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Piotr Mielus*

A VICIOUS CIRCLE OF THE BENCHMARK REFORM

INTRODUCTION

Financial market indices play an important role for the economy. They determine an amount of flows from financial contracts (loans, bonds, derivative transactions) and indicate an objective value of financial instruments. For example, 3M USD LIBOR is the reference for 100 bln USD of derivatives[1]. From the point of view of an impact range, IBOR-type money market indices are of key importance. Those indices reflect the cost of money in the interbank market and constitute the basis for settling financial contracts at a large scale[2].

The proven manipulation of indices in the financial market was an impulse for implementing the index reform[3]. The reform was initiated by Wheatley's Report describing indications of manipulation in the LIBOR market[4]. In consequence, financial market regulators commenced work aimed at developing new principles

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1 D. Duffie, J. Stein, *Reforming LIBOR and Other Financial Market Benchmarks*, Journal of Economic Perspectives, Vol. 29, No. 2, Spring 2015, p. 191–212.

2 R. Abrantes-Metz, M. Kraten, A. Metz, G. Seow, *Libor manipulation?*, Journal of Banking & Finance 2012, Vol. 36, No. 1, p. 136–150; D. Hou, D. Skeie, *LIBOR: Origins, Economics, Crisis, Scandal and Reform*, Federal Reserve Bank of New York Staff Report No. 667, March 2014; P. Mielus, *Financial Market Index Reform Dilemmas*, Gospodarka Narodowa, 4/2016, p. 91–114.

3 P. Gandhi, B. Golez, J.C. Jackwerth, A. Plazzi, *Libor Manipulation: Cui Bono?*, Finance Research Seminar, April 2015.

4 The Wheatley Review of LIBOR: final report, HM Treasury, September 2012.

for establishing and using the indices. EBA/ESMA, BIS, IOSCO and FSB prepared a set of recommendations[5], and the European Parliament started work on implementing formal regulations for the market of financial indices. The outcome of the work is the EU Regulation on indices used as benchmarks in financial instruments (hereinafter referred to as the 'BMR'), which was published in June 2016 and was in force as of January 2018[6]. The Regulation is supplemented with technical standards prepared by the ESMA[7].

At the same time, an analysis aimed at indicating an optimal form of the index reform compliant with the Regulation is being conducted. The analysis is being made both by authorities in charge of the stability of the financial market, as well as by index administrators. These are the administrators that are responsible for implementing the Regulation by ensuring a relevant quality of indices to be published. On the one hand, current administrators have time to implement changes that are regulatory compliant in the light of the new BMR. On the other hand, supervisory guidelines published a few years ago have not been fully implemented by administrators. The latter is not a good forecast for a success.

Having that in mind, we face an economic problem of conversion of current benchmarks used in the European Union in order to make them compliant with the EU regulations. The conversion means a legal and economic change that has to be imposed in an orderly manner that is transparent for stakeholders and does not affect the financial stability.

This article describes research problems identified during the reform of money market indices and suggests how the problems can be solved. Particular attention is paid to the achievement of the goals of the reform without prejudice to the legal and economic continuity of the benchmarks. At the same time, the fulfilment of regulatory recommendations and the assurance that there are no disturbances in the financial market is the "vicious circle" title of the reform. For the most suggested conversion paths, the aforementioned goals exclude each other or one of the goals is achieved insufficiently. The author analyses possible solutions and indicates their impact on an index and index stakeholders.

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5 *ESMA-EBA Principles for Benchmark-Setting Processes in the EU*, ESMA/2013/659, June 6, 2013; *Principles for Financial Benchmarks Final Report*, OICU-IOSCO, FR 07/13, July 2013; *Towards Better Reference Rates Practices: A Central Bank Perspective*, Bank of International Settlements, March 2013; *Reforming Major Interest Rate Benchmarks*, Financial Stability Board report, July 22, 2014; *Market Participants Group on Reforming Interest Rate Benchmarks. Final Report*, March 2014; *Review of the Implementation of IOSCO's Principles for Financial Benchmarks*, International Organization of Securities Commissions report, July 2014.

6 Regulation of the European Parliament and of the Council on indices used as benchmarks in financial instruments and financial contracts, Brussels, 8.06.2016.

7 Final Report. Draft technical standards under the Benchmarks Regulation, ESMA 30.03.2017.

MARKET CONDITION

The Benchmark Regulation provides for relationships between an administrator and users of indices and aims mainly at protecting consumers against manipulations that have an adverse impact on the index reliability. The Regulation applies to all indices used in financial instruments or used as benchmarks for the evaluation of results achieved by investment funds. The indices are classified based on their significance into three groups: critical indices which are used to index financial instruments or contracts of a total nominal amount exceeding EUR 500 billion or which are of key importance for the stability of the economy; significant indices that are used to index instruments of a nominal value from EUR 50 billion to EUR 500 billion, and non-significant indices[8]. Depending on the significance of an index, a level of requirements for the administrator changes. Firstly, the administrator must ensure that the index is representative, transparent and resistant to manipulation. A key document that defines the index, which must be prepared, is a Benchmark Statement[9]. The document describes in detail economic values represented by the index and an index measurement methodology. To ensure that the index is adequate to economic values it represents, the market must be followed. For that purpose, the index must be based on actual transactions and not on declarations of the panel's participants. The practice shows, however, that this is not always possible.

IBOR-type indices are based now on declarations made by panelists, i.e. banks acting as data contributors. For example, LIBOR panel counts between 11 and 17 contributors (depending on the currency) and EURIBOR panel consists of 20 banks[10]. The banks send their partial quotations which are used by the administrator to calculate the index. The final figure is usually a trimmed average of single quotes in order to exclude outliers. The quotations are based on a given bank's individual approach to the market and should comply with the applicable definition of an index (Table 1).

The very contribution, unless it results from actual transactions, is based on an expert judgement of a given fixing participant. Given market players' attitudes, the following problems in that market model can be identified:

- if a transaction does not need to be made, rates quoted may significantly differ from actual rates at which the bank would be eager to or could make a deposit transaction[11];

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8 Regulation of the European Parliament…, *op. cit.*, Article 13–14.

9 *Ibidem*, Article 27.

10 Information based on IBA (www.theice.com/iba/libor) and EMMI (www.emmi-benchmarks.eu) web pages as of September 2017.

11 Even if there is a formal obligation to make the transaction (like in the case of WIBID/WIBOR), the probability that the transaction is made is small (given credit limits between fixing par-

Table 1. Definitions of selected indices

Index	Administrator	Currency	Definition
EURIBOR	European Money Market Institute (EMMI)	EUR	Euribor is the rate at which Euro interbank term deposits are offered by one prime bank to another prime bank within the EMU zone.
LIBOR	ICE Benchmark Administrator (IBA)	USD, GBP, EUR, JPY, CHF	ICE LIBOR provides an indication of the average rate at which a LIBOR contributor bank can obtain unsecured funding in the London interbank market for a given period, in a given currency.
WIBID/ WIBOR	ACI Polska – the Financial Markets Association*	PLN	The rate at which a bank is ready to accept a deposit** from another fixing participant (bid rate) and grant it to another fixing participant (offer rate) during the first fifteen minutes upon the publication.

* As communicated on 3.11.2016, ACI Poland will hand over the administration of WIBID/ WIBOR to the Warsaw Stock Exchange.

** A deposit is defined as an unsecured deposit in PLN accepted or granted in the interbank market between a domestic bank, credit institution, a foreign bank branch or a credit institution branch.

Source: EMMI, IBA, ACI Poland.

- when rates published are strictly supervised by the regulator (which is the case since the manipulation of LIBOR and EURIBOR in the years 2005–2010 was proved), panelists try to reduce the risk of irregularities by minimising dispersion in relation to rates of other market participants and minimising rate volatility in relation to previous quotations, which distorts a natural variation of deposit rates, petrifies index levels deviating from actual funding costs, and stigmatises those participants that show their actual, although inconsistent with other participants, cost of funds in the money market;
- as a result of the change in the manner of financing a bank's balance sheet after the crisis in the years 2007–2009, the liquidity of the interbank money market dropped significantly and permanently, moreover negative interest rates and expansionary policy of central banks (especially visible in Eurozone) crowds out the interbank activity[12] [Rostagno et al. 2016] – in consequence, money

ticipants and the lack of capital and tax effectiveness of interbank deposits) and a maximum amount of the deposit generates a slight interest rate risk for fixing participants.

12 M. Rostagno, U. Bindseil, A. Kamps, W. Lemke, T. Sugo, T. Vlassopoulos, *Breaking through the zero line: The ECB's Negative Interest Rate Policy*, Brookings Institution, Washington DC, June 6, 2016.

market benchmarks describe a market that does not exist (unsecured deposits of maturity exceeding one day are rare and are supplanted by secured deposits and deposits from non-financial institutions).

An example of the phenomenon described above is the maintenance of interest rates for several selected markets. Charts 1–4 (see the appendix) present a change in selected interest rates in Germany and Poland and the volatility of differences between those rates. The exchange of a mutual location of interest rates as a result of the financial disturbances in the years 2007–2009 is essential. Before the crisis, IBOR rates determined a marginal cost for a price of funds acquired by banks and were close to a risk-free rate determined by OIS rates. Deposits from non-financial entities were accepted at lower rates. After the outbreak of the crisis, as a result of the rapid growth of credit and liquidity risks, a distance between IBOR and OIS rates increased. In addition, IBOR was no longer used as a marginal funding cost because banks stopped acquiring funds in the interbank market and started acquiring them from the non-bank market[13]. That structural change in the funding methods applied by banks resulted, among others, from new liquidity regulations, which penalised unsecured deposits in the wholesale market and created preferences for more stable funding from the non-wholesale market. Therefore, as banks were not able to effectively borrow funds in the interbank market, they started paying higher rates for stable funds obtained from corporations and natural persons[14].

As a consequence of the aforementioned phenomena, IBOR-type indices became non-representative and sensitive to external shocks. There are three indications of that sensitivity:

- firstly, a level of the index cannot be verified any longer because the underlying market which it came from and referred to has disappeared;
- secondly, the index still influences cash flows and an economic value of index-based financial contracts whose nominal value exceeds the underlying market many times;
- thirdly, banks are exposed to the basis risk connected with the divergence between IBOR that is quoted and a real funding cost, which makes assets and liabilities management ineffective[15].

Those processes are reflected in the statement of turnovers and volumes recorded in various segments of the money market in the American dollar and the Polish zloty (Table 2).

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13 V. Brousseau, A. Chailloux, A. Durré, *Interbank Offered Rate: Effects of the financial crisis on the information content of the fixing*, IÉSEG School of Management Working Paper, December 2009.

14 P. Mielus, T. Mironczuk, *Structure of the cost of deposits in selected EU countries*, Safe Bank 3(60), Warsaw 2015, p. 89–101.

15 V. Brousseau, A. Chailloux, A. Durré, *Fixing the Fixings: What Road to a More Representative Money Market Benchmark?*, IMF Working Paper No. 13/131, May 29, 2013.

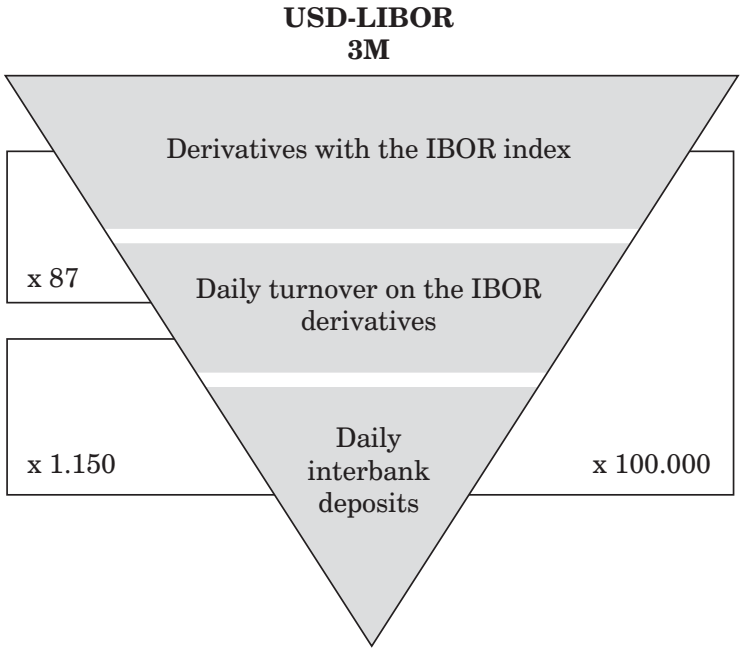
Thus, this is an "upside down pyramid" with a very brittle foundation: a small underlying market influences indexation of a large reference market (see Figures 1–2). Furthermore, the analysis of detailed data indicates that instruments indexed to money market benchmarks are not homogeneous. Apart from derivatives, there are loans and variable coupon bonds indexed to IBOR. Thus, these are not only an off-balance-sheet exposures, but balance-sheet instruments whose share is different in different countries, as well. For details, see Table 3.

Table 2. Turnover and open positions in selected segments of the USD and PLN market

Market segment	USD LIBOR (3M)	WIBOR (1M, 3M, 6M)
Open derivatives indexed to IBOR	USD 100 trillion	PLN 6.5 trillion
Daily turnover from IBOR-indexed derivatives	USD 1.15 trillion	PLN 23.5 billion
Daily turnover from interbank deposits	USD 1 billion	PLN 8.2 million

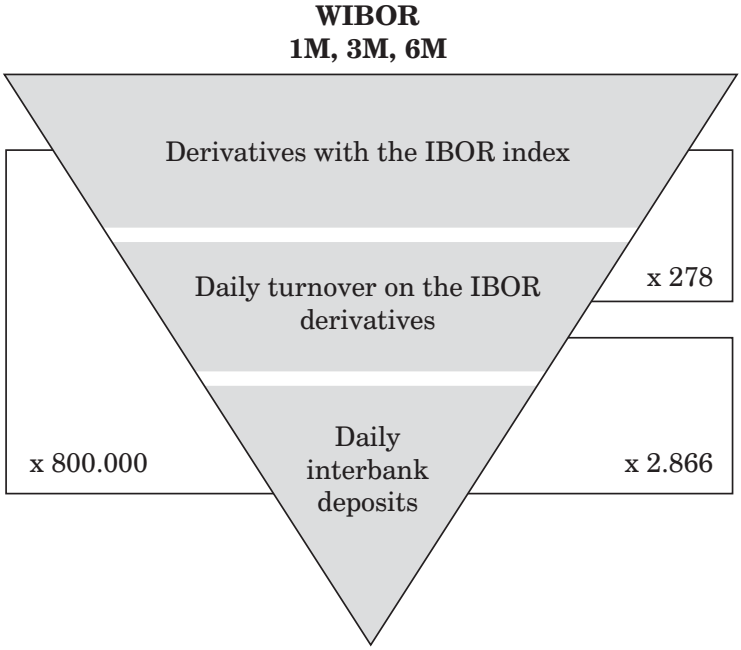
Source: D. Duffie, J. Stein, *Reforming LIBOR…*, *op. cit.* for USD,"The Volume of Open Positions Indexed to the WIBOR rate", Gdańsk Institute for Market Economics and Money market Institute, IBnGR 2015, www.smrp.pl [7.02.2016] for PLN.

Figure 1. Relation between the underlying market and indexed market for USD LIBOR



Source: own study based on D. Duffie, J. Stein, *Reforming LIBOR…*, *op. cit.*

Figure 2. Relation between the underlying market and indexed market for WIBOR



Source: own study based on *The Volume of Open Positions Indexed …*, *op. cit.*

Table 3. Decomposition of instruments indexed to IBOR-type benchmarks

Instrument	USD (Libor)	EUR (Euribor)	GBP (Libor)	CHF (Libor)	PLN (Wibor)
Off-balance sheet	USD 144 trillion	EUR 147 trillion	GBP 33 trillion	CHF 6.3 trillion	PLN 6.5 trillion
Balance sheet	USD 9 trillion	EUR 8 trillion	GBP 1 trillion	CHF 0.3 trillion	PLN 0.6 trillion
Total	USD 153 trillion	EUR 155 trillion	GBP 34 trillion	CHF 6.6 trillion	PLN 7.2 trillion
Balance-sheet share	5.9%	5.2%	2.9%	4.5%	8.3%

Source: *Reforming Major Interest…*, *op. cit.*, *The Volume of Open Positions Indexed …*, *op. cit.*

The divergent impact of off-balance sheet items and balance-sheet items on the macroeconomic stability has to be underlined. Although off-balance sheet instruments are mainly traded in the wholesale market and their net exposure is balanced (i.e. a sum of long and short-term positions in the interbank market is close to zero), balance-sheet instruments generate a risk mainly for the non-

financial sector (and in the case of mortgage loans, for consumers). Therefore, the risk connected with a change in the value of an index is asymmetrical for balance-sheet instruments and may influence income distribution in the economy. This is particularly important in countries where the share of balance-sheet instruments based on a variable interest rate (i.e. indexed to IBOR-type benchmark) is high, like in Poland, where the share of balance-sheet exposures is much higher than in other countries.

The inadequacy of indices that are quoted constitutes a potential source of new disturbances in the financial market in the future. Summing the existing threats connected with the maintenance of non-reformed financial market indices, we have to take into account the following significant risk factors:

- in relationships between banks (B2B segment), there is a financial contract continuity risk because the index does not reflect original economic values;
- in relationships with customers (B2C segment), we are observing a risk of lawsuits resulting from the inadequacy of an index based on banks' declarations;
- in relationships with the regulator (B2R segment), there is a risk of manipulation as the index is not embedded in the transactions made;
- in relationships with the market (B2M segment), there is a basis risk, which means a divergence between the index and actual funding costs and a liquidity risk of instruments that are based on the non-representative index.

Thus, the index based on declarations creates not only regulatory risks in the light of the EP Regulation, but it also generates system risks resulting from the post-crisis financial market. The problem results from the fact that the index definition, which was prepared in the past, does not match the new changed market. This implies potential tensions for the economic stability and means that indices must be reformed. The preparation of benchmarks for the reform resulting from the BMR Regulation is a challenge for index administrators. Possible reform models are analysed in the following chapter.

ANALYSIS OF REFORM MODELS

As the practice applied by two main index administrators (IBA for Libor and EMMI for Euribor) shows, index conversion comprises of arrangements with a wide group of stakeholders, because this is a complex process which is likely to influence the macroeconomic stability. The stakeholders are benchmark users (issuers and investors for variable coupon bonds, borrowers and creditors for variable interest rate loans), an administrator as an entity responsible for index reliability, panelists responsible for the quality of data sent during index preparation, and a regulator supervising the administrator and panelists. Special attention should be paid to an interest of consumers that are index users.

The reform of indices is made of several stages:

(i) the identification of a gap between the present market and the BMR requirements;
(ii) a review of index definition and measurement methodology in terms of compliance;
(iii) an analysis aimed at identifying available information necessary to prepare the index reform;
(iv) communication with the stakeholders (panelists, users, regulators) to reach a consensus concerning the target index model and a path along which the model will be reached;
(v) an agreement on the final shape of the index that will both comply with regulations and be feasible;
(vi) tests of measuring the new index value;
(vii) legislation work by the administrator and panelists aimed at implementing the new index measurement methodology (resulting in the publication of the Benchmark Statement).

A key element of that procedure is defining a relevant conversion path which, on the one hand, is feasible and, on the other hand, guarantees the continuity of index publication and does not violate existing contracts. For that purpose, it is necessary to analyse the liquidity and depth of the underlying market, carry out back tests of the reliability and stability of the existing and suggested rate, and check whether the rates are consistent with other financial market benchmarks. Finally, it will be necessary to conduct a legal analysis which will identify whether the suggested conversion path does not violate the existing contracts, which could have a destructive impact on the stability and reliability of the financial market.

Those challenges restrict the room for manoeuvre for the administrator. This results from the unquestionable and irreparable disappearance of the underlying market and a change in banks' financing structure, which contributes to natural divergence between indices and actual funding costs and makes positive verification of the existing indices difficult or sometimes impossible. On the other hand, all attempts of the reform are highly likely to change the economic character of the rate, which generates significant legal and economic risks.

The literature presents two basic solutions taking into account the existing risks and aiming at developing an effective benchmark[16]:

- an evolution solution which consists in a moderate transformation of the definition of the index to make it based, to a greater extent, on transactions without prejudice to the legal continuity and economic character of the benchmark;
- creating an alternative index which would be quoted simultaneously to the present index.

[16] D. Duffie, J. Stein, *Reforming LIBOR…*, *op. cit.*

Developing this approach, one can elaborate four models of the reform of the existing benchmarks:

- ❖ enforcing procedural changes that would prevent manipulations and leaving the definition and methodology of index measuring without modification, i.e. delaying the implementation of the reform (the LEAVE AS IT IS model);
- ❖ smoothly replacing the index measurement methodology without changing the economic and legal character of the index, but using transaction data to a wider extent (the SEAMLESS TRANSITION model);
- ❖ implementing the new definition and methodology for index measuring which would be based on prices of transactions made with prejudice to the existing economic character of the index, but without prejudice to legal continuity (the REPLACEMENT method);
- ❖ creating a parallel index based on transaction data and maintaining the existing index at the same time (the PARALLEL LISTING model).

The implementation of individual models, on the one hand, is dependent on economic and legal conditions that are specific for a given market and, on the other hand, brings about consequences for the future use of converted indices. A detailed analysis of various paths of achieving the models is described in Diagram 1 in the Appendix hereto.

The decision tree is made of 11 paths. 7 paths lead to a positive solution and the remaining ones to a negative solution (see: Table 4). A positive solution means that one of 4 possible models of the reform is used. A negative solution means that the model cannot be used and another path must be chosen. The negative solution can be corrected only if the model of the reform can be changed (which means going back to the prior decision node in order to choose another path of the reform). Finally, if none of the positive solutions is possible, the outcome is negative.

The decision tree is made of 10 nodes where an administrator chooses a further path. Questions that are to support a decision on choosing an optimal path of the reform are analysed in Table 5. Answers to individual questions are dependent on the specificity of a given market: liquidity, competitiveness of panelists, availability of instruments, the regulator's role, etc. The decision tree comprises of the following key research questions:

1. Can the implementation of a full version of the reform consisting in replacing an index based on declarations with an index defined on the basis of actual transactions be delayed?
2. Is it possible that panelists could give up their obligation of contributing input data necessary to measure the index? If yes, when is it possible?
3. Is there a collection of transactions which enable to measure the index in a reliable way? Is it necessary to add new panelists or new instruments in order to obtain that collection of transactions?

Table 4. Decision paths for various reform models

Reform model*	Scenario for a decision path		Number of iterations
Leave AS IT IS	1	The regulator's consent to delay the reform, panelists' positive reaction	2
	2	The regulator's consent to delay the reform and impose a quotation obligation on panelists	3
SEAMLESS transition	3	Sufficient number of adequate transactions to move fluently to a transaction-based index without prejudice to the economic character of that index	2
	4	When the number of panelists is extended, fluent shift to a transaction-based index without prejudice to the economic character of that index is possible	3
	5	When the number of acceptable instruments is extended, fluent shift to a transaction-based index without prejudice to the economic character of that index is possible	5
REPLACEMENT	6	Despite of a change in distribution for the new index upon the implementation of the transaction model, clauses confirming the violation of agreements between contracting parties are not activated	7
PARALLEL listing	7	Implementation of an alternative index because it is impossible to reform the present index without prejudice to agreements between the contracting parties	6
Failure	8	The regulator's opposition to delay the reform	2
	9	The regulator does not intervene when panelists waive their quotation obligation	4
	10	Instruments used to modify the index measurement formula cannot be extended	4
	11	Clauses confirming the violation of agreements between contracting parties are activated	7

* The words written with the capital letter in the path names are consistent with the Diagram 1. The failure model means the lack of a positive solution.

Source: own study.

4. Is the index based on transactions comparable to the index based on panelists' declaration? And does it indicate a comparable variation?
5. Can a change of the index measurement methodology from the declaration-based index to the transaction-based index, which resulted in a shift in the index distribution, activate contractual clauses under which contracting parties must terminate transactions because of a significant change in the characteristics of the index that determined their flows from the financial contract[17]? Is it connected with a litigation risk?

Table 5. Questions based on which a preferred path is selected

Node	Question	Next path
1	Will the index measurement method be changed?	If YES: go to the item 2, if NO: go to the item 8
2	Is a sufficient number of transactions that can be used to determine the benchmark made in the market?	If YES: choose the "seamless transition", if NO: go to the item 3
3	Can the panel be supplemented with additional banks to improve the quality of collected data?	If YES: choose the "seamless transition", if NO: go to the item 4
4	Can instruments that will enable to measure the index be added?	If YES: go to the item 5, if NO: go back to the starting point
5	Has the distribution of the index (level, variation) measured on the basis of new instruments changed?	If YES: to go the item 6, if NO: choose the "seamless transition"
6	Will the index be replaced although its distribution changed?	If YES: to go the item 7, if NO: choose the "parallel listing"
7	Are legal clauses in financial contracts violated?	If YES: go back the starting point, if NO: choose the "replacement".
8	Has the regulator agreed to delay the implementation of the reform?	If YES: go to the item 9, if NO: go back to the starting point
9	Are banks waiving data contribution to the panel?	If YES: go to the item 10, if NO: choose the "leave as it is"
10	Is the regulator intervening and obliging banks to stay in the panel?	If YES: choose the "leave as it is", if NO: go back to the starting point

Source: own study.

[17] This means, for example, the activation of MAC (a material adverse change) clauses embedded in ISDA MAs (International Swaps and Derivatives Association Master Agreements) providing for rights and obligations of parties to a derivative contract.

An optimal path is determined by a feasibility study for selected paths and a risk analysis connected with a selection of each of the reform models. Advantages and disadvantages of each model (in the form of a SWOT analysis) are described in the Table 6.

Table 6. SWOT analysis of individual reform models

Reform model*	Strengths	Weaknesses	Opportunities	Threats
Leave AS IT IS	The simplest solution, which does not require changes for the administrator	Temporary solution that is contrary to the BMR, protective actions for the regulator must be taken	More time to prepare an optimal solution	Unstable solution, the problem is deferred, possible objection by ESMA, risk of lawsuits from non-resident banks and local consumers, risk that the panelists will leave
SEAMLESS transition	Simple solution consistent with the BMR	Limited implementation feasibility because of the lack of adequate transactions that would constitute the basis for the index measurement	Possible assurance of the index publication continuity	That solution may turn out to be unstable if the economic character of the index changes
REPLACEMENT	Assurance of full compliance with the BMR	Low probability of implementation because of a wide range of risks	Possible full index adjustment to the actual market	Significant risk of the termination of contracts as a result of the activation of clauses confirming that agreements have been violated

Tabela 6 cont.

Reform model*	Strengths	Weaknesses	Opportunities	Threats
PARALLEL listing	Implementation of solutions consistent with the BMR without prejudice to the stability of the existing benchmarks	Introduction of a parallel panel can weaken the liquidity of one of indices	Possible development of an optimal index without prejudice to the continuity of the former, which meets FSB/IOSCO recommendations	Risk that the significance of the former index decreases if it is found that the new index is highly advantageous or a liquidity risk of the new index is low

* The words written with the capital letter in the path names are consistent with the Diagram 1. The failure model means the lack of a positive solution.

Source: own study.

It is difficult to estimate the probability of the models of the reform because the distribution of the probability for individual choices at particular nodes of the decision-making process is not measurable. It is worth pointing out here that the probability of a given scenario is determined by decisions made by entities involved in the reform. Those decisions are influenced by information coming from the process participants, those participants' own interest and an assessment of present and future risks, as well as signals from other process participants (in particular regulators).

Table 7 estimates the total probability for the models of the reform based on various assumptions concerning the probability distribution for each node where the next path is chosen. In one case (50/50 distribution), there is no preference for any path at each node. In turn, for other three cases (67/33, 75/25, 90/10 distribution) a preference for one of the alternatives is taken into account[18]. The preferred alternatives are described in the Table 8.

[18] For simplicity purposes, the fixed probability distribution in all nodes is assumed. In reality, dis- tributions differ and individual probabilities cannot be estimated. The example reflects the sensitivity of the final probability distribution to changes in the theoretical probability assigned to particular nodes.

Table 7. Probability for the reform models given different assumptions for distribution

Reform model	Probability*			
	50/50 distribution	67/33 distribution	75/25 distribution	90/10 distribution
Leave AS IT IS	18.75%	8.48%	5.08%	0.91%
SEAMLESS transition	40.63%	43.57%	40.72%	23.66%
REPLACEMENT	0.78%	1.47%	1.48%	0.59%
PARALLEL listing	1.56%	9.05%	17.80%	53.14%
Failure	38.28%	37.43%	34.92%	21.69%

* The probability of a final result is calculated on the assumption that a preferred variant is chosen at the probability of at least 50% and always equal to the one indicated in the distribution.

Source: own study.

Table 8. Preferred variant for particular decision nodes

Node	Choice	Preferred variant
1	Index change?	YES
2	Are transactions adequate?	NO
3	Can the panel be extended?	NO
4	Can instruments be added?	YES
5	Has the distribution changed?	YES
6	Will the index be replaced?	NO
7	Are contractual clauses violated?	YES
8	Has the regulator given its consent?	NO
9	Are the panelists resigning?	YES
10	Is the regulator intervening?	YES

Source: own study.

In consequence, the seamless transition is the most probable variant, provided that the probability of choosing the preferred path does not exceed 83% at each node of the decision tree. Otherwise, the most probable variant is parallel listing. It is worth noting that the higher probability that a preferred path is chosen, the lower probability that a scenario resulting in the lack of a positive solution will come true. Given the low probability for the preferred path, the seamless

transitionvariant "wins", but the negative scenario, i.e. the lack of a constructive solution of the problem, is still highly probable. The scenario analysis for the administrator should aim at minimising the probability of failure during the index reform. Thus, it is reasonable to draw a conclusion that aiming at the parallel listing variant generates the lowest failure risk[19].

The administrator's function is to minimise the failure risk in the index reform, i.e. aim at excluding scenarios which mean that the quoted index will not meet the requirements of the BMR or related regulations (MAD/MAR) or the index will be no longer published because of the panelists' resignation and, as a consequence, the lack of sufficient data necessary to calculate the benchmark. Thus, the administrator will take up streamlining actions for the purpose of maximising the probability of the successful reform. That streamlining consists in choosing such a path of the reform that ensures the safe process and brings about the greatest benefits for a widely understood market, i.e. mainly to index users. In order to train the reform on a relevant path, the stakeholders should define their preferred manner of proceeding and take up actions aimed at making adequate choices at individual nodes of the process described in the Diagram 1.

CONCLUSION

The reform of money market indices is a phenomenon made of many aspects and determined both by the regulations and by a change in the model of funding of the banking sector and risks that were not identified earlier (the basis risk, legal risk, reputation risk). The consequences of the implementation of the reform will have an impact on the whole financial market (banks, borrowers, investors). Therefore, any incorrect implementation of the reform or any waiver of the key elements of the reform may threaten the macroeconomic stability of countries and markets to which the reformed indices refer.

This article focuses on the detailed analysis of possible scenarios aimed at finalising the reform of indices. Unfortunately, many available paths lead us astray and do not let us find a solution consistent with the EU regulations and safe for the financial market at the same time. As a positive solution cannot be find, the title "vicious circle" materialises. It exists when there is no solution that would enable to comply with the regulations without prejudice to the rights of parties to contracts based on indices, which may threaten the stability of the financial system. Then, one of the following negative scenarios may be possible:

[19] The table 7 indicates that for 90/10 preference distribution, the probability of failure is only 21.69%, and the probability of parallel listing is 53.14%.

- ❖ index frustration, which means a significant drop of the benchmark's reliability as a result of the loss of representativeness and/or change of the economic character of the benchmark, which generates a risk that the continuity of financial contracts based on the index will be questioned. In that case, market participants will avoid indexing instruments by the use of the former benchmark and will choose alternative indices (if available);
- ❖ index discontinuation, which means the administrator not being able to quote the index because of the loss of a sufficient number of panelists or because of the fact that the index does not meet thresholds defined by regulatory authorities; in that case an alternative index must be created.

The administrator faces a stark choice between maintaining the stability of indices he manages and a need to create new indices that will meet the BMR and regulators' recommendations. The administrator must mainly maintain the continuity of index quotations by keeping a relevant group of banks that contribute quotations used to calculate the benchmark. However, quotations based on declarations are dangerous for panelists because of a risk that they will be suspected of manipulation. In turn, the conversion to a transaction-based index (which is safe for panelists because they are no longer responsible for an "expert judgement") is rarely possible without prejudice to the economic character of the quoted index (which may bring about serious legal consequences).

An indication of the change in the economic character is a different distribution of a new index, which is reflected by one of the following phenomena:

1. the new index is quoted at a structurally different level (a parallel shift) because of a different cost of money generated by actual transactions in comparison with non-binding declarations of panelists;
2. the new index shows a different (usually higher) variation because transaction prices respond to changes in liquidity and other market factors, which is in contrast with the inertia of declaration-based quotations.

The literature[20] suggests paths aimed at solving the problem. Firstly, it is possible to maintain the existing index measurement model based not only on dispersed population data, but on individual quotations of panelists as well (subject to cutting marginal findings). In that case, the mix of data used to measure the index (the waterfall feed) made of direct transactions, prices implied by correlated transactions and declarations based on market phenomena that are observed (and evidenced) would be acceptable. Secondly, in order to minimise variations, smoothing techniques could be used. In addition, to increase level convergence in relation to the former benchmark, correction spread could be applied.

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[20] *Evolution of ICE LIBOR Feedback Statement*, IBA, 1.05.2015; *Euribor Transition Policy*, European Money Markets Institute, 14.05.2015.

It is worth noting that technical aspects are crucial for the assessment of a selected path as far as the minimisation of system risks is concerned. Only given the excellent knowledge of processes determining prices in the market segment described by a given index, the impact of changes on the liquidity and volatility of the underlying market and reference markets where the index is used can be adequately estimated.

It seems that to minimise the probability of negative scenarios, a relevant consensus in the group of panelists, users and regulators must be reached. The solutions developed in such a way should provide for fluent transition to the new index measurement model without prejudice to the continuity of contracts and without side effects in the form of reputation or economic risks that have an adverse impact on the performance of the sector and that sector's customers.

Abstract

The Benchmark Regulation (BMR) imposes the necessity of the conversion of the quote-based financial indices to the transactional-based ones. The reform is a challenge for administrators of indices that perform feasibility studies of the conversion process. The article analyses pros and cons of various methods of the index reform indicating the optimal path of such activity as far as money market is concerned. A choice for a "parallel listing" path seems to be the safest one if one takes into account the legal and economic risks embedded in various transition models.

Key words: financial indices, benchmark regulation, money market

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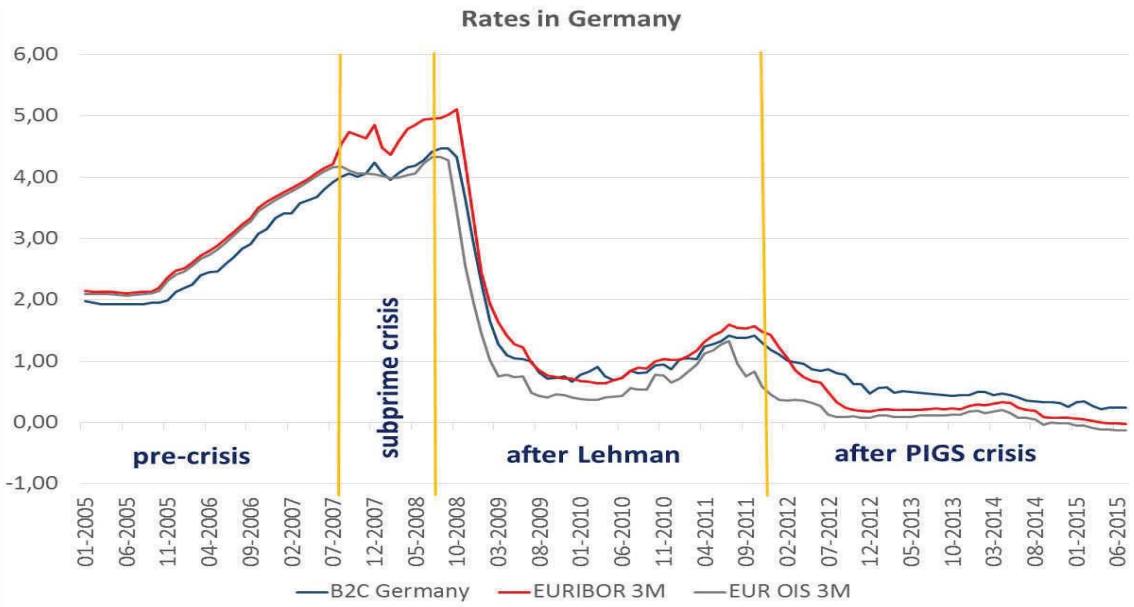
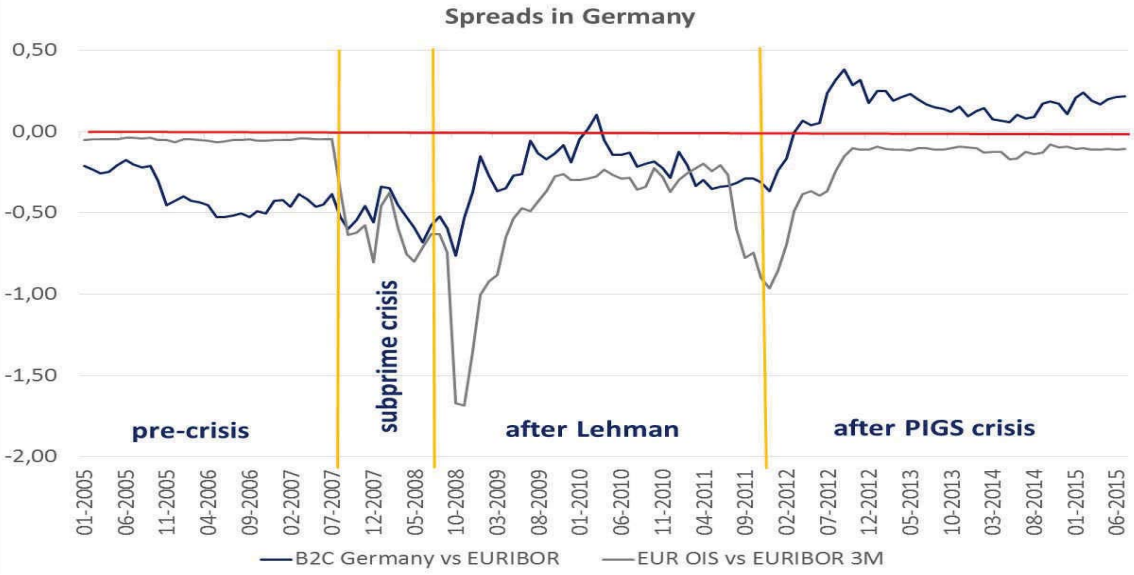
APPENDIX

Chart 1. Interest rates in Germany



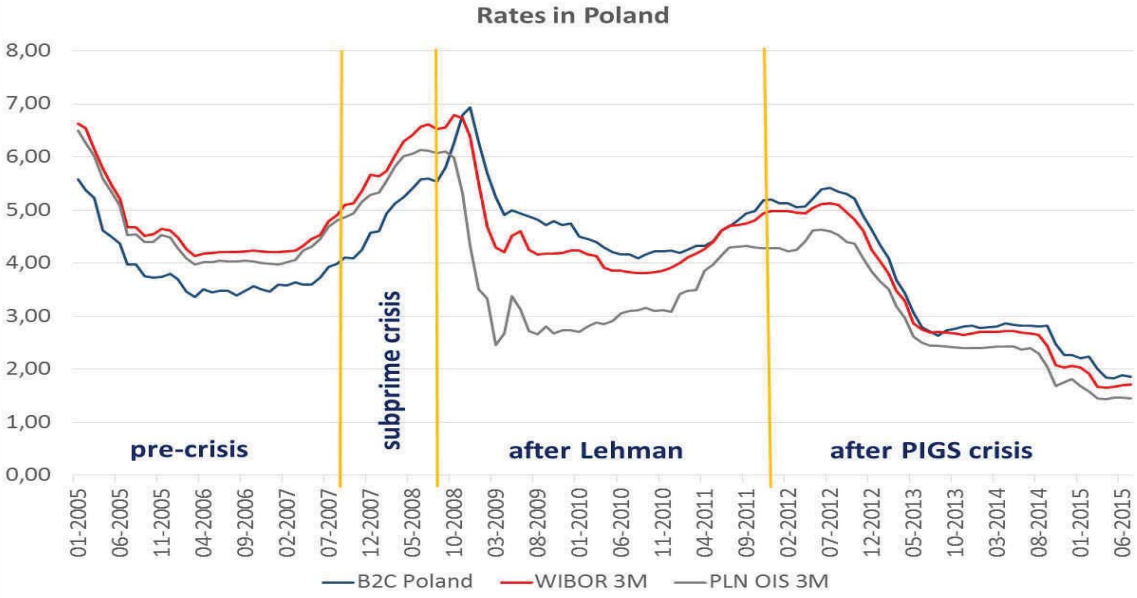
Source: ECB, Thomson Reuters.

Chart 2. Spreads between interest rates in Germany



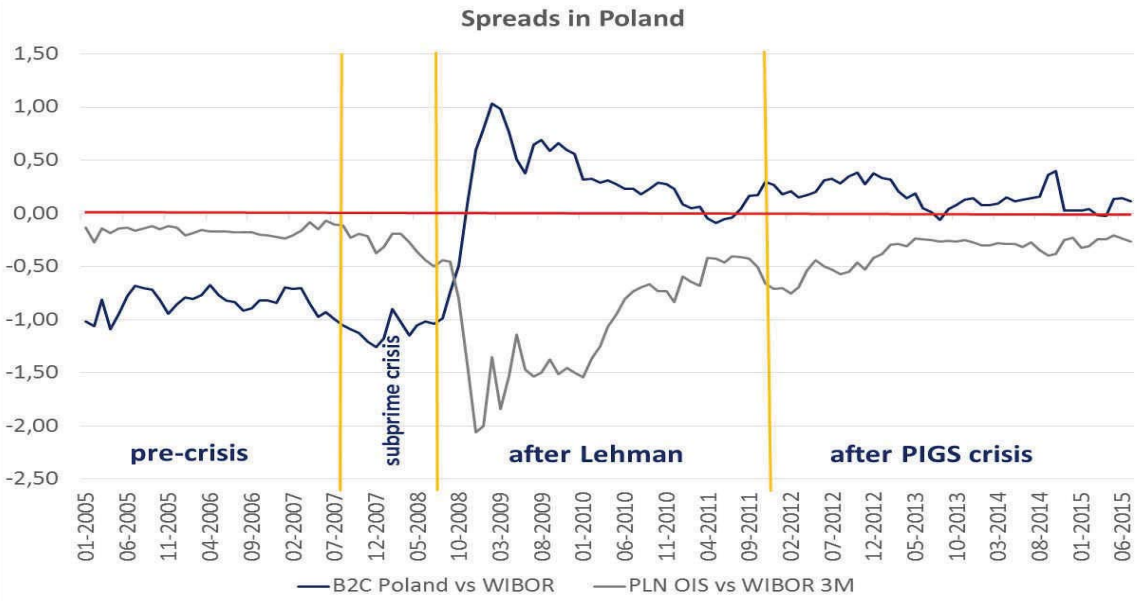
Source: own study based on NBP data, Thomson Reuters.

Chart 3. Interest rates in Poland



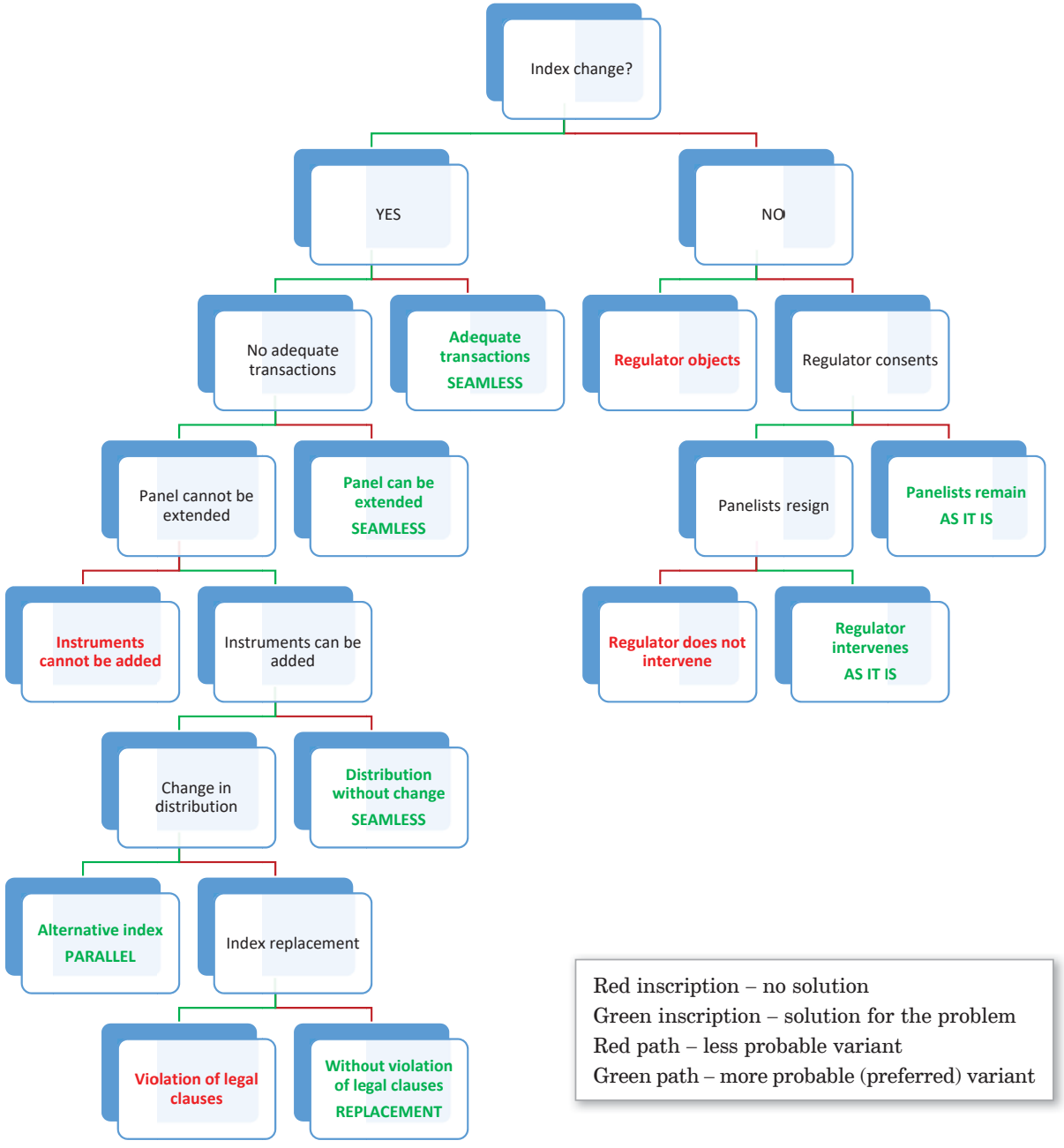
Source: NBP, Thomson Reuters.

Chart 4. Spreads between interest rates in Poland



Source: own study based on NBP data, Thomson Reuters.

Diagram 1. Paths for the index administrator



Source: own study.