

## ТРАНСПОРТ ТА ЛОГІСТИКА

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### ENSURING THE GIVEN LEVEL OF THE VOYAGE EFFICIENCY CONSIDERING THE RISKS FACTORS ASSOCIATED WITH THE CHARTER PARTY TERMS

*The terms of the agreement for voyage chartering of the vessel (voyage charter-party) are identified as those the wordings of which can affect the risk of increasing the voyage time and, accordingly, the voyage costs of the shipowner-carrier. Their possible wordings are given, the nature of their impact on the components of the voyage time are characterized. Noted the possibility of their assessment by shipowner during the negotiations before the charter-party conclusion. The approach of the ensuring the voyage efficiency is developed. It based on the assessment the risk of the voyage time increasing due to the charter-party terms.*

**Keywords:** voyage chartering, voyage time, voyage efficiency, risks.

**Онищенко С.П., Коскина Ю.А. Обеспечение заданного уровня эффективности работы судна с учетом факторов риска, связанных с условиями чартер-партии.** Выделены условия договора фрахтования судна на рейс (чартер-партии на рейс), формулировки которых влияют на появление в процессе выполнения перевозки рисков увеличения продолжительности времени рейса и, соответственно, расходов судовладельца-перевозчика. Приведены их возможные формулировки, охарактеризован характер их влияния на общую продолжительность времени рейса по составляющим. Отмечена возможность их учета судовладельцем при ведении переговоров по заключению фрахтовой сделки. Предложен методический подход обеспечения эффективности выполнения рейса на основании оценки риска увеличения времени рейса в связи с формулировками чартерных условий.

**Ключевые слова:** фрахтование на рейс, продолжительность выполнения рейса, эффективность рейса, риски.

**Онищенко С.П., Коскіна Ю.О. Забезпечення заданого рівня ефективності роботи судна з урахуванням факторів ризику, пов'язаних з умовами чартер-партії.** Названо умови договору фрахтування судна на рейс (чартер-партії на рейс), формулювання яких впливають на появу під час виконання перевезення ризиків збільшення тривалості часу рейсу та, відповідно, витрат судовласника-перевізника. Подано їх можливі формулювання, охарактеризовано характер їх впливу на загальну тривалість рейсу по складових, оскільки частина умов та їх формулювань є визначальними для тривалості власне переходу між портами, у той час як, виходячи з інших, формується час стоянки судна у портах під вантажними роботами. Зазначено, що за деякими умовами чартер-партії торгування є неможливим, у той час як за іншими можливими є перемовини щодо формулювань, якими їх буде викладено у договорі. Наголошено на можливості їх урахування судовласником при проведенні перемовин щодо укладання фрахтової угоди та, відповідно, під час попередньої калькуляції рейсу (часових та грошових витрат). Ілюстративними розрахунками продемонстровано зміни часових параметрів рейсів і величини витрат, пов'язаних із їх виконанням, відповідно до тих чи інших чартерних формулювань.

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*Запропоновано методичний підхід забезпечення ефективності виконання рейсів на підставі оцінки ризику збільшення часу рейсу у зв'язку із формулюваннями чартерних умов. Такий підхід базується на визначенні величини збільшення витрат судновласника-перевізника завдяки збільшенню тривалості ходового та стояночного часу рейсу у зв'язку із різними можливими формулюваннями чартерних умов щодо портів заходу та термінів стоянки судна у портах під вантажними роботами. Таку величину витрат можна розглядати як надбавку до ставки фрахту, на якій може наполягати судновласник-перевізник під час перемовин із фрахтувальником з метою забезпечення ефективності виконання рейсу. Окрім того, зміни часових параметрів виконання рейсів можуть урахуватися при вирішенні задач організації та оперативного планування роботи суден.*

**Ключові слова:** *фрахтування на рейс, тривалість виконання рейсу, ефективність рейсу, ризику.*

**Description of the problem.** The effectiveness of the concluded charter-party (C/P) and the subsequent voyage for the shipowner is determined by the ratio of the amount of his voyage costs and the estimated freight value. Voyage costs largely depend on the duration of the voyage, which is the result of arrangements on many C/P terms and their wording. The second «efficiency-forming» factor is income being usually freight, formed on the basis of freight rate. In this regard, it is quite logical that a lot of C/P terms and wordings are reflected in the value of the freight rate, as far as both are negotiable by the parties in the negotiation process. That is why for the shipowner-carrier the proposed «idea» of the freight rate is acceptable only in the context of other C/P terms and wordings, since his voyage costs largely depend on them. Moreover, some C/P terms affect not only the cost of the voyage, but also form certain risks of a possible increase in these costs, that causes some commercial risks for the shipowner at the stage of signing the C/P.

Naturally, in the process of negotiating a fixture the shipowner needs to assess the possible risks of increasing costs and ensure that they are taken into account when formulating the level of the freight rate. In [1], such an idea was expressed for considering the losses of time of maritime transportation under the influence of the uncertainty of the conditions of the transport process, and a method for calculating the «risk premium» was proposed as an extra charge for the basic freight rate (the freight rate idea). To our opinion this idea can be extended to the commercial risks of the shipowner, and the used approach will subsequently allow the integrated estimating of both the production and commercial risks of the shipowner-carrier, and the potentially associated additional costs which occur with them. As a result of such integrated estimating the necessary level of voyage efficiency can be reached.

**Review of existing research and publications.** The problem of assessing and formalizing risks as factors determining the commercial shipping is considered to a small extent by the author and is more concerned with assessing the influence of market factors on the efficiency of a vessel and/or fleet operation. In the majority of publications by national and foreign authors [2-9], the operation of the shipping company is considered as a part of its implementation on the global shipping market, and the main risk-forming factors are the demand and supply on the chartering market, their relationship and development, and accordingly, the dynamic freight rates. It is no doubt, this approach is completely fair - being the subject of the global chartering market, shipping companies are clearly exposed to the risks of market origin. That is why many of these authors have noted the need to monitor market situation and its development and forecasting freight rates (for example, [10]).

However, the impact of the market on the efficiency of freight operations of shipping companies as a whole has the nature of an external impact, while making a deal and its immediate result – the C/P is concluded and the voyage is subsequently executed under this contract – also have a significant impact, since they are characterized by certain risks belonging to the category of «commercial». The possible negative impact of C/P terms on the voyage efficiency was characterized as far as consideration of these factors when negotiating and concluding a fixture was searched in [11], however, a formalized assessment of this influence was not made. The classification of commercial risks arising from C/P negotiating and voyage performing from financial, operational and legal positions was discovered in [12], also without proposals for tools of their assessment and/or calculations. Issues of risk assessment of changes in freight rates and prices for the bunker and their accounting tools in the value of

freight rates are considered and proposed in [11-13], but the main attention is paid to forecasting the risks of their change to estimate the profit of tonnage operators. In particular, the overall risk index proposed in [14] is based on a summary assessment of risks associated with vessel characteristics, as well as risks related to the direct passages of a vessel between ports, which is inherently close to understanding of operating risks in [15].

**The objective of the article.** Thus, the purpose of this study is to identify and to formalize the possible increase of voyage costs under the influence of the terms of a voyage C/P, as well as the development of a method for assessing the «risk premium» being an extra charge to the freight rate idea and to ensure a given level of efficiency. That means the following steps to be made:

- to characterize the nature of commercial risks of the shipowner upon a particular voyage;
- to identify the commercial risks associated with the specifics of C/P terms;
- to formalize the possible impact of such commercial risks on the efficiency of the voyage;
- to develop a mechanism for assessing the «risk premium» being an extra charge to the freight rate idea for ensuring a given level of efficiency.

**Basic material.** It is well-known, shipping involves risks of a different nature, which can arise for the shipowner at various levels, and one of them is the level of a particular voyage. From all the variety of the shipowner's possible risks in the performance of a given voyage, this research is dedicated to the commercial risks. It is noted in [13] that shipowner's commercial risks occur at the time of signing the C/P, but are manifested (if they occur) during the voyage, that is, in the operating. Thus, during the voyage, the shipowner is potentially exposed to both operating and commercial risks. The operating risks include accidents, ship breakdown, bad weather. In [1], to the operating risks, the authors also attributed the loss of time due to coordination (or rather, inconsistency) of transportation operations by its various participants.

The arising of the commercial risks of the shipowner during the particular voyage leads either to an increase in the voyage time, which indirectly causes an increase in costs; or directly leads to an increase in costs during the voyage; either simultaneously, or both. For example, the charterer's option of the port (to be analyzed in more detail below) can lead to an increase in the voyage time compared to the planned one, and, consequently, to an increase in the costs for the bunker and also provides a higher level of disbursement expenses, that is associated with different tariff policies of the ports of the region.

The risks, which occur for the shipowner upon the particular voyage, are the result of the C/P terms and wordings, and these risks are considered to be named «commercial» as far as they establish all commercial particulars for the «sale» of transportation services. In this context all the C/P terms can be divided into two categories: the terms which have an element of uncertainty, for example, option of the port; the terms which strictly define the duration of some voyage time elements, but these terms in themselves (for example, laytime) cannot be exactly calculated due to the uncertainty of voyage implementation (for example, the vessel is en route between ports) and the fact that C/P is usually concluded beforehand. So, the terms of this category entail the uncertainty of the transportation parameters.

Let's analyze in more details the influence of the main terms of a C/P on the formation of the commercial risks of the shipowner.

Since the total time of the voyage is formed as the sum of the time en route and the time in ports awaiting/under cargo operations, the most significant terms among the C/P are:

- loading and discharging ports, which determine the voyage route and vessels time en route;
- loading and discharging rates, which determine time in port under the hadnling;
- laytime calculating, which similarly, together with loading and discharging rates, estimates the vessel's time in port;
- Notice of Readiness (NOR) terms, which determines the vessel's additional time in port.

Ports, between which the cargo should be carried, as it was said before, determine the voyage time, and, first of all, the time en route. However, meaning the duration of time en route, not only the ports themselves, but also the wording in which these ports are indicated in the C/P are important. The simplest variant of the voyage is the carriage of cargo between one loading port and one discharge port (basis 1/1), while the ports are exactly named in the offer (charter). In this case, the shipowner can accurately calculate almost all the voyage costs: a disbursement (the amount of which depends on the rates of port charges and the size of the vessel); fuel costs (primarily as a function of sea days) and

operating costs (determined by the total voyage time). The time en route between ports is [16]

$$t_r = \frac{L}{V}, \quad (1)$$

where  $t_r$  – time in route, days;  $L$  – distance between loading and discharging ports, miles;  $V$  – vessel's speed, miles per day.

Due to the specifics of the trade of some goods, as well as the uncertainty with the shipment at the time of negotiating the conclusion of the C/P, the charterer may use his option of the port and declare as loading and/or discharging places, not specifically named ports, but the port of a certain country or a section of the coast (range). Of course, when the voyage is being performed, the shipowner (master) will receive clear instructions as to the port of call the ship should proceed for cargo operations. However, at the stage of negotiations and preliminary calculations of the efficiency of the voyage, they may indeed contain the wording of the loading place as a port located on the range. The range itself can cover a sufficiently large geographic area, and that fact leads to an increase in the distance of the voyage and relatively the time en route.

Obviously, in preliminary calculating, the shipowner must take into account the possible risk of increasing the voyage distance under the influence of the uncertainty of the C/P terms regarding to the ports of call, and authors propose to calculate the additional time in route as

$$t'_r = t_r + \Delta t'_r = t_r + \frac{\Delta L'}{V}, \quad (2)$$

where  $t'_r$  – time en route when range chartering, days;  $\Delta t'_r$  – additional time en route due to the distances between ports of the range, days;  $\Delta L'$  – additional distance between extreme ports on the range (for each specific offer, the terms of which are subsequently transformed into the terms of the charter, the shipowner must estimate the most feasible  $\Delta L'$ ).

There is also the charterer's option of the number of ports of call. Given the terms of the trade contract, the charterer may declare in the offer (and further C/P) the call of the vessel for loading and/or discharging in two or more ports. Thus, the previously named «classical» voyage on basis 1/1 (from 1 port of loading to 1 port of discharging) can be transformed in its structure due to the number of ports of call: 2 ports of loading – 1 port of discharging; 1 port of loading – 2 ports of discharging; 2 ports of loading – 2 ports of discharging etc. Another variant option of the port is wording «1/2» that being indicated in the C/P as a consequence of offer terms means that the vessel can be sent to one or (maybe) two ports for loading and/or discharging if the charterer is in need.

If the vessel calls at more ports upon the voyage provided that «1/1» it obviously increases the voyage time on  $\Delta t''_r$  and respectively the voyage costs. Even if we take into account that normally in such cases the ports are situated rather close to each other and the time en route will increase insignificantly. However, in combination with other factors this can lead to significant changes in the voyage efficiency. In such circumstances, the time en route should be determined by the shipowner with the following calculations proposed by authors

$$t''_r = t_r + \Delta t''_r = \Delta t_r + \frac{\Delta L''}{V}, \quad (3)$$

where  $t''_r$  – time in route if voyage includes the additional loading/discharging ports, days;  $\Delta L''$  – distance between possible additional loading/discharging ports, miles.

When the charterer uses his option of the port and the wordings of ports of calls are unclear, an obligatory additional clause is the so-called rotation of ports of call being the order of calls at ports for cargo operations, which is also in the charterer's option. At the same time, at the charterer needs (usually based on the readiness of the cargo for shipment and convenience for discharging at the port of destination), the rotation can be specified as geographical (by passing ports as the vessel moves), reverse (entering ports from the farthest from the vessel) and broken (the order of the ports is indicated in the charter). Definitely, the charterer's demand for reverse or broken rotation is fraught with increasing the time en route for the shipowner (which should be taken into consideration making the preliminary calculation), while geographic rotation is more acceptable to him.

The direction of the voyage, indicated in the C/P by the ports of loading and discharging, also determines the need for the passage of the vessel by main narrowways, where the speed of the vessels

is limited. Thus, the voyage time can be further increased by  $\Delta t_n$  that is defined by authors as

$$\Delta t_n = \frac{\Delta L_n}{V_l}, \quad (4)$$

where  $\Delta L_n$  – distance of the narrowways, miles;  $V_l$  – limitation of vessels' speed, miles per day.

It should be noted here that in this case it is a question of the main bottlenecks that may occur in the case of a certain realization of the option of the ports. Thus, this situation either may arise or not. In this case, in (1), (2),  $\Delta L'$  and  $\Delta L''$  should be excluded from the distance  $\Delta L_n$ .

Thus, depending on the terms of the C/P on the ports, the time en route can change, and such changings authors propose to estimate as

$$\Delta t_r = \Delta t_r' + \Delta t_r'' + \Delta t_n. \quad (5)$$

This increase in time en route naturally leads to an increase in fuel costs, which authors suggest to calculate as

$$\Delta R_b = C_b \cdot q_b' \cdot \Delta t_r, \quad (6)$$

where  $\Delta R_b$  – additional fuel costs, USD;  $C_b$  – cost of the marine fuel, USD per tonne;  $q_b'$  – fuel consumption underway, tonne per day.

In addition, the call of the vessel at a more expensive port (by the level of port charges and dues) in comparison with the base one, or the call of a vessel at additional ports in case of unclear C/P terms by the nomination and the number of ports, leads to an increase in disbursement costs, which generally reflects on the total voyage costs. Thus, there are additional costs for the shipowner  $\Delta R_d$ . One should also take in mind that the passage of the bottlenecks is also connected with payment by the vessel of certain vessel fees and charges, which are to be reflected in  $\Delta R_n$ . Thus, the uncertainty of the terms of the C/P regarding ports of call can lead to the additional costs of the shipowner, estimated by authors with

$$\Delta R_v = \Delta R_b + \Delta R_d + \Delta R_c, \quad (7)$$

where  $\Delta R_v$  – additional voyage costs, USD.

Table contains the results of calculations of the shipowner's additional fuel costs if the port of call is indicated in the C/P as «1 port of Ukraine» and the shipowner's calculations based on Odessa port. The calculations include the time of passage of the port channels. The up-to-date fuel price for IFO-380 in the region was put into calculations based on the details of the vessels of 5000 tns and 25000 tns of deadweight. Accordingly, for larger vessels with higher daily fuel costs, the possible additional costs will be much higher.

Table

Possible additional fuel costs of the shipowner with uncertain terms on the port of call

Indicator	Odessa	Nikolaev	Kherson	Mariupol
Distance, miles	346	396	406	547
Time en route, days	1,20	1,68	1,51	2,10
Time en route increasing, days	-	0,48	0,31	0,90
Additional bunker expenses, USD:				
- vessel of 5000 dwt	-	3648	2379	6907
- vessel of 25000 dwt	-	13224	8623	25037

As one can see, if the shipowner, in calculating the efficiency of a 5,000-dwt vessel, is oriented to the port of Odessa, when the charterer nominates, for example, the port of Mariupol, the additional fuel costs are about \$ 7,000, the port of Nikolaev is 3600 USD. For a vessel of 25000 dwt, the nominating by the charterer of the port of Mariupol will cost the shipowner 25000 USD more expensive in regards of the fuel costs. At the same time, the port of Nikolaev is the most «expensive» port among the mentioned above in the terms of disbursement, which is affected mostly by the cost of pilotage. For vessels with a deadweight of 5,000 tns, the difference in the disbursement accounts may be about 6000 USD, which leads to a general increase in the shipowner's costs if the charterer nominates this port for almost 7000 USD, for ships with a deadweight of 25000 tns, the difference is almost 20000 USD.

Another C/P term that affects the voyage time is the urgency of tonnage for loading, indicated in the offer and further – in the C/P named laycan. At least, the shipowner has to relate these dates to the duration of the ballast passage from the last port of call to the port of loading nominated by the charterer. The ballast passage is the part of the voyage that required it to be fulfilled, so the time spent on the passage of the vessel in ballast (if any) should be taken into account by the shipowner. Unable to demand direct money compensation for the ballast passage, the shipowner, however, can indirectly receive it by «pawning» the relevant costs in the freight rate level. Here, obviously, it will be important to relate the ballast time to the (first) port of loading with the laydays date, in order to avoid the vessels' idle time after arrival waiting for the readiness of cargo. For the shipowner, it is possible that the vessel makes the ballast passage at a reduced speed than the actual and ensures the arrival of the vessel at the port of loading not earlier than the laydays. The second option is that with early arrival of the vessel at the port of loading the vessel expects laydays. In practice, the parties can agree on setting the vessel to the berth before the date of laydays, but not always the charterer has such opportunities.

To obtain a formalized generalized estimation of the shipowner's additional costs that may arise due to laydays is quite difficult. But, for example, because of the need «to be ready» by a given date, the vessel can carry out a ballast passage at an increased speed, which leads to additional fuel costs by  $\Delta R_b$ . Authors developed (8) to consider these additional costs:

$$\Delta R_b = R_b(V_{t+}) - R_b(V_t) = r_b(V_{t+}) \cdot \frac{L_b}{V_{t+}} - r_b(V_t) \cdot \frac{L_b}{V_t}, \quad (8)$$

where  $R_b(V_{t+})$  and  $R_b(V_t)$  – bunker expenses for ballast passage with the increased speed  $V_{t+}$  and usual speed  $V_t$ ;  $r_b(V)$  – relation of fuel consumption and speed;  $L_b$  – distance of ballast passage.

Among the terms of the C/P regarding the duration of the vessel's stay under cargo operations are the loading and discharging rates, as well as the calculations of laytime days. Based on the rates, the shipowner is able to roughly calculate the number of days during which the vessel must be loaded/discharged [16]:

$$t_{lt} = \frac{Q}{M_l} + \frac{Q}{M_d}, \quad (9)$$

where  $Q$  – cargo quantity to be loaded/discharged, MT;  $M_l$  and  $M_d$  – loading and discharging rates, MT per vessel per day.

The C/P terms fixing the necessity and/or the possibility of handling on weekends and holidays allow to calculate the estimated total time in port. With a SHEx terms stated in the C/P, the estimated number of days in port should be increased for the period of time specified in the C/P as excluded from the calculation of the laytime (weekends and holidays according to local customs and rules). For sure, the weekends and holidays that will «fall» during handling depend on the day the vessel arrives at the ports of loading and discharging, which cannot always be accurately calculated by the shipowner preliminary. However, the shipowner, when assessing the effectiveness of the voyage, should probably be guided by the worst possible option, therefore, the probability of an excluded period based on the total number of laytime days should obviously be taken into account. Thus, the shipowner must take into account that, under the C/P term SHEx, the vessel's time in each of the ports  $t_p$  will be formed taking into account possible without cargo operations  $\Delta t_{SHEx}$ , and authors includes weekends and holidays to the time in port:

$$t_p = t_{lt} + \Delta t_{SHEx}. \quad (10)$$

The estimation of  $\Delta t_{SHEx}$  is rather difficult, unless the C/P is concluded a few days before the proposed voyage. In this situation, starting from the current position of the ship and knowing the weather conditions of the passage  $\Delta t_{SHEx}$  can be fairly reliably assessed. Otherwise, one should use the forecast chart of the position of the vessel and its future passages.

The next term relates to the timing of the notice of the readiness of the vessel. According to the agreement of the parties, the notice of readiness (NOR) can be submitted and accepted only in official working hours (usually it is indicated in the C/P, based on the customs of the port), or at any time of the day and any day of the week. Concerning these wordings, the principal moment may be the day of

the week, in which the vessel arrives at the port for cargo work - working or weekend day/holiday, as well as the time of arrival of the vessel. In such situations, the time between berthing and/or giving a NOR can be extended for longer periods. At the same time, it should be taken in mind that if the C/P is concluded in advance, the shipowner has virtually no opportunity to more or less accurately estimate these time losses. NOR given in «www» terms, in fact, implies the beginning of the account of laytime immediately after the expiration of the «grace period» according to the terms of the C/P pro forma. At the same time, the wording obliging the vessel to submit NOR only after berthing and getting a «free pratique» will, of course, «lengthen» the time spent by the vessel waiting the commencement of laytime and handling.

Accordingly, the shortest idle time of the vessel awaiting cargo handling will be subject to the acceptance of the NOR on «www» basis at any time on any day of the week. If the notice is specified as www, but to be given only during official working hours, the shipowner must bear in mind that upon the arrival of the vessel beyond official working hours, the master should wait for the start of the working day/week, because even the transmitted NOR may not be accepted. The most prolonged will be the waiting period in the wordings allowing the master to give the NOR only during working hours, being berthing and after the port formalities. To estimate the time losses due to waiting for the NOR declaration is possible only during the vessel's passage to the port considering the weather conditions, port rules etc.

As a result, the increase in the actual time in the port is possible by the (11) developed by authors

$$\Delta t_p = \Delta t_{SHEx} + \Delta t_{www}, \quad (11)$$

where  $\Delta t_p$  – additional port time due to the NOR terms, days;  $\Delta t_{www}$  – waiting for the working time to give a www-NOR, days.

This, in turn, leads to an increase in fuel costs during the vessel's time in port  $\Delta R_b^p$  and authors propose to estimate it as

$$\Delta R_b^p = C_b \cdot q_b'' \cdot \Delta t_p, \quad (12)$$

where  $q_b''$  – fuel consumption in port, tn per day.

Summarizing all possible increases in the costs of the voyage  $\Delta R$ , both underway and in port under the influence of uncertainty of the C/P terms, as well as the impossibility of reliable planning of the vessel's operating, it is obtained by authors

$$\Delta R = \Delta R_v + \Delta R_b^p \quad (13)$$

and the total duration of the voyage may increase by the  $\Delta t$  which authors propose to calculate as

$$\Delta t = \Delta t_p + \Delta t_r. \quad (14)$$

Formalizing the possible impact of commercial risks arising within the C/P terms on the efficiency of the voyage is based on a conventional indicator of the efficiency of the vessels work on cargoes of cargoes is the time-charter equivalent  $TCE$ , calculated as follows [17]

$$TCE = \frac{f \cdot Q - R}{t_v} = \frac{f \cdot Q - (R_b + R_d + R_n)}{t_v}, \quad (15)$$

where  $f$  – freight rate, USD per MT;  $R$  – variable expenses of the shipowner in the voyage including bunker expenses  $R_b$ , disbursement port costs  $R_d$  and channel costs if any  $R_n$ , USD;  $t_v$  – voyage time (including the ballast passage time if any), days.

It is assumed that the shipowner using (14) evaluates the effectiveness of the proposed voyage on some basic terms regarding the time in port and laytime. In order to take into consideration the possible impact of the onset of commercial risks associated with the specificity of the C/P terms, (14) to authors opinion should be

$$\begin{aligned} TCE' &= \frac{f \cdot Q - (R_b + R_d + R_n) - (\Delta R_v + \Delta R_b^p)}{t_v + t_p + \Delta t_p + \Delta t_r} = \\ &= \frac{f \cdot Q - (R_b + R_d + R_n) - (\Delta R_b + \Delta R_d + \Delta R_n + \Delta R_b^p)}{t_v + t_p + \Delta t_{SHEx} + \Delta t_{www} + \Delta t_r' + \Delta t_r'' + \Delta t_n}. \end{aligned} \quad (16)$$

In this case, possible increases in costs for the bunker underway and in port are functions of the possible increase in the elements of the voyage time –  $\Delta R_b(\Delta t'_r, \Delta t''_r, \Delta t_p)$  and  $\Delta R_b^p(\Delta t_{SHEX}, \Delta t_{www})$ .

Calculation of the time-charter equivalent as to (16) allows to take into account the possible risks of the shipowner «bargaining» at the level of the freight rate more reasonable and to estimate the efficiency with a greater degree of compliance with the vessel's operation.

So, the charterers option on the ports of call and some terms determined the calculation of lay-time, are a source of commercial risks of the shipowner. On the other hand, the existence of these terms can be compensated by the level of the freight rate at which the shipowner can insist during the negotiations. Thus, for the shipowner, the only way to protect himself from an unplanned increase in the voyage time and the corresponding increase in his voyage costs is to adequately increase the freight rate. Moreover, the more uncertain the terms and their wordings are, the more relevant for the shipowner the establishment of a higher freight rate is.

Obviously, the shipowner adheres to a certain level of time-charter equivalent concluding C/P deals, which corresponds to the current state of the freight market. Denote this level  $TCE^*$ . If the charterer in his offer proposes the idea of a freight rate as  $f$ , but, based on the terms of the future C/P set out in the offer, the shipowner assesses its commercial risks associated with the C/P terms and wordings, and has the intention to provide the necessary level of efficiency, then during the negotiations he may bargain for increase in the freight rate  $\Delta f$ , that is, for the actual getting (17), created by authors:

$$TCE^* = \frac{(f + \Delta f) \cdot Q - (R_b + R_d + R_c) - (\Delta R_b + \Delta R_d + \Delta R_n + \Delta R_b^p)}{t_r + t_p + \Delta t_{SHEX} + \Delta t_{www} + \Delta t'_r + \Delta t''_r + \Delta t_n}. \quad (17)$$

From (17) authors obtained:

$$\Delta f = \frac{TCE^* \cdot (t_r + t_p + \Delta t_{SHEX} + \Delta t_{www} + \Delta t'_r + \Delta t''_r + \Delta t_n)}{Q} + \frac{(R_b + R_d + R_n) + (\Delta R_b + \Delta R_d + \Delta R_n + \Delta R_b^p)}{Q} - f. \quad (18)$$

Note that  $\Delta f$  naturally depends on the magnitude of possible time losses and increase in costs, the higher they are – the higher the level of «compensation» for the possible risk is. Thus, (18) allows to determine the extra charge for the freight rate offered by the charterer, which would ensure a given level of efficiency taking into account the possible commercial risks of the shipowner.

### Conclusions

A C/P is a contract of carriage by sea in tramp shipping contains a number of terms that in many situations lead to uncertainty of the voyage performing, namely option on the ports of call, the port of arrival and laytime terms. These terms are sources of commercial risks for the shipowner during the voyage. In this study, the possible losses of time and additional costs of the shipowner under the influence of the specified terms of a voyage C/P are characterized. The possible impact of the commercial risks of the shipowner on the vessels efficiency indicator – the time-charter equivalent – was formalized. In order to eliminate the possible negative impact of these risk factors on the efficiency of the vessel's operation, the shipowner should evaluate possible time losses and additional costs and use this information to estimate the premium to the proposed (by charterer) freight rate level, in compensation for possible risk. For this purpose, a mechanism has been developed to estimate the magnitude of this compensation. The result of this study is a tool for substantiating decisions on the freight operations and, unlike existing studies, take into account the impact of the terms of a voyage C/P on the commercial risks.

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### ОСОБЕННОСТИ ПЛАВАНИЯ СУДОВ В ЛЕДОВОЙ ОБСТАНОВКЕ ПРИ ПЕРЕВОЗКЕ ГРУЗОВ В МАРИУПОЛЬСКОМ МОРСКОМ РЕГИОНЕ

*В статье рассматриваются особенности плавания судов в Мариупольском морском регионе с учетом ледовой обстановки. Практика показывает, что судовождение по каналам Азовского моря осложняется гидрометеорологическими условиями: туманами, морозами, ветрами, дрейфом льда, изменением направления течения, быстрым обледенением корпуса судна и другими природными факторами. Одним из таких факторов является появление «ледовой реки»; рассматриваются особенности ее возникновения и поведения при резком понижении температуры, а также влияние на мореходные качества судов по каналам.*

**Ключевые слова:** ледовая река, сопротивление, ледовая обстановка, судно, шуга.

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