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GLOBAL SOURCING AND TRANSPORT STRATEGIES OF FASHION COMPANIES: AN ECONOMIC MODEL FOR SUPPLIER SELECTION UNDER TIME CONSTRAINTS

ГЛОБАЛЬНИЙ СОРСИНГ ТА ТРАНСПОРТНА СТРАТЕГІЯ FASHION-КОМПАНІЙ: ЕКОНОМІЧНА МОДЕЛЬ ВИБОРУ ПОСТАВОК В УМОВАХ ДЕФІЦИТУ ЧАСУ

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This paper examines the relationship between global sourcing strategies and transportation choices in the fashion industry under conditions of time scarcity. It is demonstrated that delivery time significantly influences firms' economic performance due to its impact on product pricing and revenue generation. An economic-mathematical model is proposed that integrates sourcing geography, transportation mode, production costs, logistics costs, inventory holding costs, and markdown losses. The results reveal a trade-off between cost minimization and time responsiveness. Offshore sourcing reduces production costs but increases delivery time and revenue risks, whereas nearshoring improves responsiveness at higher production costs. The study shows that transportation choices act as a flexible adjustment mechanism under time pressure. Scenario analysis identifies threshold conditions under which firms switch transportation modes and sourcing strategies. The findings emphasize the importance of flexible and integrated supply chain management in time-sensitive industries.

Keywords: global sourcing, fashion industry, transport strategies, economic efficiency, time-sensitive demand, hybrid logistics solutions.

У статті розглядається економічний зв'язок між глобальними стратегіями постачання та вибором транспорту в сфері індустрії моди в умовах дефіциту часу. На відміну від традиційних підходів, які в першу чергу зосереджені на мінімізації витрат, дослідження демонструє, що час доставки відіграє вирішальну роль у формуванні рішень через його прямий вплив на отримання доходу. У fashion-індустрії, де життєві цикли продукції короткі, а попит дуже чутливий до плину часу, затримки в доставці призводять до зниження цін та збільшення втрат від уцінки, що суттєво впливає на фінансові показники. Розроблено економіко-математичну модель, в якій компанії одночасно обирають географію постачання та спосіб транспортування. Модель враховує виробничі та транспортні витрати, витрати на зберігання та втрати від уцінки, одночасно чітко враховуючи вплив часу доставки на ціноутворення. Попит моделюється як стохастична змінна, що дозволяє аналізу враховувати невизначеність та її наслідки для рішень щодо ланцюжка поставок. Результати дослідження показують, що компанії стикаються з компромісом між ефективністю витрат та оперативністю реагування на попит. Офшорні

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постачання забезпечують нижчі виробничі витрати, але пов'язані з довшим терміном доставки та вищими ризиками втрати доходу. На противагу, ніаршоринг забезпечує швидшу доставку, але передбачає вищі виробничі витрати. Вибір транспорту слугує проміжним механізмом коригування, що дозволяє компаніям реагувати на тиск часу, не реструктуризуючи негайно свої стратегії постачання. Проведений аналіз визначає порогові умови, за яких компанії переходять від морського до повітряного транспорту, а згодом від офшорного до ніаршорного постачання. Показано, що ці переходи є нелінійними та дискретними, що вказує на те, що навіть невеликі зміни чутливості до часу можуть спричинити значні зміни в конфігурації ланцюжка поставок. Результати також підкреслюють важливість гібридних логістичних стратегій, які поєднують різні варіанти постачання та транспортування для балансування вартості, швидкості та ризиків.

Надана загальна інтегрована основа для аналізу рішень щодо постачання та транспортування в галузях, чутливих до часу. Результати мають важливі управлінські наслідки, підкреслюють необхідність розглядати час як ключову економічну змінну, коли застосування гнучких мультимодальних стратегій ланцюжка поставок слугують для підтримки конкурентоспроможності в умовах зростаючої волатильності ринку.

Ключові слова: глобальний сорсинг, fashion-індустрія, транспортні стратегії, економічна ефективність, тимчасова чутливість попиту, гібридні логістичні рішення.

Statement of the problem. In the context of globalization, the fashion industry has developed complex international supply chains based on the fragmentation of production processes across countries with different cost structures. Global sourcing has become a key instrument for enhancing firms' competitiveness, enabling the reduction of production costs through the allocation of orders to regions with lower labor costs and large-scale manufacturing capacity. However, this model is associated with longer supply chains, increased transportation risks, and a higher dependence on delivery time.

A distinctive feature of the fashion industry is the high sensitivity of demand to time-to-market. The short life cycle of collections, strong seasonality of sales, and rapidly changing consumer preferences imply that delivery delays are directly translated into revenue losses, increased markdowns, and product shortages. Under these conditions, the choice of supplier geography and transportation mode becomes not only a logistical issue but also a strategic economic decision.

Modern companies are forced to balance between two opposing strategies: offshore sourcing, which ensures low production costs but involves long delivery times, and nearshoring, which reduces transport distance and lead time but is associated with higher production costs. Additional complexity arises from the choice of transport strategy: air freight significantly reduces delivery time but increases transportation costs, while sea and rail transport are more cost-efficient but slower.

In the presence of time constraints, a fundamental economic trade-off emerges between production costs, transportation costs, delivery speed, and product availability in the market. This trade-off requires formalization in the form of a model that allows for the quantitative determination of the optimal combination of sourcing decisions and transportation strategies.

Analysis of recent research and publications. The issues of global sourcing and supply chain optimization occupy a central place in modern economic literature, particularly in industries characterized by high time sensitivity, such as the fashion industry. The theoretical foundations of the global fragmentation of production were established in studies on the international disaggregation of value chains, demonstrating that the choice of supplier geography is determined by the trade-off between country-specific production advantages and coordination (transaction) costs [1–3].

One of the key research directions focuses on the trade-off between low production costs and the time-related risks inherent in long supply chains. Christopher and Peck argue that increasing the length of global supply chains raises business vulnerability to logistical disruptions and reduces firms' resilience in the presence of external shocks [4]. Subsequently, Gereffi and Fernandez-Stark showed that global value chains in the fashion industry are particularly exposed to risks of time delays due to high demand seasonality and short product life cycles [5]. The choice between offshoring, nearshoring, and reshoring has been intensively studied in recent years in the context of changes in the global logistics architecture. Antràs and Chor demonstrate that sourcing geography is determined not only by labor cost differentials but also by the speed of response to market demand, especially in fast fashion sectors [6]. Empirical studies (e.g., Gray et al.) indicate that reducing the distance to suppliers significantly shortens lead times, decreases supply uncertainty, and increases inventory management flexibility [7]. A substantial contribution to the development of economic models of transportation choice has been made by Hummels and Schaur, who demonstrated that delivery time has an independent economic value and directly affects market prices [8]. Their findings show that firms are willing to pay a premium for faster delivery when the benefits of timely market entry exceed additional transportation costs. This insight is particularly relevant for the fashion industry, where even minor delays may result in a significant loss of product relevance. In sector-specific studies of the fashion industry, considerable attention is given to the relationship between logistics speed and the commercial success of collections. Cachon and Swinney developed models of rapid replenishment in fast fashion, showing that shorter delivery times improve demand responsiveness and reduce markdown losses [9]. Tokatli's research on global retail networks highlights that competitive advantage is largely based on the ability to combine nearshoring production with accelerated transportation logistics [10]. Another important strand of the literature addresses the modeling of transportation choices under demand uncertainty. Simchi-Levi et al. consider transportation as a tool for balancing cost efficiency and responsiveness, emphasizing that the optimal mode of transport depends on demand volatility, stockout costs, and the rate of product obsolescence [11]. This approach is particularly relevant for the fashion industry, where the time value of products fundamentally shapes the economic trade-off between air and sea transportation.

Highlighting previously unresolved parts of the overall problem. Despite the substantial body of research, most existing studies analyze either sourcing geography or transportation decisions in isolation. An integrated approach that simultaneously considers supplier selection, transport mode, and time constraints within a unified economic-mathematical framework-particularly in the context of the fashion industry remains insufficiently explored. This research gap defines the relevance and scientific novelty of the present study.

Formation of the objectives of the article. The aim of this paper is to develop an economic-mathematical model of sourcing decisions in the fashion industry, taking into account the interdependence between global sourcing, transportation mode, time constraints, and market outcomes.

To achieve this objective, the following tasks are addressed:

– formalization of the relationship between sourcing geography and delivery time;

– development of a model for selecting suppliers and transportation modes;

– analysis of the trade-off between costs and delivery speed;

– assessment of the impact of time constraints on prices and product availability;

– formulation of practical recommendations for fashion companies in the field of global sourcing.

Summary of the main research material. Under conditions of global sourcing, fashion companies make strategic decisions simultaneously along two interrelated dimensions: the choice of supplier geography and the choice of transportation mode [6–8]. The economic nature of this problem lies in minimizing total costs while maintaining the ability to bring products to market in a timely manner. Under time constraints, this decision becomes a multicriteria optimization problem, where cost savings from remote sourcing may be offset by higher transportation costs and an increased risk of revenue loss due to delivery delays [8,10].

Let us consider the basic structure of an economic model for sourcing decisions under time constraints. Specifically, we analyze a fashion company that chooses the sourcing location ($s \in \{nearshore, offshor\}$), the transportation mode $m \in \{air, sea, rail, road\}$, and the shipment volume Q. The firm's objective is to maximize expected profit: $\max_{Q,s,m} E[\Pi]$.

The profit function is defined as:

$$\Pi = R(Q, T_{sm}) - C_p^s(Q) - C_t^{sm}(Q) - \\ - C_h(Q, T_{sm}) - C_m(Q, T_{sm}),$$

where: $R(Q, T_{sm})$ is revenue depending on sales volume and delivery time; $C_p^s(Q)$ denotes production costs depending on the sourcing region; $C_t^{sm}(Q)$ represents transportation costs; $C_h(Q, T_{sm})$ are inventory holding costs; and $C_m(Q, T_{sm})$ captures markdown losses.

In the fashion industry, delivery time becomes a critical parameter [8; 12], as the market price of a product decreases with delays in the collection's market entry [10]. Thus, time is treated as an economic variable.

The firm's revenue function, depending on time T and sales volume Q, is given by:

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

where D is stochastic demand and $P(T)$ is the time-dependent price function decreasing over time.

For simplicity, assume a linear decline in price over time:

$$P(T) = P_0 - \beta T,$$

where P_0 is the initial price of the collection and β is the rate of time-based value depreciation. The higher the value of β, the more sensitive the market is to delays.

It is well established that offshore sourcing provides lower production costs [7], which can be expressed as:

$$C_p^{offshore} < C_p^{nearshore}.$$

However, this is accompanied by:

$$T_{offshore} > T_{nearshore},$$

and typically:

$$C_t^{offshore,air} > C_t^{nearshore,road}.$$

Therefore, cost savings in production may be offset by longer logistics cycles, and products arriving after peak demand periods are often sold at discounted prices. This can be formalized as:

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

where:

$$Q_{unsold} = \max(0, Q - D).$$

This reflects a key characteristic of the fashion sector: delivery delays do not merely increase costs but directly reduce the market value of the product [8]. Consequently, transportation choice in the fashion industry is fundamentally a trade-off between delivery speed T and total cost C [5].

The considered transportation modes are characterized by the following relationships $T^{air} < T^{rail} < T^{road} < T^{sea}$, and simultaneously $C_t^{air} > C_t^{rail} > C_t^{road} > C_t^{sea}$. Thus, the firm faces a classical trade-off problem: faster transport reduces markdown losses, while slower transport minimizes direct logistics costs. Accordingly, the optimal transport mode is selected based on the rule $m^* = \arg\max_m E\left[\Pi(m)\right]$.

Let us now consider the conditions for choosing between offshore and nearshore sourcing for a fashion company.

Global sourcing is economically justified if:

$$\left(C_p^{nearshore} - C_p^{offshore}\right) > \left[\Delta C_t + \Delta C_h + \Delta C_m + \Delta R_{loss}\right],$$

where the right-hand side represents the additional costs associated with longer supply chains [1]. This leads to a key condition of the model: if the cost advantage in production is smaller than the losses associated with time, nearshoring becomes the preferable option.

The economic interpretation of the proposed model is as follows. Under time constraints, minimizing production costs ceases to be the sole efficiency criterion. For fashion companies, the economically optimal supplier is not necessarily the cheapest one, but the one that provides the best balance between production costs, delivery speed, transportation expenses, and the risk of losing seasonal revenue.

Thus, global sourcing in the fashion industry can be interpreted as a dynamic optimization problem in which supplier choice and transport decisions must be evaluated jointly. The time factor transforms transportation strategy into a key source of competitive advantage, while sourcing geography becomes not only a production decision but also a logistics-economic one.

To provide a quantitative illustration of the proposed model, let us consider three baseline logistics strategies:

1) Offshore + Sea (S_1) characterized by minimal production and transportation costs and maximum delivery time;

2) Offshore + Air (S_2) characterized by low production costs, high delivery speed, and expensive logistics;

3) Nearshore + Road (S_3) characterized by higher production costs and minimal delivery time.

Next, we compare the proposed strategies in terms of expected profit. For each strategy, expected profit is defined as:

$$E\left[\text{Đ}_j\right] = E\left[R\left(Q,T_j\right)\right] - C_p^j(Q) - \\ - C_t^j(Q) - C_h\left(Q,T_j\right) - C_m\left(Q,T_j\right),$$

where $j \in \{S_1, S_2, S_3\}$.

As an illustrative example, consider two strategies: Offshore + Air versus Offshore + Sea. The difference in expected profit between them is:

$$\Delta\Pi_{A-S} = E\left[\Pi_{air}\right] - E\left[\Pi_{sea}\right]$$

or, decomposed into components:

$$\Delta\Pi_{A-S} = (\Delta R) - (\Delta C_t) - (\Delta C_h) - (\Delta C_m),$$

where: ΔR is the gain in revenue due to faster market entry; ΔC_t represents additional transportation costs of air freight; ΔC_h denotes savings in inventory holding costs; and ΔC_m reflects the reduction in markdown losses.

Air transport is preferred if the additional transportation costs are outweighed by the combined benefits:

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

that is, air freight is economically justified when the gains from speed exceed the associated costs.

Now consider the comparison between Offshore and Nearshore sourcing. The difference in expected profit is:

$$\Delta\Pi_{N-O} = E\left[\Pi_{near}\right] - E\left[\Pi_{offshore}\right].$$

Decomposing into components yields:

$$\Delta\Pi_{N-O} = -\left(\Delta C_p\right) - \left(\Delta C_t\right) - \left(\Delta C_h\right) + \left(\Delta R\right) + \left(\Delta C_m\right),$$

where: ΔC_p is the increase in production costs under nearshoring, while ΔR and ΔC_m represent gains from reduced delivery time.

The condition for switching to nearshoring is therefore:

$$\Delta R + \Delta C_m > \Delta C_p + \Delta C_t + \Delta C_h.$$

Thus, the transition to a nearshoring strategy becomes economically justified when the benefits of reduced delivery time – expressed through increased revenue and lower markdown losses – exceed the additional costs associated with higher production costs and potentially higher transportation and inventory expenses. In other words, when demand is highly time-sensitive and delays generate substantial losses, firms tend to shift from lower-cost offshore production toward faster and more flexible nearshore solutions.

As noted earlier, time pressure plays a crucial role in the fashion industry. In this context, it is useful to introduce a parameter of time sensitivity θ, which reflects the responsiveness of price to delivery time:

$$\theta = \frac{\partial P(T)}{\partial T}.$$

When θ is low, time is not critical and the optimal strategy is Offshore + Sea; at moderate levels of θ, acceleration becomes economically justified, leading to the choice of Offshore + Air; at high values of θ, speed becomes critical, and firms switch to Nearshore + Road.

There are two key threshold values of the parameter θ: θ_1, corresponding to the transition from sea to air transport, and θ_2, corresponding to the shift from offshore to nearshore sourcing, with $\theta_1 < \theta_2$. This implies that firms first adjust transportation modes and only subsequently reconsider sourcing geography.

From an economic perspective, the scenario analysis leads to several important conclusions:

1) Transportation is a more flexible adjustment mechanism than sourcing decisions.

2) Air freight acts as a "buffer," allowing firms to preserve offshore production models.

3) Nearshoring represents an extreme measure applied under high time pressure.

4) The key driver of decisions is the time value of the product, rather than costs alone.

Thus, an important intermediate conclusion can be drawn: sourcing strategy in the fashion industry exhibits a threshold nature and is determined by the level of time pressure. Firms should not immediately switch to costly nearshoring but should first exploit faster transportation options, highlighting the priority of logistical flexibility over structural changes in supply chains.

To illustrate the practical applicability of the proposed model, consider a numerical example with the following parameters: shipment volume $Q = 10{,}000$ units; initial price $P_0 = 100$ (monetary units); time depreciation coefficient $\beta = 0.02$; delivery time for Offshore + Sea $T_S = 40$ days, Offshore + Air $T_A = 10$ days, and Nearshore + Road $T_N = 5$ days.

Then, the corresponding prices are:

$$P\left(T_S\right) = 100 - 0.02 \cdot 40 = 99.2,$$

$$P\left(T_A\right) = 100 - 0.02 \cdot 10 = 99.8,$$

$$P\left(T_N\right) = 100 - 0.02 \cdot 5 = 99.9.$$

The resulting revenues are:

$$R_S = 992{,}000 \; R_A = 998{,}000 \; R_N = 999{,}000.$$

Given the cost structure:

production:

$C_p^{offshore} = 500{,}000$, $C_p^{nearshore} = 650{,}000$;

transportation: $C_t^{sea} = 50{,}000$, $C_t^{air} = 200{,}000$, $C_t^{road} = 80{,}000$;

inventory holding: $C_h^S = 40{,}000$, $C_h^A = 10{,}000$, $C_h^N = 5{,}000$;

markdown losses: $C_m^S = 60{,}000$, $C_m^A = 20{,}000$, $C_m^N = 10{,}000$.

The resulting profits are:

$$\text{Sea}\left(S_1\right): \Pi_S = 992{,}000 - 500{,}000 - \\ -50{,}000 - 40{,}000 - 60{,}000 = 342{,}000,$$

$$\text{Air}\left(S_2\right): \; \Pi_A = 998{,}000 - 500{,}000 - \\ -200{,}000 - 10{,}000 - 20{,}000 = 268{,}000,$$

Nearshore (S_3):

$$\Pi_N = 999{,}000 - 650{,}000 - 80{,}000 - \\ -5{,}000 - 10{,}000 = \quad = 254{,}000.$$

The numerical illustration leads to the following conclusions:

1) At low time sensitivity, the Sea option is preferred.

2) Despite higher revenue, Air transport does not compensate for its higher transportation costs.

3) Nearshore is the most expensive option and is used only under strong time pressure.

The example confirms the theoretical result: firms adjust transportation first, and only then reconsider sourcing geography.

Figure 1 presents a graphical interpretation of transport and sourcing choice versus time sensitivity (θ vs. strategy).

To interpret the graph, note that the X-axis represents time sensitivity θ, while the Y-axis reflects logistics strategies: 0 – Offshore + Sea; 1 – Offshore + Air; 2 – Nearshore.

The economic interpretation is as follows: at low θ, firms choose slow but cost-efficient delivery; at moderate θ, air transport is preferred as the fastest (though more expensive) option; at high θ, a transition to nearshoring becomes necessary. The key insight from the graph is that these transitions are not gradual but discrete, indicating structural shifts in logistics decisions. This constitutes a central theoretical result of the proposed model under time constraints.

Conclusions. The analysis allows us to formulate several key findings.

First, the choice of global sourcing strategy in the fashion industry is determined not only by differences in production costs but also by the time sensitivity of demand. The time factor directly affects revenue, transforming transportation from a supporting function into a key driver of profitability.

Second, firms' adaptation to time pressure occurs in stages. Initially, companies adjust their transportation strategy, shifting from sea to air freight. Only with further increases in time pressure do they undertake structural changes toward nearshoring.

Third, the choice of strategy exhibits a threshold nature. There exist critical values of time sensitivity at which discrete changes in logistics decisions occur.

Fourth, hybrid strategies can smooth these transitions by balancing costs, speed, and risks.

The results have important practical and regulatory implications:

1. Transport infrastructure development. Accelerating sea and rail logistics can significantly reduce dependence on air transport without increasing costs.
2. Nearshoring incentives. Government support for local production (e.g., subsidies, tax incentives) is justified in industries with high time sensitivity.
3. Supply chain digitalization. Improved demand forecasting reduces the importance of time constraints and lowers reliance on expensive transport options.
4. Reduction of logistics uncertainty. The stability of delivery times may be more important than their average level, requiring investment in supply chain reliability.
5. Integrated logistics management. Firms should treat transportation, sourcing, and inventory management as a unified decision-making system.

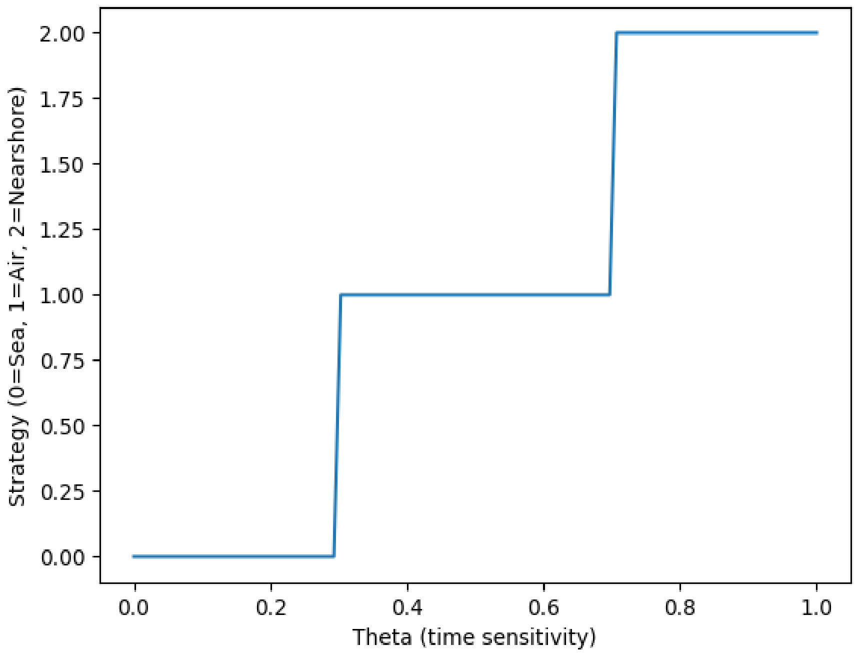

Figure 1. Graphical interpretation of transport and sourcing choice versus time sensitivity

Source: compiled by the author

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