading. In this sense, financial, lagging or coinciding economic indicators may signal warnings on default with a time lag in comparison to leading ones (Albrice 2014).

Ideally, the models and factors should not solve only specific one-time problems; therefore, appropriate inclusion of different types of factors in model may help to address the problem from higher number of dimensions (Brett *et al.* 2012). In modelling probability of default, it would mostly relate to usage of different types factors. Some of the factors may represent only borrower-specific information (financial factors), business sector tendencies (sectorial factors) and macroeconomic (macroeconomic factors) or can be blended (borrower-sector, sector-macroeconomic). Therefore, it is important to understand which type of information it represents. This is useful not only for interpretation part but also to understand interdependencies of factors in analysis of multicollinearity.

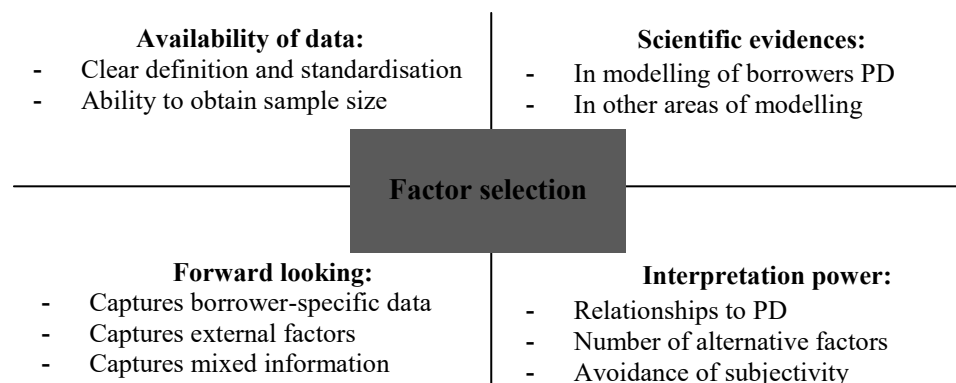
*Interpretation power.* Interpretation power criteria include examining which of the variables corresponds to a factor by giving that factor a name or theme. For instance, several variables may construct particular factor, all of which relate to one perception-creating name for that factor. Usually, at least two or three variables should be used on one factor so it can give a meaningful interpretation

(Henson, Roberts 2006). However, this labelling has subjectivity nature, more theoretical process and is dependent on researcher's definitions. Generally, such research should aim to find those factors that taken together explain direct or indirect relationships. For the purpose of interpretation, it is essential that these names would correspond to the theoretical intent. Therefore, the scientific literature should provide adequate number of alternative interpretations.

In addition to researcher's subjectivity, some of the information may be exposed to subjectivity of its creator or intermediate (Gervasio, Montani 2013). This would create relatively lower representation of objective reality and could lead to erroneous forecasts. For instance, financial information such as annual financial statements may include subjective judgments of accountant or financial officers such as depreciation or amortisation schedule or other in accounting policy-stated judgements. To avoid these subjectivities, researchers should state the deviations and desirably find solutions to correct them.

Finally, a well-functioning model should be developed in manner to be able to share its semantics (Brett *et al.* 2012). In the assessment of overall credit risk in commercial banks, different models using different factors may lead to inconsistencies of results, that is, models representing different views on factors would be hard to compare and interpret in general assessment of all risks.

*Mapping the criteria.* Generally, the criteria link areas of data gathering, design of modelling and ability to use them in forecasting of default probabilities (for generalisation, see Fig. 1).



**Fig. 1. Mapping of criteria for factor selection** (Source: author's compilation)

It can be stated, basing on the literature reviewed, that factors, first, have to be clearly defined, ideally should be stable and well understood. Another related common issue is availability to obtain sample size. In other words, there should be enough qualitative historical data in order to test and validate modelling results. In addition, factors should be weighted enough in terms of scientific evidences, and their long-term behaviour should be well understood to avoid errors in further stages of modelling. As the purpose of default probabilities considered as predictive, it should use factors, which are forward looking, extensible and reusable. It is also important to analyze to which type of information these factors correspond. It is important not only for interpretation part but also to understand interdependencies amongst factors in the analysis of multicollinearity. Finally, for the purpose of interpretation, it is essential that clarification would correspond to the theoretical intent in such way avoiding researchers' subjectivity. In addition, it should be taken into account that some of the information may be exposed to subjectivity of its creator or intermediate.

### ***Financial and economic factors***

History of scientific researches on factors for default probability modelling is closely related to the development of credit risk assessment tools. This financial research area was initiated in 1932 when FitzPatrick found a relationship between default probabilities and financial ratios of borrowers. These

researches based on relatively standard and in nature similar financial ratios; however, in later researches, more complex and various ratios were applied. Recently, in spite increased interdependencies of economies and financial markets, macroeconomic ratios started to be applied in default probabilities estimations gaining the ability to capture systemic risk factors. This part of the article provides literature analysis of each factors group aiming to identify their applicability determined by scientific evidences, interpretation power, forward-looking features and availability of data.

### *Financial Factors*

The studies of financial factors already have rich history – summing up the development of researches and use of financial ratios, they can be grouped into three (Cibulskienė *et al.* 2014 and others):

- Balance structure and accounting profit based;
- Financial cash flow based;
- Blended.

The first group of ratios started to use in early researches and included ratios such as working capital/assets, income/assets, profit/assets, equity/liabilities, profit/short-term liabilities and similar. In later researches, cash-flow-based ratios were included in default probability estimations in addition to balance and accounting profit based. Finally, methodologies developed by modern rating agencies have included all types of ratios (included blended ratios). However, in later years, to facilitate cash-flow-based analysis, methodologies of Standard & Poor's (2013) rating put more weight on cash flow based and blended ratios. However, at the beginning, researches used relatively simplistic financial ratios related to balance sheet and accounting profit, since then methods have been significantly improved and more complex financial cash flow ratios were used.

The intuition behind using financial cash-flow-based ratios is relatively simple – the borrower who is able to generate positive free cash flow (after all related costs) is less dependent on external financing sources and will be able to generate dividends and increase borrower's value. This is mainly based on discounted cash flows method, which was firstly developed by Fisher (1930) and more extensively used in further researches. For instance, rating agencies usually put more weight on financial cash-flow-based ratios in modelling default probability. The underlying reason behind this is that, sometimes, book values in balance sheet are more exposed to subjectivity of accounting rules and accountants. However, there are some drawbacks of these ratios as well – mainly because the ratios are not compared to liabilities or other balance sheet values. For instance, although borrower may generate high financial cash flow, it may have even higher financial liabilities to cover (which sometimes may be too high to serve). In order to outweigh such drawback, it is advisable to use blended ratios. For instance, financial cash flow relative to balance sheet and accounting profit may give more comprehensive view on covering capacity overall debt or dependency on external financing. Generally, usage of all types of financial ratios is proven empirically and methods to include them have been tested well. Worth noting because of differences in business sectors, the level of requirements for each borrower's ratio should be different as well. In addition, if necessary information is available, it is advisable to adjust these ratios with following corrections: transaction with related parties, re-evaluate balance sheet values, consider off-balance liabilities. Therefore, to have most representative ratios, there should be ability to compare them to peer group and adjusted if needed.

These types of factors usually are well defined because of the convergence of international accounting standards. Several factors including the belief that it would increase the comparability of different entities' accounting numbers drive convergence (Financial Accounting Standard Board 2012). However, this is more applicable for corporate borrowers, which often have to comply with international standards, and to make periodically audit of competent external parties. Small and medium enterprises (SME) borrowers have less defined and accurate accounting systems, which vary in different countries. In addition, these ratios may be exposed to subjectivity of accountant and management as several flexibilities are left in the standards (Gervasio, Montani 2013).

Although these ratios are relatively well defined, availability of information may vary depending on the type of the borrower. Information of corporate borrowers, who traded in stock exchange market, is publicly available and comprehensive, although, sometimes in order to fully understand the business additional information needed. However, there is a tendency regarding SME – the smaller the borrower is, the less publicly available information you can get. Therefore, banks have to request additionally borrowers to submit such information and, if necessary, to ask to audit these financial statements. The main advantage of these ratios is interpretation power because of the well-defined practices of accounting and large amount of scientific researches. For each group of financial factors in literature, you can easily find more than three possible variables that give opportunity to compare them. The biggest drawback of these ratios is relatively long lag of information provided. According to Kaplan (2010), traditional financial and cost accounting measures record what has happened in a previous period and are often referred to as lagging factors. Sometimes, in order to receive audited financial statements, commercial banks have to wait for four to six months. The lag is smaller if we consider using final non-audited accounts. In these cases, the process would speed up to two or three months. However, recent dynamic economic changes and increasing interconnectedness amongst economies and sectors set new requirements for default modelling and suggest not rely only on financial ratios.

### *Economic Indicators*

*Lagging and Coinciding Economic Indicators.* Other type of factors, macroeconomic indicator based, (which by typology considered as lagging and coinciding economic indicators) is seeking to identify mainly systemic type of risks using external databases. One of the best-known examples of the model using macroeconomic factors is McKinsey's Portfolio Credit View (Derbali, Hallara 2012). The methodology is useful to estimate exogenous variables on portfolio or sub-portfolio level. Although it was proved that economic indicators are useful in such type of modelling, they are made to capture too wide population and may not be useful for the estimation of default probability for separate borrowers.

Seeking to capture systemic risks in default estimations, later tools based on capital market ratios proved their ability to generate lower standard errors than macroeconomic. Hillegeist *et al.* (2004) developed one of the researches that provided necessary evidences. Such evidences encouraged number of new researches in this area and development of information technologies improves availability of this type of information. Other examples of such models include cohort analysis (based on statistical analysis of borrowers groups), survival analysis (tries to estimate the number of defaults within a fixed time interval, typically 1 year) and the most prudent estimation principle based on statistical analysis of borrowers groups (Pluto, Tasche 2005). Generally, this type of analysis proves to be helpful analytical tool to capture some tendencies in the real economy, however, has some drawbacks. First, they evaluate the level of portfolio and it is hard to attribute one or another default probability to particular borrower. Second, this type of models requires number of assumptions, which makes estimations more exposed to subjectivity. In addition, although assumption of all economic cycle inclusion in estimations makes valuation more stable, such assumption is criticised for too slow reaction to structural changes in the market (Kiff *et al.* 2013).

Researchers recently blend these factors into hybrid models taking into account advantages and disadvantages of already mentioned factors. Recent researchers found that default probability assessment is more accurate using financial, macroeconomic and capital markets factors (Chan-Lau 2006). However, there is still being debated whether hybrid models are more effective for assessments. Though most researches proved effectiveness of blended ratios inclusion, other such as Hillegeist *et al.* (2004) insisted that traditional financial ratios based tools are sufficiently effective. In accordance with such discussion and goal to blend financial, economic and market information into assessment of default probability, some scientists were seeking for more evidences supporting such hybrid models (Jimenez, Saurina 2006). For instance, Carling *et al.* (2002) research successfully uses such hybrid approach based on Swedish databases in their survival rate. In the study, they found that inclusion of economic indicators in credit risk assessments significantly improves predictability power.

As data standardisation, these factors (macroeconomic and capital markets) are generally well defined, as the science has become international matter, which motivates separate countries to converge their methodologies in longer term (International Monetary Fund 2015). This type of information is easily publicly accessible taking into account the developed databases of Eurostat, Bloomberg and other similar. Another advantage of these ratios is relatively decreased subjectivity of data in comparison to financial factors. These models are able to solve not only one-time problems because of the factor standardisation, which makes them very useful tools in order to understand estimations. However, there is still being debated whether these models are able to catch up the newest trends in the market because of their lagging and coinciding nature, in scientific literature, they are more considered as lagging and coinciding (Organization for Economic Co-operation and Development 2012).

*Leading Economic Indicators.* As it was mentioned, new requirements are set in estimation of default probability in modern society of dynamic information flows. As one of the best ones to capture market tendencies, scientific literature underlines leading economic indicators. As it was previously described, in general, economic indicators can be divided into lagging, coinciding and leading. Lagging or coinciding indicators may signal warnings on default with a time lag comparing to leading ones. In addition, it may also take some time to collect necessary information. Therefore, all these ratios may result too slow reaction to current news from real economy.

Examples of leading economic indicators may include several types depending on their nature. For instance, business, consumer or other respondents' sentiment economic indicators may be able to capture most of current tendencies in the market. Monthly retail market data may reflect trends in retail sector of particular country in more sensitive manner than general macroeconomic ratios. This ability is already proven in modern economies such as the United States, the EU and some Asian markets. In addition, there is already a significant number of evidences showing benefits of such economic indicators in risk assessment as well. This provides us useful findings regarding capability of these factors to be forward looking: they are able to indicate structural changes in the markets (Frankel, Saravelos 2011), they may be useful for indication of changes in business sectors (Nippala, Paivi 2012), leading economic indicators derived from stock exchange market may be useful as well (Izani, Raflis 2004).

Other part of researches has been describing some of the features of these factors (Fritsche, Stephan 2002). These researches showed that there is no single indicator that could potentially describe market trends; however, inclusion of leading economic indicator amongst others may results more accurate estimations. These researches commonly use leading economic indicators as money supply (M2), stock exchange market data, business and consumer surveys, buildings permits and so on. Finally, researches such as Izani and Raflis (2004) give us identification that on an average, lag between leading and coinciding economic indicator may be equal to one to three months.

However, these indicators have some drawbacks as well. It is known that these indicators may be useful tools to capture future developments, however, that are relatively sensitive and may overshoot the trends. Therefore, these factors are usable only together with other indicators such as financial and lagging or coinciding economic ones. Analysing mentioned factors scientists found that most of the economic indicators (including lagging, coinciding and leading) are exposed to seasonality. In addition, there are other troublesome issues such as ignorance of past changes and shifting levels of data sets. Also in some cases, non-linear behaviour is observed, which eliminate linear models from toolset (similar to lagging and coinciding economic indicators). Therefore, although these researches suggest that they may be useful, they have to be used with cautious by incorporating them into overall model.

Common methodologies are still being developed for standardisation of these ratios. In some cases, this may cause some higher obstacles relatively to other factors for comparability between periods and regions. Although these indicators are available from public databases, their use should involve serious analysis of methodologies (The Organisation for Economic Co-operation and Development 2012). As for interpretation, such factors as well as lagging and coinciding have numerous studies and interpretations in different economic contexts. Therefore, these factors have relatively good interpretation power and are useful; however, the application methodologies should be clearly defined.



## Results

After analysis of related scientific literature on nature of default probability estimation, applied models and criteria for factor selection, several conclusions can be made on applicability of different factor groups. In order to make such comparison, SWOT analysis was used for mapping common illustration of each factor group's features (Table 1). Exploratory factor analysis is a complex multivariate statistical approach involving many sequential steps. Therefore, this should be viewed as suggestions from scientific literature and supplement quantitative analysis of these factors.

**Table 1. SWOT analysis of financial and economic factors** (Source: author's compilation)

	Financial ratios	Economic indicators	
		Lagging and coinciding	Leading
<b>Strengths</b>	<ul style="list-style-type: none"> <li>- Highly empirically proven</li> <li>- Well standardised</li> <li>- Captures borrower specific information</li> </ul>	<ul style="list-style-type: none"> <li>- Highly empirically proven</li> <li>- Good standardisation</li> <li>- Captures trends of market in long term</li> <li>- Avoid borrower's subjectivities and complex structures</li> </ul>	<ul style="list-style-type: none"> <li>- Low number of empirical proofs</li> <li>- Sufficient standardisation</li> <li>- Captures trends of market, forward-looking features</li> <li>- Avoid borrower's subjectivities and complex structures</li> </ul>
<b>Weakness</b>	<ul style="list-style-type: none"> <li>- Long lag of information</li> <li>- Extensive informational requirements to adjust book values</li> <li>- Does not capture market developments</li> <li>- Financial statements' subjectivity and complex borrower groups</li> </ul>	<ul style="list-style-type: none"> <li>- Relatively long lag</li> <li>- Do not represent borrower specific information</li> <li>- More commonly applied portfolio level analysis</li> </ul>	<ul style="list-style-type: none"> <li>- Less standardised</li> <li>- Do not represent borrower's specific information</li> <li>- More commonly applied portfolio level analysis</li> </ul>
<b>Opportunities</b>	<ul style="list-style-type: none"> <li>- Increasing convergence of methodologies in international level</li> <li>- Improving accounting standards may solve some subjectivities and adjust to fair values</li> </ul>	<ul style="list-style-type: none"> <li>- Increasing convergence of methodologies in international level</li> <li>- Improving standards may improve applicability</li> </ul>	<ul style="list-style-type: none"> <li>- Increasing convergence of methodologies in international level</li> <li>- Improving standards may improve applicability</li> </ul>
<b>Threats</b>	<ul style="list-style-type: none"> <li>- There will always be some subjectivity of borrower's management</li> <li>- Globalisation makes borrower groups more complex</li> </ul>	<ul style="list-style-type: none"> <li>- Development of methodologies may result in some inconsistencies</li> </ul>	<ul style="list-style-type: none"> <li>- Developing methodologies may result higher inconsistencies than to other economic indicators</li> </ul>

The analysis indicates main benefits and drawbacks of each of ratios and indicators group, which should be taken into account before starting to collecting data and executing quantitative analysis. If these features are taken into account in advance, it would help academics as well as practitioners to overcome main limitations or state them together with research results.

## Conclusions

After analysis of scientific literature on factors used in default assessment, several findings can be stated on benefits and drawbacks of using financial and economic indicators. These findings are important for theoreticians as well as for practitioners to apply factors in order to have forward-looking default probability models.

First, it was approved that development of default probability methodologies in commercial banks should take into account not only historical information of borrowers but also include implied assessment of market tendencies. To include factors into assessments, logistic method is considered as the most accurate with relatively easier interpretation power; however, it requires comprehensive database. Furthermore, these factors have to help defined models to achieve their goals and qualitative criteria of factor selection by taken into account quantitative criteria as well. However, sometimes it

can be hard to define them because of the fact that it is rare topic in the scientific literature. From scientific literature, it was found that most relevant criteria for factor selection in the assessment of default probability are availability of data, scientific evidences, forward-looking features and interpretation power.

The comparison of factors indicates strengths and weaknesses of each factor. The biggest strengths of financial factors are related to high number of empirical evidences. This and good standardisation makes these factors easier to apply for more simple assessments of borrowers, especially, smaller ones when systemic and market risk is not so relevant. However, long lag of information suggests that assessment should involve other type of factors, which could indicate forward-looking tendencies in the market. Another issue is relatively high level of informational required from borrowers, which is used to eliminate subjectivity of accounting and management, complexity of borrowers' group structures. In future, some of subjectivities can be eliminated by the improvement of accounting standards; however, this will not fully solve the issue.

Whilst lagging and coinciding economic indicators have strengths in terms of standardisation and empirical evidences. These indicators are already widely used by international organisations as well as commercial banks. So, it is already proven in modelling of long-term market tendencies. However, it still has some lag in comparison to leading economic indicators and has a common drawback for all economic indicators – does not capture borrowers' specifics. In addition, these factors are more applicable for portfolio analysis because of their wide sampling reach (no detailed division on sectors). In future, methodologies should converge internationally making easier comparison amongst separate countries, although such tendency may result temporary inconsistencies of methodology as well.

Finally, the main strengths of leading economic indicators are ability to make forward-looking insights on market developments. Although these factors has significant amount of empirical evidences and sufficiently standardised, however, as methodologies are still being developed, it may cause some obstacles to consistently apply them. Therefore, they should be used carefully (with comprehensive analysis of methodologies) and in combination with other factors in order to avoid overshooting effects. In future, if methodologies be more developed and standardised internationally, applicability of these facts would improve.

Concluding the article, as borrowers default risk is one of the most relevant types of risk in commercial banking, it is important to investigate topics related to assessment of borrowers' default probability and applicability of factors that would enable to capture the newest trends of borrowers' markets. Based on the scientific literature reviewed, this paper contributes to researches on forward-looking indicators and concludes that although leading economic indicators are able to capture forward-looking signals, they should be used with careful analysis of weaknesses identified in the article and in combination with financial factors.

The limitation of the article is that analysis of factors is based on rather theoretical analysis than estimation of quantitative criteria. This suggests that while each time using leading indicators quantitative validation should be used as well. In addition, the article also found a number of topics on which further researches would be beneficial. First, there is still a lack of comprehensive study of qualitative criteria applied for factor selection. Second, more empirical studies are needed, which identify characteristics and specifics of factors' applicability in assessment of corporate versus SME borrowers. Furthermore, researches, which compare estimation methodologies of leading economic indicators, would give more insights on applicability of these factors. Lastly, surveys of experts on applicability and more related empirical analyses are needed, which would give more empirical evidences on the topic.

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