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The counterparty credit risk appetite in the Polish over-the-counter derivatives market

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ABSTRACT

Objective: The article aims to study the selected approach used to manage the counterparty credit risk, namely the application of the pre-settlement risk limits in the Polish over-the-counter derivatives market between financial institutions and non-financial counterparties. Since market practice differs in terms of hedging the same risk exposures of non-financial counterparties, the main goal is to identify and analyse key factors determining the risk appetite of financial institutions reflected in the pre-settlement limit amount.

Research Design & Methods: I based the theoretical considerations on the literature analysis. I utilized secondary data analysis and desk research, in particular concerning legal regulations both on the European and Polish levels. It considers credit policies and the counterparty credit risk rules of selected banks listed on the Warsaw Stock Exchange that offer derivative instruments for non-financial counterparties in order to hedge against specific market risks. I investigated all required information and data obtained and proceeded by banks for treasury limits. For this purpose, I analysed credit application forms and treasury limit applications. Next, I investigated the principles for managing counterparty credit risk as well as appropriate credit policy. A case study presents key differences in banking services provided for a non-financial counterparty willing to hedge market risks.

Findings: I applied a holistic approach to the counterparty credit risk policy and identified key factors affecting the counterparty credit risk appetite within financial institutions, reflected in the pre-settlement limit granted to non-financial counterparties in the Polish over-the-counter derivatives market. These determinants concern areas such as specific hedging instruments, given counterparty and financial institutions, as well as the regulatory environment.

Implications & Recommendations: The pre-settlement risk limits serve not only to cover credit exposure but also to support and enhance the entire market risk management process and day-to-day operations in financial institutions. One may also regard the implemented treasury limit setup, risk factors, margining policy, etc., in the context of competitive advantage that financial institutions may gain and thus attract more derivative business. Hence, it is crucial to recognize determinants influencing the treasury limit amount.

Contribution & Value Added: Although the main analysis of counterparty credit risk concentrates on interbank operations, mainly due to their high systemic importance, the management of the pre-settlement risk in the over-the-counter derivatives market between the financial institution and non-financial counterparty should be considered in more detail due to its growing importance. This article intends to systematize knowledge on this topic. The case study utilising international and domestic experiences shows different approaches to mitigate financial risks. The question of which approach to risk management is more effective remains open.

Article type: research article

Keywords: counterparty credit risk; pre-settlement risk; CCR limits; OTC derivatives market

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INTRODUCTION

Despite many undertaken regulatory actions, the counterparty credit risk[1] (CCR) management still remains relevant and up to date. Both the Federal Reserve (FED, 2024) and The European Central Bank (ECB, 2022) highlight the importance of this topic.[2] Polish financial institutions are also not immune to CCR-related challenges, which appear especially in times of major market turbulence caused by unexpected events, such as the 2008/09 Global Financial Crises, the outbreak of 2020 Coronavirus Pandemic, or the Russian invasion of Ukraine in 2022.

I aimed to study the application of treasury limits in the Polish over-the-counter (OTC) derivatives market to cover pre-settlement risk.[3] I paid special attention to the relationship between financial institutions and non-financial counterparties. The existing research concentrates on various risk limits, especially in the interbank market (among financial institutions). There is no comprehensive view on this topic in the analysed area, hence the study intended to fill this gap.

The article tries to examine why the amount of the pre-settlement limit set by banks for a given counterparty may differ, despite reporting the same needs in terms of financial risk hedging. Hence, the research question was: What are the key factors determining the financial institutions' CCR appetite that is reflected in the pre-settlement limit granted?

The applied research method comprised the analysis of various legal regulations both on the European and Polish levels. It also considered credit policies and the CCR rules of selected banks listed on the Warsaw Stock Exchange. A presented case study shows key differences in banking services provided for a non-financial counterparty willing to hedge market risks.

This article contributes to the literature on finance, with a particular focus on market risk management. The findings offer valuable insights for business practice, benefiting both financial institutions and non-financial counterparties. Financial institutions formally required to implement counterparty risk monitoring systems through CCR limits can leverage these results to enhance their practices. Meanwhile, non-financial counterparties may gain additional understanding and develop their knowledge and competencies in risk management. The study also holds significance for academic researchers, providing a basis for further exploration of these areas and inspiring the development of innovative solutions.

The article is organized as follows. The first section will present selected references on CCR management approaches. Then, it will depict the research method employed. Next, I will present the key factors determining the amount of pre-settlement risk limits. Subsequently, the discussion section will cover observed differences and practical implications for Polish financial institutions. The last part will contain conclusions and suggestions for further research.

LITERATURE REVIEW

There are many approaches to mitigate CCR, such as trade novation with central counterparty (CCP), credit valuation adjustment (CVA), or the application of risk limits.

In centrally cleared transactions, the CCP assumes the role of the buyer to the original seller and the seller to the original buyer (Duffie & Zhu, 2011; Norman, 2011; Rehlon & Nixon, 2013; Berndsen, 2021). The CCR is mitigated through mechanisms such as multilateral netting and collateral posting. Contract settlements are further safeguarded by default management procedures and dedicated financial resources. While centralized clearing offers many benefits, some researchers highlight potential risks. For instance, Koeppl (2013) discusses how centralized clearing can create incentives for moral

[1] Counterparty credit risk means the risk that the counterparty to a transaction could default before the final settlement of the transaction's cash flows (Art. 272, Regulation (EU) No 575/2013)

[2] The European Central Bank (ECB) identified exposure to counterparty credit risk as a supervisory priority for 2022 and initiated a range of supervisory actions.

[3] The CCR consists of pre-settlement and settlement risk (Art. 286.2b, Regulation (EU) No 575/2013). The key role in this distinction plays the timing when a specific type of risk occurs. The pre-settlement risk relates to the period from the deal date to settlement date, while the settlement risk relates only to the cash flows at the contract maturity. The latter risk is not a particular challenge in the analysed area due to delivery vs. payment rule in place (although settlement limits may also apply).

hazard, while others argue that trade novation may increase systemic risk by mutualizing the idiosyncratic risk (Pirrong, 2012; Biais *et al*., 2012; Menkveld, 2015; Gregory, 2010).

The CVA approach adjusts the contractual price by incorporating an appropriate risk spread when entering a transaction (Brigo *et al*., 2013), thereby creating an internal default fund. The CVA framework should account for counterparty-specific master netting agreements and margin terms. However, estimating the risk premium for each trading counterparty under this framework can be particularly challenging in practice (Gregory, 2010; Cesari *et al*., 2010; Barucca *et al*., 2020). The CVA-based approach is also not suitable for assets traded on an exchange (Gould *et al*., 2013).

The CCR limits are widely used in practice not only to mitigate credit exposure but also to enhance market risk management processes and day-to-day operations. They allow the maximum exposure that an institution faces from derivatives trading with any other counterparty to be set (Gould *et al*., 2017a and 2017b; Gregory, 2010). They usually cap a maximum exposure above which the collateral has to be posted (margin call rule applies). Pre-settlement risk (PRE) accounts for basically two components, namely market risk estimation and portfolio valuation. Hence, potential future exposure (PFE) and current exposure (CE) jointly determine the PRE. The PFE is very often computed using the VaR approach (Best, 1999). However, the PFE is positive and covers longer periods. The CE is calculated either as a net present value (NPV) of all non-matured contracts or the value of reverse transactions. Some recent works[4] on the PRE concentrate *i.a.* on collateral value, especially different initial margin models (Gregory, 2016; Anfuso *et al*., 2017; Caspers *et al*., 2017; McWalter *et al.,* 2018; Caspers *et al.,* 2018). As a result of bilateral initial margining their impact on derivatives pricing is analysed through so-called valuation adjustments (Vierkoetter, 2019).

The existing literature concentrates mainly on various risk limits, especially in the interbank market. There is no in-depth research on this topic from the perspective of the relationship between a financial institution and a non-financial counterparty.

RESEARCH METHODOLOGY

I aimed to identify the key factors determining the pre-settlement limit amount granted to non-financial counterparties by financial institutions in the Polish OTC derivatives market. I utilized secondary data analysis and desk research, in particular concerning legal regulations both on European and Polish levels.

In accordance with Recommendation A of the Polish Financial Supervision Authority (FSA 2010 and 2022), the pre-settlement limit[5] is required for concluding different derivative transactions. It is employed mainly to manage the counterparty credit risk exposure stemming from derivatives trading.[6] Data source covers selected commercial banks listed on the Warsaw Stock Exchange (WSE) that offer non-financial counterparties (entrepreneurs) derivative instruments to hedge specific market risk exposure (foreign exchange, interest rate and commodity risk). The article investigates all required information and data obtained and proceeded by banks in the credit application process for treasury limits. For this purpose, the credit application forms and treasury limit applications are analysed in the first place. Next, the appropriate credit procedure is examined (usually on credit policy for working capital financing) and adopted principles for managing counterparty credit risk (CCR policy).

The case study considered the CCR limit request for one entity from a capital group operating in Central and Eastern Europe. The company deals with agriculture cultivation combined with animal husbandry. As other activities, it states cultivation of cereals, legumes, and oilseeds for seeds as well as services activities supporting plant production, post-harvest services, wholesales of grain, seeds,

[4] Since the BCBS-IOSCO guidance on margining for non-centrally cleared derivatives in March 2015.

[5] Used in practice under different terms, such as 'credit lines,' 'pre-settlement treasury limits,' 'counterparty limits,' 'CCR limits,' 'transaction limits,' 'counterparty risk exposure limits,' etc. In this article, I define the pre-settlement limit in accordance with Recommendation A of Polish FSA (2010:18 p.1.6.4.a)

[6] The available treasury limit amount together with current risk requirements directly determine the notional value of the derivative transaction. After transaction conclusion the limit utilization is verified on a daily basis (to monitor and manage counterparty credit risk exposure). Usually, once the treasury limit is fully utilized, the margin call clause is triggered/issued meaning the additional collateral has to be posted or the transaction prematurely closed out and cleared. This action aim to limit the risk exposure from derivatives to the pre-settlement limit amount.

and animal feed. It conducts activities related to plant cultivation in an area of approx. 10 thousand ha. Market risks stem from the commodity exposure related to production (including wheat and rapeseed, additional expenses such as fuels), and currency exposure results from direct EU payment to the area (payments per hectare in PLN, but indexed to EUR). The application was submitted to two banks in the OTC market to check transactional availability as well as terms and conditions. Both banks are WSE-listed. However, bank A operates only locally (domestically), while bank B is a member of the leading European banking group (in terms of assets, it ranks among the largest European banks). Although reporting the same needs in terms of financial risk hedging, the entity is given two different proposals in terms of banking services (*i.a.*, various pre-settlement limits).

RESULTS AND DISCUSSION

A non-financial counterparty willing to enter into derivative transactions in the Polish OTC market should meet a number of conditions. The most important is to sign an appropriate documentation package, most often a master agreement with related annexes, among others, regulations, general terms and conditions, fill in the appropriateness test[7] (Markets in Financial Instruments Directive – MiFID), organize the LEI code (European Market Infrastructure Regulation – EMIR) and apply for a treasury limit (Recommendation A of PFSA 2010 and 2022). Request for a treasury limit requires a credit application process. The whole credit assessment is very similar to other working capital facilities and entails both the client's creditworthiness assessment and transaction evaluation (Polish Banking Law). The treasury limit is very often subtracted from the client's total approved credit, and the amount is based on the counterparty's profile and needs. Firstly, all information required to prepare the treasury limit is collected. The counterparty fills in the standard credit application (as for any other financing), usually together with the treasury limit application form. Then, a treasury unit prepares a recommendation in accordance with the CCR policy set in a given financial institution. The limit amount is estimated on the specific market risk exposures and applicable risk requirements for planned instruments. Next, the credit analyst evaluates the counterparty creditworthiness (based on current financial statements and forecasts) for the requested limit amount in accordance with the proper methodology. As for all credit lines there are different types of collaterals being also analysed. In general, there are cash or non-cash collaterals (or both). The credit decision is made at the proper credit committee level (it may be positive, negative or conditional – requires additional changes), and then a documentation package is prepared. After signing the agreement and meeting the initial conditions, the treasury limit is implemented into the bank's system, and the counterparty is able to conclude different financial instruments. During the lifetime of the treasury limit, its utilization is monitored on a regular basis. If it is fully utilized no more instruments can be opened until it is released. If the positive from the bank's perspective value of non-matured contracts matches (utilizes) the whole limit amount (together with additional collaterals paid in), the margin call rule usually applies. The treasury limit for daily business usually expires after one year or is renewed. An active derivative instrument should have a valid treasury limit. This means that if the limit expires, the transaction ought to be closed, or additional collateral should be posted. In the case of credit-related instruments the limit tenor is usually longer and adjusted to the planned hedging instrument.

The factors analysis determining the treasury limit amount followed the credit application process that indicates two main stages, namely when the limit is computed and then verified and granted. The calculation is prepared by the treasury department based on the current CCR rules. Before entering into any derivative contract, the counterparty should be verified in accordance with DIRECTIVE 2014/65 (MiFID) and the assigned target group (Table 1).

Then, risk exposures and the counterparty's hedging policy should be analysed in connection with the financial institution's CCR management policy, including proposals regarding available collateral.

[7] When assessing appropriateness, a financial institution must determine whether the counterparty has the necessary experience and knowledge to understand the risks involved in relation to the product or service offered.

All these factors affect the amount of treasury limit, the scope of available instruments offered, the tenors of both hedging instruments and requested limit and finally, the form of limit collateral.

Table 1. The determinants of pre-settlement risk limits amount to be recognized and analyzed by the treasury department unit

No	Criteria/Factors	Impact/Description
1	Counterparty category under MiFID	*I.e.*, retail customer, professional customer or eligible counterparty. Additionally, retail customers should be assessed in terms of the appropriateness of financial instruments and services (survey on customer knowledge and experience).
2	Target group	Assigning counterparty to a target group to which the institution offers the financial instruments as part of the investment service.
3	Description of risk exposures and counterparty's hedging policy	A detailed description of hedging policy (current/operating or strategic/long-term hedging), in particular: - risk exposures to be hedged with derivatives, such as foreign currency exposure (in- and out-flows, hedge ratio, contracts tenors, time of risk exposure, the origin of risks, *etc*.); interest rate exposure (whether it is an investment loan, bond issue, leasing etc.) repayment schedule, amortization amount etc., commodity exposure (amount/quantity, underlying index, terms, *etc*.), - applicable instruments in hedging activities, Determination of the transaction purpose to be concluded within treasury limit (investment goal, speculative [non-hedging] or hedging activity).
4	Financial institution's CCR management policy	In particular: - treasury limit setups, - limit utilization schemes, - risk requirements for computation of potential future exposure, - valuation methods of current exposure, - margining policy, - other.
5	Collateral form for treasury limit	Whether it is unsecured or secured (cash or non-cash form), and whether or not an initial margin is required. When exactly is the margin call triggered, and how much variation margin should be posted? There may also be limits without the margin call rule.

Source: own study.

Next, the credit risk department is responsible for the evaluation of both the creditworthiness and applicable collateral in accordance with credit methodology for a given business counterparty line (Table 2). Within financial institutions' credit policy, the main factors are (i) the credit rating system, (ii) the evaluation of credit exposure and creditworthiness and (iii) collateral.

Table 2. The determinants of pre-settlement risk limits within financial institution credit policy

No	Criteria /Factors	Impact/ Description
1	Credit rating system	The rating system verifies counterparty financial standing and impacts in the case of working capital financing facilities *i.a.*, the scope of available instruments, the credit amount, collateral form and ultimately, the costs (fees and margins). In the case of treasury limits, credit rating similarly determines whether the financial institution is willing to engage in a specific counterparty and to what extent. There is usually no up-front fee and no margin on treasury limits. The bank benefits from transactional spreads. Credit rating directly affects the amount of treasury limit and collateral form.
2	Evaluation of credit exposure and creditworthiness	The bank is obliged to verify creditworthiness for requested credit exposure. Some financial institutions determine the maximum amount of treasury limit in relation to the company's turnover (*e.g.*, no more than 10-20% of annual turnover), others in relation to EBITDA (*e.g.*, no more than 50% of the last year EBITDA), others in relation to counterparty equity (*e.g.*, no more than 50% equity value).
3	Collateral examination	An analysis of legal collaterals applicable to credit limits is conducted in accordance with the bank's policy in this regard.

Source: own study.

The final decision on the treasury limit amount considered various factors related to the planned instrument, given the counterparty and financial institution specifics on CCR management, credit risk policy, and the regulatory environment (Figure 1).

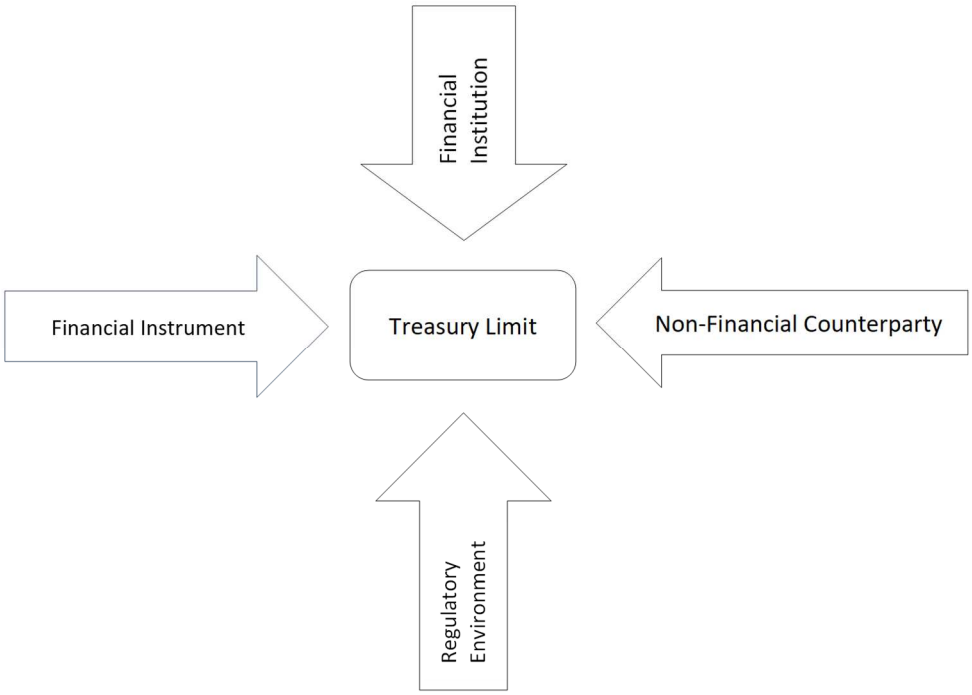

Figure 1. The key areas of treasury limits determinants
Source: own elaboration.

The case study considered in this article concerned the application process for a treasury limit in the relationship between a financial institution and a non-financial counterparty. It turned out that once the application was submitted, the received proposals were heterogeneous. The differences concern the CCR policy, including limit type, limit amount, margining rules, and others. Bank A offered a mutual/common CCR limit (there are sub-limits for currency and commodity exposure), while Bank B proposed a separate limit for each market risk (*i.e.*, single for both currency and commodity exposure). It is particularly interesting that the total amount of both limits in Bank B differs from the amount of the limit in Bank A, despite applying the 95% confidence level in market risk estimation. The limit utilization scheme was similar in both banks, assuming variable risk requirements. The margin call was issued when the limit was fully utilized. However, the minimum transfer amount differed in both banks.

Although financial institutions collect similar data from their counterparties and proceed to determine the treasury limit and set cooperation conditions, the final decision may be different across banks (in detail) in terms of (i) the scope of available hedging instruments, (ii) transaction tenor as well as limit tenor, (iii) limit amount, and (iv) the form of the collateral required. This is because of the different approaches a given institution takes in terms of the implemented counterparty risk management principles and the credit risk policy (credit methodology).

Regarding counterparty categories under MiFID and the distinction between a professional customer, an eligible counterparty, or a retail counterparty, the financial criteria are generally not particularly challenging (they are indicated in Directive 2014). However, some differences arise when examining the retail customer's knowledge and experience. Due to the lack of standardization of MiFID tests among financial institutions and different checking algorithms applied, it may happen that a given counterparty may use the entire range of derivatives offered in one institution while the scope of instruments may be limited in another one.

This is particularly important since the instrument type directly affects the treasury limit amount. As for derivatives, most of them generate counterparty risk and require treasury limits.

However, there are a few exceptions that are free from this risk, such as option purchase with premium payment on the deal date (Wybieralski, 2023). However, when the premium is shifted to the option maturity then a treasury limit is required. Flexible solutions (*e.g.*, selected option strategies, enabling participation in positive market changes) utilize limits to a lesser extent compared to fixed ones (*e.g.*, foreign exchange forward contracts).[8]

Especially important factors are those directly related to the exposure being hedged, *i.e*. the risk sources, the transaction amount, and the contract tenor (in the context of the probability of risk materialization). The type of hedging policy (both on the bank side as well as counterparties) directly affects the amount of the limit.[9] Risk sources and exposure origins are important. Are these specific invoices (already issued/received) or future, just planned cash flows? In the case of the former, the perfect hedging (100% of the exposure) is not usually problematic. In the case of the latter, a maximum hedging level/ratio may be set, *e.g.*, no more than 80%.[10] This is about operational (current) or strategic (long-lasting) hedging policy. Derivative tenors up to 12-24 months are generally possible (tradable) in analysed banks. However, transaction tenors above six months may require more detailed projections and justification in some institutions. There are also a few banks that enable strategic hedging in longer time frames, *e.g*., up to five years (introducing some constraints, *e.g.*, no more than 20% of the annual FX turnover to be concluded in such instruments, Wybieralski 2020). However, long transaction tenors are more or less challenging, especially those exceeding the treasury limit tenor. Longer trades utilize treasury limits to a greater extent due to the higher risk involved. Dilemmas on limit amount emerge after its expiration while renewing process. Whether the original value should be requested or the amount that is based on the current risk requirements (*e.g.*, lower due to time decay)? Another issue deals with the bank's collateral policy on non-matured transactions after the limit expires (and is not renewed). Whether hedging instrument should be premature closed-out or just additional collateral should be posted?

Risk requirements are extremely important in terms of potential future exposure (PFE) and limit amount estimation. Banks often apply different VaR approaches to calculate risk factors (in terms of the method used, reference markets, time series, confidence levels, etc.) and update them differently. This means that risk requirements may vary in individual institutions. Thus, specific trades usually utilize treasury limits differently across financial institutions.

The limit tenor for daily business is usually up to 12 months. In the case of credit-related transactions, it is usually longer and matches the maturity of the interest-hedging instrument. A complication may arise when a company concludes both daily hedging (*e.g.*, foreign exchange) and credit-related hedges. Are there two single limits in place (separate limits for each specific market risk) or just one with sublimits (and then what is the limit tenor and expiration date)? The practice differs in this regard within analysed banks.

The nature of the planned transactions usually affects the collateral form of treasury limit. The real cash flows (financial) hedging is concluded very often within unsecured limits (no initial margin required). Non-hedging activities (speculative transactions), if allowed, they are usually concluded within secured limits (initial margin has to be posted).

The adopted limit utilization scheme has a significant meaning. The CCR exposure can be calculated differently. It usually consists of PFE and CE. The question arises of whether the treasury setup employs and maintains the fixed (original) or variable risk requirements and what the holding period is. It is connected with the margin call policy, which specifies when exactly and how much variation margin should be posted. Within selected banks (WSE listed), the dominant pattern for daily business and one-off transactions under pre-settlement risk limits applies variable risk requirements

Regarding credit policy, credit analysts usually follow credit methodology for working capital financing to evaluate treasury limit amounts. As mentioned, credit rating plays a crucial role in influencing both the amount and the collateral form. Financial institutions may distinguish between the limit amount and threshold amount in their internal systems. In that case, the former determines the no-

[8] Refers to the same notional amount in hedging instrument within a granted limit, see Wybieralski 2015a and 2015b.

[9] Relates to daily business transactions (such as foreign exchange and commodity) as well as one-offs (credit-related instruments).

[10] Cash flows probability should be weighed in terms of transaction tenor.

tional position across different time tenors, and the latter determines unsecured credit exposure (above which the collateral has to be posted; the margin call rule applies). The limit amount often equals the threshold amount. However, the limit amount may be higher than the threshold amount, which means that the bank is willing to conclude the planned transactions within specific tenors but accepts lower credit exposure (margin call may appear earlier/sooner). The other way is also true, namely that the limit amount may be lower than the threshold amount, which means acceptance of greater CCR exposure. Limits with no margin call rule also exist, meaning no additional collaterals at all (non-standard/higher risk requirements usually apply).

CONCLUSIONS

This article covers one of the approaches used to manage counterparty credit risk in the Polish OTC derivatives market in the relationship between financial institutions and non-financial counterparties, namely the application of the pre-settlement risk limits. When applying for treasury limits, enterprises provide banks with specific financial data and information on hedging policy together with risk exposures, and yet various banks prepare different limit amounts for those counterparties and allow them to use different financial instruments. It also happens that within the same institution, a given limit amount is sufficient to cover a specific exposure in one year, and the same exposure at risk requires a different limit amount in another year (due to risk requirements change because of higher market volatility).

The study of selected WSE-listed banks on the CCR rules and credit policy indicates a group of factors directly affecting cooperation conditions for non-financial counterparties in the Polish OTC derivatives market. The research outcome contains a list of key factors affecting the CCR appetite within financial institutions, reflected in the pre-settlement limit amount granted. The breakdown of these determinants relates to (i) the specific instrument planned to conclude, (ii) the given counterparty, (iii) the financial institution and (iv) the regulatory environment. Differences observed and practical implications for market participants are discussed. Due to limited access to data, selected banks were included in the study. Therefore, I recommend conducting a more detailed examination of all entities within the WIG-BANKI index in this regard.

Recognition and analysis of factors determining the limit amount is crucial, particularly for market practice (end-user and financial institutions) and scientists. The institutions carry out constant activities aimed at improving their CCR policy and management system to gain market advantage and attract more derivatives business. Non-financial entrepreneurs benefit from a deeper insight and awareness surrounding practical issues of treasury limits application. Academics may identify practical challenges and address them in their research in order to identify alternative solutions both on theoretical and application grounds.

As a result of the global financial crisis of the early twenty-first century, the area of OTC derivatives is subject to intensive regulatory regulations, particularly interbank operations. Due to the growing importance of transactions with non-financial counterparties, it is not surprising that this area attracts more and more attention (ECB, 2023; FED, 2024), especially since the approach to risk assessment and management is not uniform. Therefore, which path is optimal and should be particularly promoted to strengthen financial stability? A clear answer to this question requires further investigation. Research in this area should aim to recognize and develop best practices in CCR management and governance using derivative instruments to mitigate market risk within treasury limits. The practical challenges concern, for instance, the breaches of contractual terms (events of default), timely renewal of treasury limits, or market risk estimation (models). Interesting subjects are those related to treasury limit utilization schemes, treasury limit setups and collateral types or different margin call policies observed in practice. All these issues require further examination.

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Use of Artificial Intelligence

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