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LOGISTICS OF THE FASHION INDUSTRY: CHOICE OF TRANSPORT MODE, COSTS, AND ECONOMIC EFFICIENCY OF SUPPLY CHAINS

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Palant O. Yu., Sheptukha A. M. Logistics of the Fashion Industry: Choice of Transport Mode, Costs, and Economic Efficiency of Supply Chains

The article explores the relationship between logistics in the fashion industry and the economics of freight transport under changing conditions caused by globalization processes and increasing supply chain instability. Special attention is paid to the role of transportation costs, delivery time, and uncertainty as key factors determining the efficiency of logistics solutions and the financial performance of fashion sector companies. It is substantiated that transport acts both as a cost element and as a strategic tool for revenue generation, assortment management, and risk reduction. The study analyzes modern approaches to supply chain management and examines the features of the fashion industry's operations, associated with high seasonality, rapid product assortment renewal, and demand sensitivity to timing parameters. An economic-mathematical model has been developed that allows formalizing the task of choosing a type of transport, taking into account transportation, warehousing, and marketing costs, including losses from product markdowns. It is shown that the optimal logistical decision is determined by the balance between delivery speed and its cost, and also depends on demand parameters and uncertainty. Special attention is paid to analyzing the impact of logistical shocks caused by global crises on prices, assortment, and product availability. Using a quasi-experimental approach, it is substantiated that increased delivery times and their variability lead to a higher probability of shortages and markdowns, and also encourages companies to revise logistics strategies, including supplier diversification and the use of hybrid transport solutions. The research results prove that under conditions of high uncertainty, combined logistics strategies, which simultaneously reduce costs and increase the flexibility of supply chains, are the most efficient. It was concluded that there is a need to shift from static cost-minimization models to dynamic approaches that take into account the impact of time and risks on profit formation. The practical significance of the study lies in the development of recommendations for improving the resilience and economic efficiency of logistics systems in the fashion industry.

Keywords: fashion industry logistics; supply chain resilience; transportation costs; delivery time; economic efficiency; product markdowns; logistics shocks; hybrid logistics strategies.

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Палант О. Ю., Шептуха А. М. Логістика модної індустрії: вибір виду транспорту, витрати та економічна ефективність ланцюжків поставок

У статті досліджується взаємозв'язок між логістикою модної індустрії та економікою вантажних перевезень через змінні умови, викликані процесами глобалізації та зростанням нестабільності ланцюжків поставок. Особлива увага приділяється ролі транспортних витрат, часу доставки та невизначеності як ключових факторів, що визначають ефективність логістичних рішень та фінансових результатів компаній fashion-сектора. Обґрунтовано, що транспорт виступає і як елемент витрат, і як стратегічний інструмент формування виручки, управління асортиментом і зниження ризиків. У роботі проведено аналіз сучасних підходів до управління ланцюжками постачання, розглянуто особливості функціонування fashion-індустрії, пов'язані з високою сезонною залежністю, швидким оновленням асортименту та чутливістю попиту до параметрів часу. Розроблена економіко-математична модель, що дозволяє формалізувати завдання вибору виду транспорту з урахуванням транспортних, складських і маркетингових витрат, включно з втратами від уцінки продукції. Показано, що оптимальне логістичне рішення визначається балансом між швидкістю доставки та її вартістю, а також залежить від параметрів попиту та невизначеності. Особливу увагу приділено аналізу впливу логістичних шоків, спричинених глобальними кризами, на ціни, асортимент і доступність товарів. З використанням квазіекспериментального підходу обґрунтовано, що збільшення строків доставки та їх варіативність приводить до зростання ймовірності дефіцитів та уцінок, а також стимулює компанії до перегляду логістичних стратегій, включно з диверсифікацією постачальників та використанням гібридних транспортних рішень. Результати дослідження доводять, що в умовах високої невизначеності найбільшу ефективність мають комбіновані логістичні стратегії, які дозволяють одночасно знижувати витрати та підвищувати гнучкість ланцюжків постачання. Зроблено висновок про необхідність переходу від статичних моделей мінімізації витрат до динамічних підходів, які враховують вплив часу та ризиків на формування прибутку. Практична значущість роботи полягає в розробці рекомендацій щодо підвищення стійкості та економічної ефективності логістичних систем у fashion-індустрії.

Ключові слова: логістика модної індустрії; стійкість ланцюжків поставок; транспортні витрати; час доставки; економічна ефективність; уцінка продукції; логістичні шоки; гібридні логістичні стратегії.

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The modern fashion industry represents one of the most complex and dynamically evolving systems of the global economy, in which logistics processes play a key role in shaping companies' competitive advantages. In the context of production globalization, accelerated product turnover, and high volatility of consumer demand, supply chain efficiency becomes a determining factor of business economic sustainability. In this regard, the analysis of fashion industry logistics through the lens of freight transportation economics is of particular importance, since transportation costs, delivery time, and the reliability of logistics operations largely determine cost structures, pricing policies, and assortment strategies of companies [1].

The relevance of this study lies in the fact that, over the past decade, a significant shift has been observed in the parameters of global logistics. Rising transportation tariffs, congestion of transport infrastructure, disruptions of established international transport corridors, and the consequences of global crises – including the COVID-19 pandemic and increasing geopolitical conflicts and wars – have led to higher uncertainty and risks in supply chains [2]. Under these conditions, fashion companies are forced to

reconsider traditional models of production and logistics organization, including supplier selection, production location, and transport mode choices.

A distinctive feature of the fashion industry is its high sensitivity to delivery time parameters. Demand seasonality, short product life cycles, and rapid assortment renewal create the need to minimize delivery time and enhance logistics flexibility [3]. Unlike many other industries, in the fashion business the time factor directly translates into financial and economic performance: delivery delays increase the probability of markdowns, reduce margins, and lead to higher volumes of unsold products. Thus, the choice between different modes of transportation (maritime, air, rail, and road) becomes not only a logistical but also an economic decision.

Literature Review. In academic literature, issues of logistics and transportation costs are traditionally examined within the frameworks of transportation economics and supply chain management. A significant body of research by O. M. Zborovska [9–12] is devoted to these issues. Studies by D. Hummels [4] emphasize the role of transportation costs as one of the key factors shaping international trade flows and production location. Within the field of operations

management, S. Chopra and P. Meindl [5] focus on inventory optimization, lead time reduction, and enhancing supply chain resilience.

A number of studies provide comprehensive reviews of the fashion industry [13–15] as well as supply chain management in this sector [16]. Logistics and transportation costs occupy a central place in international trade theory and supply chain management, acting as key determinants of the spatial organization of production and distribution. In classical and neoclassical trade models, transportation costs are considered fundamental barriers affecting trade volumes and geographic economic structure. This approach is reflected in gravity models of trade, where transportation costs and time are critical variables determining the intensity of trade interactions between countries [4].

Modern research expands the traditional understanding of transportation costs by incorporating not only direct financial costs but also time-related costs, delay risks, and uncertainty associated with global logistics systems. In particular, study [6] highlights that time can have an impact comparable to – or even greater than – transportation costs themselves, especially in time-sensitive industries such as fashion.

From a supply chain management perspective, logistics is viewed as a tool for optimizing flows of materials, information, and finances in order to minimize total costs and improve service levels. Classical inventory and distribution models focus on trade-offs between storage, transportation, and stockout costs [5]. At the same time, the concept of resilient supply chains emphasizes the ability of systems to withstand external shocks and recover quickly from disruptions [2].

M. Bruce, L. Daly, and N. Towers [3] analyze the specifics of the fashion industry and conclude that traditional supply chain approaches face significant limitations in this sector. First, high demand volatility and short product life cycles increase the importance of time factors. Second, a substantial share of value added is generated by intangible assets such as design, branding, and marketing, which increases the importance of accurately meeting consumer preferences. Third, the high frequency of assortment renewal requires accelerated logistics solutions and greater flexibility.

G. Cachon and R. Swinney [7] demonstrate that successful fast fashion companies actively use combinations of different transportation modes, adapting logistics strategies to the characteristics of specific product flows. They emphasize that fast fashion has become a key driver of logistics system transformation, with its core principle being the reduction of time between product development and market availability through the integration of production and logistics processes.

The choice of transport mode can be viewed as an optimization problem in which companies aim to minimize total costs under time constraints and risks. Rodrigue [8] highlights that transport mode selection is a key economic decision based on comparing alternatives in terms of cost, speed, and reliability. Maritime transport offers low costs but long delivery times, while air transport ensures speed at a significantly higher cost. Rail and road transport occupy intermediate positions. Importantly, companies consider not only direct transportation costs but also indirect economic effects, such as the impact of delivery time on inventory levels, stockout probability, and markdowns [6].

A number of studies focus on the impact of logistics shocks on markets. Supply chain disruptions caused by pandemics, geopolitical conflicts, and infrastructure constraints lead to changes in transportation costs and delivery times, affecting prices, assortment, and product availability [2]. Under increased uncertainty, companies are forced to adapt their logistics strategies by diversifying suppliers and restructuring transport flows.

Thus, despite the extensive literature on transportation economics and supply chain management, the integration of these approaches within the context of the fashion industry remains insufficiently developed. In particular, the mechanisms through which logistics parameters translate into financial performance and how transport mode choice affects assortment structure and markdown levels require further investigation. This defines the research gap addressed in this study.

Research Gap, Novelty, and Objectives. The specificity of the fashion industry, characterized by high demand volatility and the critical importance of time factors, necessitates the integration of transportation economics, operations management, consumer behavior analysis, and financial economics. This study proposes an interdisciplinary approach that combines these perspectives.

The *scientific novelty* of the research lies in the development of a conceptual model linking transport mode choice to firms' economic performance through a system of interrelated indicators, including transportation costs, delivery time, and demand uncertainty risks. Within this framework, logistics is viewed not as a supporting function but as a key driver of value creation and competitive advantage in the fashion industry.

The *objective of the study* is to identify and analyze the economic mechanisms that determine the relationship between logistics decisions and business efficiency in the fashion industry. To achieve this goal, the study addresses the following tasks: analyzing supply chain characteristics in the fashion industry; ex-

aming the impact of transportation costs on supplier and transport mode selection; assessing the effects of logistics shocks; and developing a model that formalizes the relationship between logistics parameters and financial performance.

The *practical significance* of the study lies in the possibility of applying its results to improve supply chain management efficiency in the fashion industry, reduce costs, enhance resilience, and adapt to conditions of high uncertainty.

Methodology. The study is based on a comprehensive approach combining methods of transportation economics, operations management, and economic-mathematical modeling. The research methodology includes several sequential stages.

At the first stage, a theoretical analysis of scientific literature on global supply chains, transportation costs, and fashion industry logistics was conducted, forming the conceptual foundation of the study. At the second stage, the problem of logistics strategy selection was formalized through the development of an economic-mathematical model describing the relationship between total costs, revenue, transport mode choice, delivery time, and demand parameters. At the third stage, the impact of logistics shocks was analyzed using a quasi-experimental difference-in-differences approach, allowing the identification of causal relationships. Finally, the results were interpreted and practical recommendations were formulated.

The proposed research structure ensures a consistent transition from theoretical analysis to modeling, empirical interpretation, and practical conclusions.

Presentation of the Main Material and Research Findings. One of the key factors determining the configuration of supply chains in the fashion industry is transportation cost, which, under globalization, acquires a system-forming role. Historically, the development of the industry has been associated with the active use of offshoring strategies, involving the relocation of production to countries with low labor costs. Such a model made it possible to significantly reduce production costs; however, at the same time, it increased dependence on extended and complex logistics chains [4].

Within the classical paradigm of the international division of labor, the choice between localization and globalization of production is determined by comparing production and transportation costs. Formally, this decision can be represented as:

$$C_p^{off} + C_t^{off} \leq C_p^{near} + C_t^{near},$$

where C_p^{off} , C_p^{near} – denote production costs under offshoring and nearshoring respectively; C_t^{off} , C_t^{near} – denote transportation costs under the respective strategies.

Traditionally, the significant advantage of offshoring was ensured by the substantial wage gap between developed and developing countries. However, in recent years, this gap has been narrowing, while transportation tariffs have been increasing, leading to a reassessment of the economic feasibility of globally distributed production [1]. An additional negative factor is the increase in time-related costs associated with longer supply chains.

Unlike many other industries, the time factor plays a critical role in the fashion industry. Demand seasonality and the rapid turnover of collections mean that even a delay of several weeks may lead to significant financial losses. Therefore, the time component should be incorporated into the decision model between offshoring and nearshoring:

$$TC = C_p + C_t + \alpha \cdot T,$$

where T – is delivery time; α – is the coefficient reflecting the sensitivity of profit to time.

The coefficient α captures the specific features of the fashion industry and may vary significantly across market segments. In fast fashion, it takes high values, as time-to-market is a key determinant of competitiveness. In the premium segment, the value of α may be lower, but it remains important in maintaining brand image and alignment with seasonal trends.

Rising transportation costs and increasing delivery times under global logistics shocks have strengthened the attractiveness of nearshoring and reshoring strategies. Relocating production closer to end markets reduces delivery times, increases flexibility, and lowers risks associated with supply chain disruptions. At the same time, such decisions are accompanied by higher production costs, requiring a more comprehensive analysis of the overall effect [2].

Another important factor affecting supply chain structure is uncertainty related to potential disruptions. In an unstable environment, companies aim to minimize not only expected costs but also risks. This can be formalized by introducing a stochastic component into the total cost function:

$$TC = C_p + C_t + \alpha \cdot T + \beta \cdot \sigma,$$

where σ – represents uncertainty (e. g., variance of delivery time); β – is the coefficient of risk aversion.

Thus, increased variability in delivery times makes long global supply chains less attractive even when their average costs are lower. This explains the observed trend toward supplier diversification and reduced dependence on specific regions.

Changes in demand structure also play a significant role in transforming supply chains. The growth of e-commerce and rising consumer expectations regarding delivery speed intensify pressure on logis-

tics systems. Consumers increasingly expect product availability “here and now”, which requires shorter fulfillment times and more accurate demand forecasting [5]. As a result, companies are forced to reconsider not only production geography but also the architecture of distribution networks.

Empirical studies show that logistics shocks – such as port congestion, disruptions of transport corridors, and increases in transportation and storage tariffs – lead to significant changes in supply chain structures. In particular, there is an increase in the use of alternative routes and transport modes, as well as growing investment in local production capacities [2]. These changes affect not only logistics but also pricing dynamics, product availability, and inventory levels.

Thus, transportation costs and time parameters are key determinants of supply chain structures in the fashion industry. Their impact extends beyond logistics and influences strategic decisions, including production models, assortment management, and the formation of competitive advantages.

Next, we consider in more detail the problem of transport mode selection as a key element in optimizing logistics decisions and improving economic performance within the industry.

The choice of transport mode in the fashion industry represents a complex economic decision. Companies aim to minimize total costs while accounting for time constraints, demand uncertainty, and markdown risks. Unlike other industries, where transportation is primarily viewed as a cost-minimization function, in the fashion industry it directly affects revenue and profitability through timely market entry and alignment with consumer preferences.

The classical approach to transport mode selection is based on comparing direct costs and delivery time [17]. As noted above, maritime transport is characterized by low unit costs but long transit times, while air transport ensures fast delivery at significantly higher costs. Rail and road transport occupy intermediate positions, offering trade-offs between cost and speed. However, for the fashion industry, such comparisons are insufficient, as they do not account for the economic consequences of time delays.

To formalize the transport mode selection problem, the total cost function can be expressed as:

$$TC = C_t + C_h + C_m,$$

where C_t – represents transportation costs; C_h – represents inventory holding costs; C_m – represents markdown costs.

Transportation costs C_t directly depend on the selected mode of transport. In general form, their relationship can be expressed by the following inequalities:

$$C_t^{air} \gg C_t^{sea},$$

while:

$$T^{air} \ll T^{sea},$$

where T denotes delivery time.

Thus, the choice between air and sea transport represents a classical trade-off between cost and speed.

Inventory holding costs C_h are associated with the need to maintain stock during the delivery period and can be expressed as a function of time:

$$C_h = h \cdot T,$$

where h is the unit holding cost.

A longer delivery time when using sea transport leads to an increased need for working capital and higher warehousing costs.

The most specific component for the fashion industry is C_m , which reflects losses from markdowns. These costs arise in the case of untimely arrival of goods to the market or a mismatch with demand. They can be represented as follows:

$$C_m = p(T) \cdot L,$$

where $p(T)$ is the probability of markdown, increasing with delivery time; L is the magnitude of losses from markdown.

The function $p(T)$ is increasing, reflecting the relationship between the duration of the logistics cycle and the risk of product obsolescence. In the context of fast fashion, this relationship is particularly pronounced, since even a slight delay may lead to significant revenue losses [7].

Taking into account all components, the problem of transport mode selection can be formulated as a minimization problem:

$$TC^{mode} = C_t^{mode} + h \cdot T^{mode} + p(T^{mode}) \cdot L,$$

where $mode \in \{air, sea, rail, road\}$.

The rational choice of transport is determined by comparing the values of TC^{mode} across different alternatives. Under conditions of high seasonality and demand uncertainty, companies may prefer more expensive but faster modes of transport if the expected losses from markdowns exceed the savings in transportation costs.

Of particular interest is the threshold condition under which air transport becomes economically justified:

$$C_t^{air} - C_t^{sea} < [p(T^{sea}) - p(T^{air})] \times \\ \times L + h \cdot (T^{sea} - T^{air}).$$

This inequality shows that the additional transportation costs of air delivery are compensated by a reduction in markdown risk and a decrease in inventory holding costs. Thus, in conditions of high time sensi-

tivity of demand and significant markdown losses, the use of air transport becomes a rational decision.

It should be noted that in practice, companies often use combined logistics strategies, integrating different modes of transport. For example, baseline product volumes may be delivered by sea, while urgent shipments or high-margin goods are transported by air. Such an approach allows optimizing total costs while simultaneously reducing risks associated with demand uncertainty.

An additional factor influencing the choice of transport mode is the level of reliability of logistics operations. Under conditions of instability in global supply chains, not only the average delivery time but also its variability becomes important. This can be incorporated by extending the model as follows:

$$TC = C_t + h \cdot T + p(T, \sigma) \cdot L,$$

where σ reflects the variability of delivery time.

An increase in σ raises the probability of untime-ly product arrival, which further stimulates the use of more reliable, albeit more expensive, transport solutions.

Thus, the choice of transport mode in the fashion industry represents a multi-criteria problem that takes into account not only direct transportation costs but also a wide range of indirect economic effects. Logistics decisions have a direct impact on the financial performance of companies, determining the level of costs, revenues, and profitability.

Next, we consider the impact of logistics shocks on the functioning of supply chains and the economic performance of the fashion industry – namely, on prices, assortment, and shortages.

In recent years, global supply chains have been exposed to a series of large-scale logistics shocks, including the consequences of the COVID-19 pandemic, the blockage of the Suez Canal during the incident involving the container vessel Ever Given, and the increasing frequency of geopolitical conflicts and wars that have reduced the number of established transport corridors. This has led to a sharp increase in transportation costs, longer delivery times, and greater uncertainty, which has significantly transformed firm behavior and market outcomes.

From an economic perspective, a logistics shock can be defined as an exogenous change in the parameters of the transport system, leading to a shift in the cost function:

$$C_t = C_t^0 + \Delta C_t \text{ and } T = T^0 + \Delta T,$$

where ΔC_t and ΔT reflect shock-induced changes in transportation costs and delivery time, respectively.

To assess the impact of logistics shocks on firms' economic performance and market outcomes, the

quasi-experimental difference-in-differences (DiD) method is commonly applied. In the context of the fashion industry, this approach allows comparison of changes in economic indicators before and after the shock across different groups of goods or firms.

The baseline model can be represented as follows:

$$Y_{it} = \alpha + \beta \cdot Shock_t + \gamma \cdot Exposure_i + \delta \cdot (Shock_t \cdot Exposure_i) + \varepsilon_{it},$$

where Y_{it} is the variable of interest (e. g., prices, inventory levels, share of markdowns, etc.); $Shock_t$ is an indicator of the post-shock period; $Exposure_i$ reflects the degree of dependence on global supply chains; δ is the key coefficient capturing the effect of the shock.

The parameter δ is interpreted as the additional change in the indicator for units more exposed to the shock.

An increase in transportation costs directly leads to higher retail prices; however, the degree of cost pass-through depends on market structure and demand elasticity.

In the fashion industry, the following effects are observed: partial (or full) pass-through of costs to consumers (price increases); reduction in firms' margins under conditions of high competition; differentiated effects across market segments (mass market vs. premium).

Empirical studies [9] show that during periods of logistics crises, price increases for clothing can be significant, especially for import-dependent product categories.

Logistics shocks lead to changes in the assortment structure: the assortment is reduced, with firms decreasing the number of SKUs to lower risks; the assortment shifts toward more "safe" products, meaning a focus on basic models with stable demand; the share of local production increases as a response to the instability of global supply chains.

From the perspective of the considered model, this corresponds to the optimization behavior of firms under increasing uncertainty (σ):

$$\max_{\text{assortment}} E(\Pi) - \beta \cdot \sigma,$$

where Π denotes profit and β reflects the degree of risk aversion.

One of the most notable consequences of logistics shocks is the increase in product shortages. That is, an increase in delivery time and its variability leads to a disruption in the synchronization between supply and demand. This can be formalized through the probability of stockout:

$$P(\text{stockout}) = f(D, T, \sigma),$$

where D is demand; T is the average delivery time; σ is the variability of supply.

An increase in T and σ leads to a higher probability of stockouts, which, in turn, reduces revenue and worsens consumer experience. For example, during the COVID-19 pandemic, many companies simultaneously faced excess inventory in some product categories (due to a decline in demand) and shortages in others (due to supply disruptions), which further amplified the scale of markdowns and losses [10].

Under the influence of logistics shocks, fashion industry firms are forced to adapt their strategies: diversify suppliers and transport routes, increase safety stock levels, shift toward hybrid logistics models (sea + air), and invest in digitalization and demand forecasting. Companies increasingly aim to minimize not only costs but also potential losses under adverse scenarios.

Summarizing the intermediate results, it can be stated that logistics shocks have a significant impact on the fashion industry, affecting prices, assortment, and product availability. The negative effects of logistics shocks extend beyond short-term disruptions and lead to structural changes in supply chains and retail strategies. The use of quasi-experimental methods such as difference-in-differences makes it possible to quantitatively assess these effects and identify causal relationships between logistics changes and economic outcomes.

It should be noted that under conditions of high demand uncertainty, significant transportation costs, and the critical role of time, the problem of supply chain management in the fashion industry can be formalized as a profit maximization problem taking into account logistics parameters.

Let us consider a basic profit maximization model. Typically, a firm chooses the mode of transport ($mode \in \{\text{air, sea, rail, road}\}$), shipment volume Q , and the level of safety stock S . Then its objective function can be written as:

$$\max_{(Q, mode)} \Pi = R(Q, T) - C_p(Q) - C_t^{mode}(Q) - C_h(Q, T) - C_m(Q, T),$$

where $R(Q, T)$ – revenue depending on sales volume and delivery time; $C_p(Q)$ – production costs; $C_t^{mode}(Q)$ – transportation costs; $C_h(Q, T)$ – holding costs; $C_m(Q, T)$ – markdown losses.

The revenue function, taking into account the time factor, can be represented as follows. Unlike standard models, in the fashion industry revenue depends on the time of market entry, which can be described by the formula:

$$R(Q, T) = P(T) \cdot \min(Q, D),$$

where D – stochastic demand; $P(T)$ – price function decreasing over time.

The economic meaning of this expression is that the later the product enters the market, the lower the selling price due to loss of relevance (markdown effect).

Markdown losses can also be modeled. Thus, losses from markdowns can be formalized as the difference between the full and discounted price:

$$C_m = [P_0 - P(T)] \cdot Q_{unsold},$$

where P_0 – base price; $Q_{unsold} = \max(0, Q - D)$.

From this, it follows that the risk of overproduction and delivery delays directly translates into financial losses.

Next, let us model demand uncertainty. Demand in the fashion industry is stochastic in nature and can be described as:

$$D \sim F(\mu, \sigma),$$

where μ – expected demand; σ – its variability.

Thus, the firm's problem becomes the maximization of expected profit $\max E[\Pi]$, which transforms the problem into the domain of stochastic optimization.

Taking into account the firm's risk aversion, the objective function can be modified as:

$$\max E[\Pi] - \lambda \cdot \text{Var}(\Pi),$$

where λ is the coefficient of risk aversion.

This represents an extended model incorporating risk, meaning that the firm balances profit maximization with the reduction of profit volatility.

From this arises the problem of optimal transport mode selection. The choice of transport is made by comparing expected profits for each available mode:

$$mode^* = \arg \max_{mode} E[\Pi(mode)].$$

At the same time: air transport reduces T and lowers C_m , but increases C_p ; sea transport has the opposite effect; rail and road transport represent intermediate options.

The decision in favor of faster transport is made if:

$$\Delta C_t < \Delta C_m + \Delta C_h + \Delta R,$$

where ΔC_t – additional transportation costs; ΔC_m – reduction in markdown losses; ΔC_h – savings in holding costs; ΔR – increase in revenue due to timely sales.

This is a key result of the study: transport is not merely a cost component, but a tool for managing revenue and risk.

The solution to the problem demonstrates that under uncertainty, a mixed strategy is often optimal:

$$Q = Q^{sea} + Q^{air},$$

where Q^{sea} – base volume (low cost); Q^{air} – adjustment volume (fast delivery).

Such a strategy reduces the risk of stockouts, lowers the probability of excess inventory, and balances costs and flexibility.

Logistical shocks can be incorporated into the model as changes in the parameters T and C :

$$T = T^0 + \varepsilon_T, C_t = C_t^0 + \varepsilon_C,$$

where ε represents random shocks.

This leads to an increase in the optimal Q^{air} , higher safety stock levels, and changes in supply geography.

At this stage, the following interim conclusions can be drawn regarding the model:

1. The optimal choice of transport is determined not only by costs but also by its impact on revenue.
2. The time factor is critical in the fashion industry.
3. Uncertainty increases the importance of logistics flexibility.
4. Hybrid strategies represent a rational response to risks.
5. Logistical shocks lead to structural transformations in supply chains.

CONCLUSIONS

The conducted study made it possible to comprehensively analyze the relationship between logistics decisions and the economic efficiency of supply chains in the fashion industry. Unlike the traditional approach, which considers transport primarily as a source of costs, this paper substantiates that the choice of logistics strategy directly affects revenue formation, profitability, and business sustainability.

A key result of the study is the formalization of time as an economic resource. Under conditions of high seasonality and rapidly changing consumer preferences, the time factor becomes a critical element determining not only cost levels but also a company's ability to sell products at full price. Delivery delays are transformed into revenue losses through markdown mechanisms and stockouts, which fundamentally distinguishes the fashion industry from other sectors.

The developed model demonstrates that the choice of transport mode represents a multi-criteria problem in which companies balance transportation costs, delivery time, risks, and potential revenue. An important conclusion is the existence of threshold conditions under which more expensive but faster transport modes become economically justified due to reduced markdown losses and increased probability of timely product sales.

Special attention is paid to the impact of logistical shocks, which in recent years have unfortunately become a systemic factor in the functioning of global supply chains. It is shown that such shocks lead not

only to short-term disruptions but also to long-term structural changes, including the reconsideration of production geography, supplier diversification, and changes in transport strategies. As a result, the role of resilience is strengthened as one of the key decision-making criteria.

From a practical perspective, the obtained results make it possible to formulate a number of recommendations for companies in the fashion industry:

1. Integration of the time factor into decision-making systems, where companies should account for the impact of delivery time on revenue and markdown probability, rather than limiting analysis to direct transportation costs.

2. Use of hybrid logistics strategies, where combining different modes of transport (for example, sea and air) allows both cost reduction and increased supply chain flexibility.

3. Diversification of suppliers and routes, reducing dependence on specific regions and transport corridors while increasing resilience to logistical shocks.

4. Risk and uncertainty management, where incorporating stochastic parameters into decision-making models, allows for a more accurate consideration of variability in delivery times and demand.

5. Investment in demand forecasting and digitalization, where improved forecast accuracy reduces the likelihood of both excess inventory and stockouts, thereby decreasing markdown losses.

6. Reconsideration of production geography, where nearshoring and reshoring strategies become economically justified despite higher production costs due to reduced delivery time and increased reliability.

Overall, the results of the study highlight the need to move from static cost-optimization models toward more complex, dynamic, and stochastic approaches that account for the interrelationships between logistics, demand, and financial performance.

Directions for further research may include the empirical validation of the proposed models at the micro level (firm-level data), as well as the expansion of the analysis to incorporate environmental factors and sustainable development, which are becoming increasingly important in the modern fashion industry. ■

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THE METHODOLOGICAL SUPPORT FOR ASSESSING THE IMPACT OF INNOVATIVE DEVELOPMENT OF INDUSTRIAL ENTERPRISES ON EXPORT-IMPORT ACTIVITY

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Malyarets L. M., Skliar T. P. The Methodological Support for Assessing the Impact of Innovative Development of Industrial Enterprises on Export-Import Activity

In modern conditions, the development of all types of activities of industrial enterprises is transformed due to innovative development. This impact is especially significant on the export-import activity of enterprises. The aim of the article is to substantiate the information and analytical support for assessing the impact of innovative development of industrial enterprises on export-import activity on the basis of specifying the type of impact, main components and directions of innovative development of export-import activity of industrial enterprises in Ukraine. Theoretical significance is given to the substantiated main components of the impact of the innovative development of industrial enterprises on their export and import activities separately, as well as the main directions of innovative development of export-import activities of industrial enterprises in Ukraine. Practical significance is given to the recommendations on the system of indicators that characterize the transition from the raw material model to the export of products with high added value at the macro level and the system of indicators that characterize the impact of the innovative development of industrial enterprises on export-import activities. It is found that the lagging effect of the innovative development of industrial enterprises on export-import activity and the assessment of its lag are of significant practical importance. The article proposes dynamic econometric models with a distributed lag to determine this lagging effect of two types: in the form of a multifactor model with lag variables and a pair nonlinear model with lag variables. The definition of lag is of particular importance in the formation of management decisions. The main stages of the methodological approach to assessing the innovative development of export-import activity of large State-owned industrial enterprises, which ensure economic stability in conditions of limited activity, are proposed.

Keywords: assessment; innovative development; export-import activity; indicator system; lagging effect; dynamic econometric models with distributed lag; methodological approach.

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