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Multi-Factor Cost Adjustment for Enhanced Export-Oriented Production Capacity in Manufacturing Firms

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Abstract: Many manufacturing firms face considerable difficulties in building export capacity and selling their products in international markets. These firms often struggle with unpredictable cost changes, logistical problems along the supply chain, and rising labor expenses that could threaten the competitive edge of manufacturing operations. As there is also a clear absence of practical export models tailored to the unique needs of industrial firms, our study aims to offer a more holistic approach to assessing the impact of cost components on enhancing export-oriented production capacity (*EOPC*), a perspective not comprehensively provided by the comparative advantage theory, the Heckscher–Ohlin model, or the resource-based theory. While offering a comprehensive analysis of cost components in production, we argue that adjusting the resources, managing the costs, and enhancing production efficiency can significantly improve the *EOPC* of the manufacturing firms. Using primary data collected from 200 manufacturing firms in Oman during the period 2012–2016, multiple regression analysis followed by descriptive statistical analysis together with a correlation matrix indicates strong positive relationships between the *EOPC* and factors such as the raw material cost (*RMC*), labor wages (*LW*), labor force (*LF*), and R&D costs (*RND*). Multicollinearity assessment shows VIF values below the threshold, suggesting reliable estimates. Interaction terms and market conditions were integrated into the model, enhancing its predictive accuracy. Preliminary multiple regression analysis confirms the significant impact of the *RMC*, *LW*, *LF*, and R&D on the *EOPC*, while highlighting the importance of market conditions in moderating these effects. The model's adjusted R^2 value indicates a strong fit, showing that the independent variables account for a substantial proportion of the variance in the *EOPC*. Each variable's importance is reflected in its coefficient, while p-values assess the statistical significance, highlighting which factors are crucial for enhancing export capabilities. Specifically, low p-values for cost components, labor force size, and wages confirm their significant influence, and varying market conditions further modulate these effects, demonstrating the accurate interplay between internal and external factors. Adjustments in cost components under varying market scenarios were analyzed, indicating optimal strategies for increasing the *EOPC*. Of the five scenarios proposed to distribute the cost either among some variables while keeping others constant or among all the factors, the best-case scenario adjusted all variables together, resulting in a 20% increment in exports. We conclude with some practical and policy implications for governments to support industries in accessing cheap resources through tax reductions on imported raw materials and efficient supply chains, while promoting innovation, technology adoption, and R&D investment at the firm level.

Keywords: export-oriented production capacity; cost adjustment; production factors; pricing; manufacturing

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1. Introduction

Export capacity (EC) is a holistic measure of a firm's ability to produce and sell products or services in international markets. It involves various components, such as production efficiency, logistical management, and market reach (Hoque et al. 2022). The EC reflects a firm's overall potential to engage in export activities, driven by its capability to manage production costs, ensure timely delivery, and cater to diverse international customer requirements. It is an essential indicator of a firm's global competitiveness and its ability to sustain and grow its presence in foreign markets.

On the other hand, export-oriented production capacity (*EOPC*) is a more focused concept within the broader EC framework. The *EOPC* emphasizes the adjustment of production processes specifically for the export market. This includes implementing efficient production techniques, adopting cost-saving measures, and leveraging advanced technologies to enhance product quality and reduce production costs (Ma and Ahn 2021). The *EOPC* is crucial for firms aiming to improve their export performance, as it directly impacts on their ability to offer competitively priced, high-quality products that meet international standards.

The relationship between the EC and *EOPC* is synergistic. While the EC represents the overall export potential of a firm, the *EOPC* provides the necessary foundation by ensuring that production processes are aligned with the demands of international markets. By improving the *EOPC*, firms can significantly enhance their EC, leading to increased export volumes, competitive pricing, and greater market reach. This interconnectedness underscores the importance of focusing on the *EOPC* to build a robust and sustainable export strategy.

Several studies argue that adjusting the production processes is fundamental to improving firm competitiveness and building export capacity (Ortigueira-Sánchez et al. 2022; Hossain et al. 2022; Aghazadeh et al. 2022). Firms can substantially enhance efficiency and scale up their output through adjustments and the refinement of operation. This approach not only drives down the cost per unit but also fosters competitiveness in the global marketplace by ensuring that products meet quality standards while remaining cost-effective (Zahoor and Lew 2023; Zhang and Jedin 2023; Sadeghi et al. 2023). By simplifying production processes and implementing cost-saving measures, firms can effectively lower their production costs while simultaneously strengthening their operational efficiency (Yao et al. 2022; Adegbola et al. 2024; Sarwar et al. 2022). This practice enables firms to offer competitive pricing for their products in international markets, ultimately increasing their attractiveness to potential buyers and improving their export potential. (Matzner et al. 2023; Sudirjo 2023; Babayev and Balajayeva 2023; Fröhlich 2023; Keskin et al. 2021).

From a technical perspective, production efficiency involves developing labor skills and improving production methods to effectively take advantage of numerous opportunities in the global market (Joel et al. 2024; Rivero-Gutiérrez et al. 2024; Feng et al. 2020). It enables firms to expand their scope and thrive by entering international markets. Yet, grabbing these opportunities poses significant challenges, mainly arising from various technical and financial aspects such as efficiently managing production costs. This requires embracing innovative technologies and strategies to overcome these obstacles and achieve sustainable growth in the increasingly competitive global market (Hegab et al. 2023; Allioui and Mourdi 2023; Mansion and Bausch 2020; Naradda Gamage et al. 2020). These cost challenges can be broadly categorized into three main areas: raw materials, labor force size and salaries, and research and development (R&D) (Chandra et al. 2020; Sanyal et al. 2020; Gupta and Chauhan 2021; Naradda Gamage et al. 2020; Kaplinsky and Kraemer-Mbula 2022; Grossman and Oberfield 2022). The cost of raw materials can change a lot because of global market shifts and supply chain problems. Firms that rely on imported materials may see their costs go up significantly, affecting their profits and ability to compete internationally (Swazan and Das 2022; Bhuyan and Oh 2021). For example, the primary reason for the decline in woven exports is the reliance on imported raw materials, which has caused production delays and affected delivery times (Giri and Singh 2022). In contrast, knitwear production uses domestically produced yarn and fabrics, allowing for a faster production process (Chandra and Ferdaus 2020).

Consequently, managing raw material cost is very important to let firms venture into the global markets (Nyu et al. 2022; Lima et al. 2022). In terms of workforce size and salaries, managing labor costs is another critical challenge (Ozkan-Ozen and Kazancoglu 2022; Salimova et al. 2022; Webber 2022). Rising wages, especially in regions with increasing living standards or labor shortages, can add to firms' financial burden. Also, attracting and retaining skilled labor often requires competitive salaries and benefits, which can further elevate costs (Ewers et al. 2022; Castro-Silva and Lima 2023; Oliinyk et al. 2021). For instance, there has been a notable rise in labor expenses throughout China, prompting concerns regarding the potential loss of its manufacturing advantage and its renowned status as the global factory. Huang et al. (2021) argue that increasing labor costs affect China's appeal to multinational corporations and subsequently its competitiveness in global exports. They also find variations in minimum wage distortions across regions, which could act as external factors impacting unskilled-labor expenses. Therefore, labor size and wages are very important to let firms venture into global markets (Amit et al. 2022; Azar et al. 2024; Eeckhout 2022).

With an increasing number of firms exploring global markets, the entry key for their international growth lies in expanding their R&D activities and efficiently distributing R&D expenditures from domestic to international markets (Tung and Hoang 2024; Peters and Roberts 2022; Davcik et al. 2021). Investment in R&D is essential for innovation, enabling firms to maintain a competitive edge in the global market (Peters and Roberts 2022). However, R&D activities require substantial financial resources that come with inherent risks (Edeh et al. 2020; Naradda Gamage et al. 2020). Firms must allocate funds for developing new products, improving existing technologies, and ensuring compliance with international standards (Edeh et al. 2020; Pylaeva et al. 2022). For smaller firms or those with limited budgets, these expenditures can be a significant barrier to entry into export markets. The uncertainty of returns on R&D investments can make it difficult for firms to justify and sustain these costs over time (Sanford and Yang 2022; Naradda Gamage et al. 2020).

The reliance on imported or local costly raw materials can also pose significant challenges for firms attempting to expand globally. These challenges include potential cost increases due to fluctuations in international market prices, delays in production caused by supply chain disruptions, and difficulties in meeting delivery deadlines, which can negatively impact a firm's global competitiveness (Kanike 2023; Swazan and Das 2022). Limited supplier options and short contracts could cause problems for firms, putting them at risk (Bhuyan and Oh 2021). In addition, high labor costs, particularly in regions experiencing increased living standards or labor shortages, pose another significant challenge for firms, as notable surges in labor expenses raise concerns about their manufacturing competitiveness (Oliinyk et al. 2021; Huang et al. 2021).

This introductory brief underscores a significant research gap in the literature and the need for further investigation to help industrial firms facing difficulties in their global expansion. These firms often struggle with unpredictable cost changes, logistical problems along the supply chain, and rising labor expenses that could threaten the competitive edge of manufacturing operations. Also, there is a clear absence of practical export models tailored to the unique needs of industrial firms, making the challenge even more difficult to overcome. Consequently, our investigation is crucial in developing new recommendations and guidelines that enable firms to better manage production costs, navigate trade barriers, and enhance their capacity to succeed in international markets. More specifically, this study examines the impact of production cost components, including raw material costs, labor force size and wages, and R&D spending, on the *EOPC* of firms seeking global expansion. It seeks to improve the understanding of how these cost factors collectively influence firms' production efficiency and export capacity. It is expected to provide new insights for policymakers and industry practitioners to identify appropriate policy measures to support industries in accessing resources and innovative technology at reasonable costs, as well as offering practical guidance for firms in adjusting resource allocation and managing production costs to exploit export opportunities in global markets.

Additionally, this study is particularly relevant to Oman, where industrial diversification and enhancing export capacity are crucial for economic development. The Omani government has been actively promoting policies to boost production efficiency and export capability as part of its economic diversification strategy. By focusing on the specific challenges and opportunities within the Omani context, this study aims to provide actionable insights that can aid local firms in overcoming the barriers to global market entry and enhancing their competitiveness

It is worth noting that this investigation is probably the first to offer a more holistic approach to assessing the impact of cost components on enhancing export capacity, a perspective not comprehensively provided by the comparative advantage theory, the Heckscher–Ohlin model, or the resource-based theory. It provides the first comprehensive and comparative analysis of cost components in production and hence building the export capacity. Additionally, by adjusting resources, managing costs, and enhancing production efficiency, the export capacity can be significantly improved.

2. Literature Review

2.1. Developing Firms' Production Capacity

The literature in production economics identifies several factors to build and develop the export capacity of a firm. Hossain et al. (2022) argue that optimizing cost components is a critical aspect of developing a firm's export capacity. Rezazadeh et al. (2023) find that effective cost management strategies can significantly enhance a firm's competitive edge in international markets. Rognes (2023) stresses that the efficient sourcing of raw materials can lead to substantial cost savings. Firms can achieve this by negotiating better terms with suppliers, opting for bulk purchasing, and identifying alternative sources of raw materials.

Saka and Bolanle (2023) examined the relationship between credit financing by commercial banks and capacity utilization in Nigeria's manufacturing sector. Their findings suggest that while bank financing exerts a positive but insignificant short-term impact, it does not significantly affect long-term capacity utilization. This underscores the complexities in financial dynamics affecting production capacity, particularly in emerging markets like Nigeria.

To build export capacity, adjusting product pricing is mandatory (Dethine et al. 2020; Aharoni 2024). Several steps should be taken into consideration: (1) focusing on strategic raw material selection (Hool et al. 2022); (2) conducting thorough market research to understand consumer preferences and competitor pricing (Shabbir and Wisdom 2020); and (3) identifying key raw materials and evaluating sourcing options, considering factors like cost, quality, and availability in target markets (Teerasoponpong and Sopadang 2022). By aligning raw material costs with market demands, competitive prices can lead to building promising export capacity.

Salimova et al. (2022) and Huang et al. (2021) underscore that the importance of investing in skilled labor is essential for maintaining high productivity and quality standards. However, they stress that optimizing labor costs must involve balancing wage levels with productivity improvements. Phan (2022) adds that increasing skilled-labor numbers and wages for export capacity must be aligned with promoting a positive work environment and career growth opportunities to retain talent. Other scholars highlight the importance of investing in training and development to enhance existing workforce skills and attract new talent. Offering competitive wages and benefits packages attracts skilled workers, particularly when payment packages are aligned with industry standards and local economic conditions. Al-Harthy et al. (2022) stress that firms must continuously monitor labor market trends and adjust recruitment strategies and compensation structures accordingly, ensuring a skilled and motivated workforce capable of driving export success.

Further investigation underlines the significance of R&D in improving product specifications and building a strong production capacity in a competitive market. By investing in R&D, companies can come up with new ideas and improve their products to stay ahead of their competitors. Edeh et al. (2020) and Naradda Gamage et al. (2020) indicate that R&D

is critical in helping firms to understand customers' preferences and in exploiting innovative technology to improve the quality of products in a faster time and with lower costs. This finding reaffirms that R&D helps firms to keep improving, making their production stronger and their products more attractive to customers.

2.2. Building Firms' Export-Oriented Production Capacity

There are several conceptual foundations concerned with cost component optimization in building export capacity. For example, comparative advantage theory argues that firms can internationalize by taking advantage of differences in opportunity costs between countries, which determines their comparative advantage in producing certain goods or services. This concept implies that firms should specialize in producing goods or services where their countries have a comparative advantage, meaning they can produce these goods or services at a lower opportunity cost compared to other countries (Shen et al. 2022). While the theory does not explicitly address cost components, its focus on opportunity costs indirectly touches upon the efficiency and cost-effectiveness of production.

The Heckscher–Ohlin model adds a new dimension to firm internationalization by stressing its capacity to efficiently utilize its local and internal resources. This theory implies how firms can optimize their resource allocation, including skilled labor or natural or raw materials, to facilitate exporting (Matezo and Matondo 2022). By specializing in producing goods that rely on abundant resources in their countries, firms can enhance their competitiveness and export capacity to compete in the global market. Moreover, resource-based theory emphasizes the utilization of a firm's unique resources and abilities to gain a competitive edge. It argues that firms can focus on making the most of their resources to operate more efficiently and lower production costs, indirectly connecting with the ideas of comparative advantage (Siregar et al. 2024). By using resources efficiently, firms can make goods or services more competitively, potentially resulting in better pricing in export markets. These conceptual models and theories underline the importance of efficient resource allocation and utilization to lower production costs and enhance export capacity and competitiveness domestically and internationally.

2.3. Effects of External Economic Factors on Export-Oriented Production Capacity

In addition to internal factors such as production efficiency, external economic factors significantly influence a firm's export capacity. Recent studies have highlighted the impact of economic policy uncertainty, bilateral trade intensity, and capital flows on export dynamics (Liu et al. 2020). Notably, economic policy uncertainty, bilateral trade intensity, and capital flow affected China's financial cycle spillover across varying institutional distances from 1997 to 2017. Liu et al. (2020) reveals a consistent linear effect of these factors on financial cycle spillover across the entire sample period, with non-linear impacts emerging during normal and crisis periods. Specifically, the transition function exhibits a gradual shift under normal economic conditions and a double-threshold effect during crises, suggesting varying facilitating and restraining effects on export capacity across different economic periods. Understanding these dynamics is crucial for policymakers aiming to craft effective macroprudential policies tailored to different economic contexts.

2.4. Effects of Cost Components on Export-Oriented Production Capacity

2.4.1. Impact of Raw Material Cost on Export-Oriented Production Capacity

Empirical studies argue that raw materials such as fabrics, yarns, and other inputs constitute a substantial portion of the production costs in the ready-made garments (RMGs) sector (Swazan and Das 2022). Fluctuations in the prices of these raw materials can directly influence the overall cost structure of garment production. When raw material costs increase, it can squeeze profit margins for manufacturers, making their products less competitive in the global market (Swazan and Das 2022; Bhuyan and Oh 2021). This argument is apparently critical in the impact of raw material costs on the export capacity of the Bangladeshi RMG industry. While Bangladesh has established itself as a leading exporter in the global apparel market, the fluctuating costs of raw materials significantly affect the industry's competitiveness and export potential (Swazan and Das 2022). Efforts to mitigate the impact of raw material costs on export capacity may include strategies such as diversifying sourcing channels, investing in vertical integration to reduce dependency on imported materials, negotiating favorable pricing agreements with suppliers, and implementing efficient inventory management practices. Moreover, advancements in materials science and sustainable sourcing practices can further optimize raw material costs and enhance export capacity (Ninduwezuor-Ehiobu et al. 2023).

Hypothesis 1. *Raw material costs have a positive influence on the export-oriented production capacity. The efficient sourcing of raw materials reduces costs, thus enhancing a firm's competitiveness and export performance by lowering production costs and improving product quality.*

2.4.2. Impact of Skilled-Labor Adjustment on Export-Oriented Production Capacity

It is generally accepted in business and economics that skilled labor improves productivity. Higher productivity can lead to more competitive pricing and better-quality products, making a firm more attractive in international markets (Gallego and Gutiérrez Ramírez 2023). Empirical studies highlight that skilled labor can have a beneficial impact on labor productivity within firms, ultimately contributing to their export capacity. Oliinyk et al. (2021) emphasized that the presence of skilled workers is a fundamental factor influencing a firm's decision to engage in exports, with companies employing a highly skilled workforce being more inclined to enter foreign markets. Through empirical observations, Pholphirul et al. (2020) and Oliinyk et al. (2021) have demonstrated a significant and positive correlation between a skilled workforce and export performance. This reaffirms the early notion that human capital, as indicated by the proficiency of the workforce, plays a crucial role in a nation's development. As for labor wage, China demonstrates an exemplary model, as wages for Chinese factory workers went up by more than five times between 1990 and 2015, which is more than wage increases in nearby countries like Vietnam, Indonesia, India, and the Philippines. As a result, big firms like Nike moved their factories to other places like Vietnam, which has been the top choice for making their products since 2009 (Huang et al. 2021). This shift is also seen in the decrease in foreign-owned companies doing business in China from 58% in 2006 to 44% in 2016. As labor gets more expensive, China's advantage in making labor-intensive things like clothes and furniture gets weaker.

Furthermore, it is crucial to distinguish between skilled labor and generic labor. Oliinyk et al. (2021) and Pholphirul et al. (2020) emphasize that the performance gains associated with a skilled workforce are not merely a function of labor quantity but rather the quality and productivity of the labor employed. This distinction is vital for understanding the true impact of labor composition on export performance.

The relationship between labor force size and labor wages is complex and interdependent. An increase in labor wages can attract a larger workforce, which in turn can enhance productivity and the quality of output. Conversely, a larger labor force size can lead to competitive wage structures, as firms seek to retain skilled labor while maintaining cost efficiency. This interdependency can influence research results, as changes in one variable (e.g., wages) can significantly impact the other (e.g., labor force size), thereby affecting the overall OEPC. This dynamic emphasizes the need for a balanced approach to managing labor costs and adjusting workforce size to achieve sustainable export performance.

Hypothesis 2. *The labor force has a positive influence on the EOPC. A well-trained and -compensated labor force boosts productivity and quality, thereby enhancing a firm's export capacity.*

Hypothesis 3. *Labor wages have a positive influence on the EOPC. Labor wages influence the EOPC. Adequate compensation incentivizes productivity, leading to better product quality and enhanced export performance.*

Hypothesis 4. *The interaction between labor wages and labor force has a positive influence on the EOPC. Labor wages have a positive influence on the EOPC.*

2.4.3. Impact of R&D Spending on Export-Oriented Production Capacity

Empirical research underlines the crucial role that innovation plays in building the *EOPC*, as most firms are increasingly investing in R&D to create new knowledge and innovative technologies that are fundamental to producing new products and better-quality goods at lower costs (Davcik et al. 2021). For firms, investment in R&D is key not only to staying competitive but also to developing a technological edge to make their products sellable and easily exported to the international markets (Davcik et al. 2021). It also complements educational and training programs that contribute to the creation of skilled workers and a well-educated workforce. Innovation, achieved through creating new products and improving existing ones, can help companies move up in the supply chain. A firm's ability to compete technologically depends on its talent for innovation. R&D can also help firms to understand trade patterns and what factors influence export performance and to navigate global markets (Charoenrat and Amornkitvikai 2021). According to Pholphirul et al. (2020), manufacturing firms in the Greater Mekong Subregion countries saw a significant boost in their export performance.

Overall, the above theories emphasize the critical role of optimizing cost in general and refer mainly to raw materials as a main resource for cost optimization in enhancing production and export capacity. On the other hand, the literature argued that effective cost management strategies, including efficient sourcing, strategic raw material selection, and investing in skilled labor, can significantly improve a firm's competitive edge in international markets (Hossain et al. 2022; Rezazadeh et al. 2023). These approaches focus on lower opportunity costs, optimal resource allocation, and the efficient use of unique resources. R&D investments are essential for technological progress and cost reduction, further strengthening export capacity (Davcik et al. 2021). By efficiently managing these cost components, firms can lower production costs, enhance product quality, achieve better pricing, and ultimately boost their export performance.

Despite the theories and the literature emphasizing the importance of optimizing cost components for enhancing production capacity, there is a notable gap in understanding how each individual factor specifically contributes to production adjustment. This lack of detailed understanding obstructs the development of a comprehensive model for improving production capacity. Our study aims to address this gap by focusing on the specific impact of each cost component on the production capacity, specifically the export-oriented production capacity. While our primary focus is on production adjustment for export purposes, we also explore the potential implications these factors might have on export capacity. However, we acknowledge that further research is needed to fully establish the direct link between cost components and export capacity.

Hypothesis 5. *R&D spending has a positive influence on the EOPC. Investment in R&D drives technological progress and cost-effective production, enhancing a firm's competitiveness and export performance.*

Hypothesis 6. *Market condition moderates the relationship between the independent variables (raw material costs, labor force, labor wages, R&D spending) and the EOPC.*

2.5. Hypothesis Development

Ultimately, this study rigorously investigates the impact of key cost components—raw material costs, labor force, labor wages, and R&D spending—on the export-oriented production capacity (*EOPC*). By analyzing empirical data and integrating theoretical frameworks, it is proposed that the efficient sourcing of raw materials positively influences a firm's competitiveness and export performance by reducing production costs and enhancing product quality (Hypothesis 1). Additionally, a well-trained and adequately compensated labor force boosts productivity and quality, thereby improving a firm's export capacity (Hypothesis 2). Adequate compensation further incentivizes productivity, leading to higher product quality and better export performance (Hypothesis 3). This study also examines how the interaction between labor wages and labor force size positively influences the *EOPC*, with labor wages enhancing the effects of a well-trained workforce on export performance (Hypothesis 4). Investment in R&D fosters technological progress and cost-effective production, which enhances a firm's competitiveness and export performance (Hypothesis 5). Furthermore, this study explores how market conditions moderate the relationships between these cost components and export-oriented production capacity, aiming to elucidate how external factors influence these dynamics (Hypothesis 6). These hypotheses, grounded in substantial empirical evidence and theoretical insights, aim to address the existing research gap by offering a comprehensive understanding of how each cost component contributes to adjusting the production capacity and enhancing export performance.

3. Research Methodology

The analysis of the data performed is based on a statistical model using multiple regression analysis (MRA), with the aim of investigating the impact of each input variable on production capacity to build the export capacity. MRA is a fundamental statistical method used to understand and quantify the relationship between many variables. In this approach, one variable, termed the independent variable, is used to predict or explain the variability in another variable, known as the dependent variable. By fitting a straight line to the data points, a simple linear regression enables researchers to explore patterns, identify trends, and make predictions within a straightforward framework. To perform this analysis, we collected a set of relevant data and developed a proposed model that serves our objective.

3.1. Data Collection

The data were collected from the database of the Ministry of Commerce, Industry, and Investment Promotion, Sultanate of Oman, covering the period between 2012 and 2016. These data were collected annually by the ministry from manufacturing firms located in various industrial cities under the management of the Public Establishment for Industrial Estates (Madayn). The extensive database contains key business and economic indicators from various companies over a specified timeframe. This study encompasses a diverse range of Omani manufacturing firms operating in various sectors, including food production, construction materials, plastics, chemicals, and engineering services. These sectors reflect the broad industrial base of Oman's economy. The paid-up capital for these firms shows significant variation, illustrating the diversity in financial resources among the firms. Smaller firms may have capital around OMR 15,000, reflecting lower initial investment requirements, while larger firms exhibit substantial paid-up capital reaching up to OMR 80,000,000. This extensive range in capital not only highlights the varying scales of operation but also provides a comprehensive basis for examining cost adjustment strategies. The diverse specializations and capital sizes allow for a nuanced analysis of how different investment levels and sector-specific needs influence cost management and operational efficiency.

The key relevant variables selected for this study are the raw material cost, labor force, labor wages, and R&D spending. The dependent variable is the export-oriented production capacity (*EOPC*), while the independent variables are the raw material cost, labor force, labor wages, and R&D spending.

The collected dataset underwent a meticulous cleaning process to establish a robust foundation for assessing the relationship between each variable and export-oriented production capacity. This cleaning procedure was essential to ensure the inclusion of only real and logically sound numerical values, thereby enhancing the precision and reliability of the subsequent analysis. The cleaning process followed strict logical criteria to ensure that the data were both realistic and representative of actual industry conditions. Initially comprising 200 entries, the dataset was refined through this process, which aimed to eliminate inconsistencies and outliers, allowing for a more accurate and meaningful exploration of the complex connections between the selected variables and the export-oriented production capacity under investigation. It is important to emphasize that Oman's labor market has been characterized by a significant emphasis on skilled labor, reflecting its investment in human capital development. This focus aligns with the broader GCC labor market trends, where skilled labor plays a crucial role in driving productivity and economic growth.

Table 1 presents a summary of the variables and their measurements, detailing the type, measurement unit, data source, and a description of each variable. The table provides a clear and concise overview of the variables used in this study, facilitating an understanding of how each variable is quantified and the source of the data. This detailed description ensures clarity and comprehensiveness in the data collection and cleaning process, thereby strengthening this study's validity and reliability.

Table 1. Summary of variables and measurements.

Variables	Type	Measurement Unit	Data Source	Description
Raw material cost	Independent	Omani Rial (OMR)	The ministry from manufacturing firms located in various industrial cities under the management of the Public Establishment for Industrial Estates (Madayn)	Cost of raw materials purchased by the firms
Labor force	Independent	Number of workers		Number of employees engaged in production
Labor wages	Independent	OMR per month		Average monthly wage paid to employees
R&D costs	Independent	Omani Rial (OMR)		Expenditure on research and development activities
Export-oriented production capacity	Dependent	Omani Rial (OMR)		Total annual exports

Source: authors' own work.

3.2. Causal Chain Analysis

To establish a clear causal chain, a theoretical framework was developed that outlines the expected relationships between the independent variables (raw material cost, labor force, labor wages, and R&D spending) and the dependent variable (export-oriented production capacity). This framework is built in both the theoretical literature and empirical evidence, forming the basis for our hypotheses.

Raw material cost: The efficient sourcing and cost management of raw materials are critical for reducing production costs. Lower production costs enhance a firm's competitiveness, enabling higher production capacity geared towards export markets.

Labor force: The quantity and quality of labor directly impact a firm's production capacity. A larger, skilled labor force can increase productivity and output, thereby boosting export capacity.

Labor wages: Competitive labor wages are essential for attracting and retaining skilled workers. Fair compensation correlates with higher productivity and quality of output, which are crucial for maintaining and expanding export markets.

R&D spending: Investment in research and development drives innovation and technological advancement. Firms that invest in R&D can develop new products, improve existing ones, and enhance production processes, leading to increased export capacity.

Interaction term (labor force and labor wages): Including the interaction term between the labor force and labor wages allows us to explore how the impact of labor wages on production capacity varies with the size of the labor force. This interaction acknowledges the interdependency between these variables, suggesting that the benefit of higher wages on productivity and export capacity could be more pronounced with a larger labor force.

Moderator (market condition): Market conditions can influence the effectiveness of each independent variable on the export-oriented production capacity. For example, in favorable market conditions, the positive effects of a large labor force, competitive labor wages, and R&D spending might be magnified, leading to greater export capacity. Conversely, in less favorable market conditions, these effects might be diminished.

The market condition (*MC*) impact is analyzed on a scale from 1 to 10, showing its moderating effect on cost adjustments required for export growth. *MC* Scale 1–3 represents unfavorable market conditions, necessitating higher adjustments in variables to achieve the desired export increase. *MC* Scale 4–6 reflects neutral market conditions, where base adjustments are generally sufficient. *MC* Scale 7–10 indicates favorable market conditions, potentially reducing the required adjustments in variables to achieve the desired export increase. This approach demonstrates how varying market conditions influence the effectiveness of cost adjustments in achieving export growth.

3.3. Proposed Conceptual Model of Firms' Export-Oriented Production Capacity

The conceptual model developed for this study investigates the complex relationship between the export-oriented production capacity and key economic factors. The primary independent variable is the export-oriented production capacity. The four identified dependent variables—raw material cost, labor cost, labor force, and R&D spending—have been hypothesized to exercise influences on the export amount, as shown in Figure 1. Raw material cost represents the expenses associated with primary inputs, while labor cost and labor force denote the human capital dimension. Additionally, R&D spending reflects a firm's investment in innovation and technological advancement. To enhance the understanding of these relationships, we introduce an interaction term, labor force × labor wage ($LF \times LW$), to examine how the impact of wages on the production capacity varies with labor force size. Additionally, we include a market condition moderator to assess how varying market conditions affect the relationship between these factors and the export-oriented production capacity. The hypotheses suggest that variations in these factors, including the interaction and moderating effects, directly impact a firm's export performance, explaining the complex interplay between economic inputs and competitiveness. This model seeks to contribute valuable insights into the dynamics shaping exports and economic outcomes.

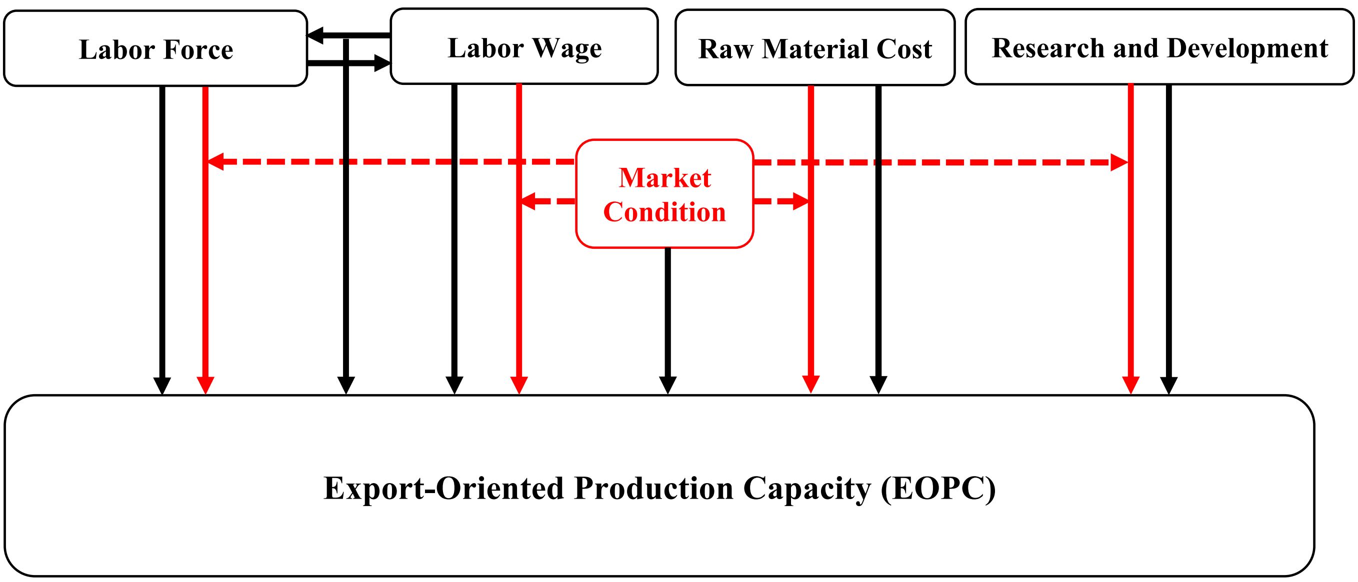

Figure 1. The conceptual model of variables affecting export-oriented production capacity. Source: authors' own work.

The input factors (raw material cost, labor force number, labor wage, and R&D) collectively enhance a firm's export capacity by adjusting production costs, improving product quality, and encouraging innovation. The efficient sourcing of raw materials reduces costs, while a well-trained and -compensated labor force boosts productivity and quality. Investment in R&D drives technological progress and cost-effective production. By managing these inputs effectively, firms can lower production costs, improve competitiveness, and ultimately enhance their export performance.

3.4. Multiple Regression Analysis

MRA is an appropriate method when the research problem includes one unique metric-dependent variable that is related to one metric-independent variable. It helps us to learn about the relationship between several independent or predictor variables and a dependent or criterion variable. The objective of this analysis is to use the independent variables whose value is known to predict the value of the unique dependent variable. A multiple regression model without an intercept was selected for this model. This model is forced through the origin (0,0). The advantage of excluding an intercept is that the theoretical reasons may suggest that the dependent variable should be zero when all independent variables are zero, which is logical for this study. MRA with a constant zero can be generally represented in the following. The employed data are plotted in Figure 2. The regression model can be represented as follows in Equation (1):

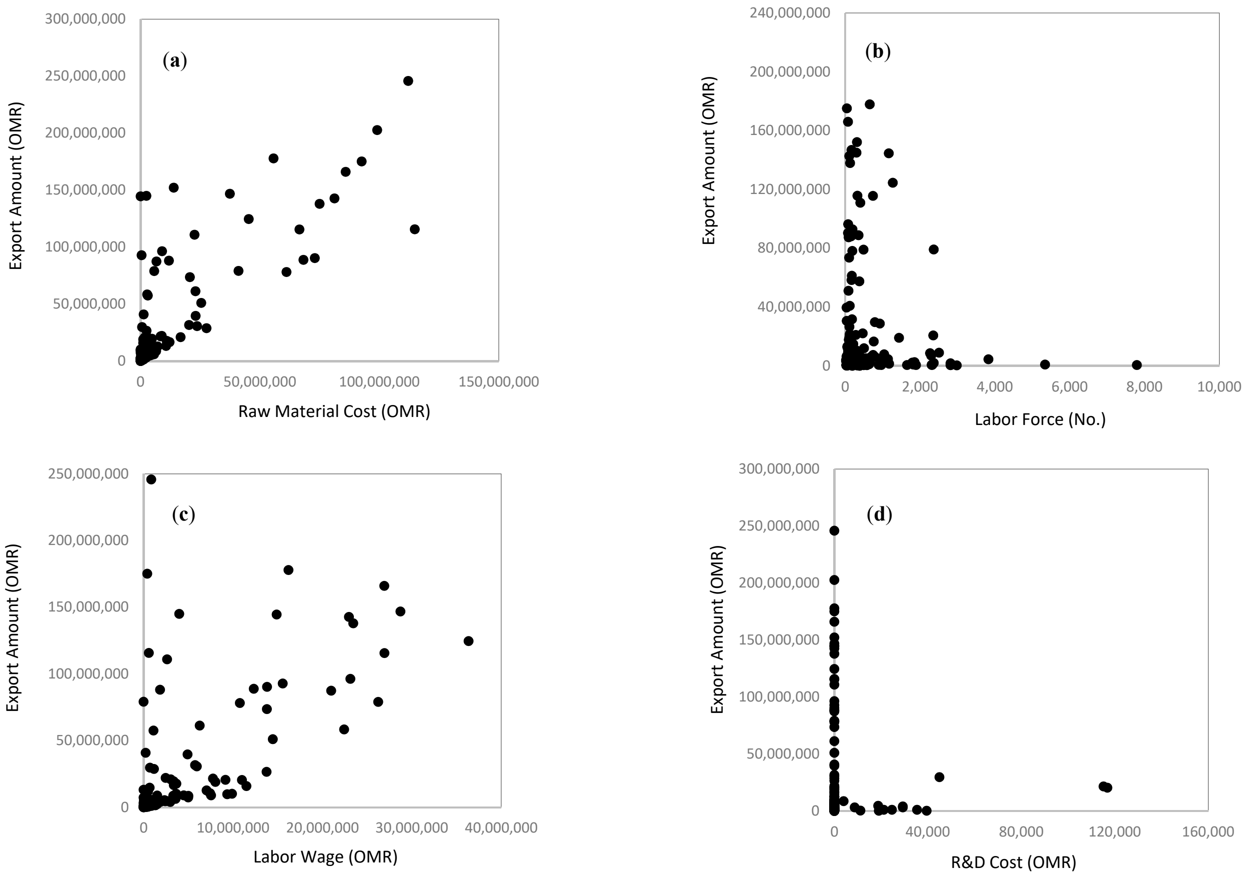

Figure 2. Data distribution for (**a**) raw material cost, (**b**) labor force, (**c**) labor wages, and (**d**) R&D cost.

$$EOPC = \beta_1\ RMC + \beta_2\ LF + \beta_3\ LW + \beta_4\ RND + \beta_5\ (LF \times LW) + \beta_6\ MC \\ + \beta_7\ (MC \times RMC) + \beta_8\ (MC \times LF) + \beta_9\ (MC \times LW) + \beta_{10}\ (MC \times RND) \quad (1)$$

where the following variables are included:

EOPC: export-oriented production capacity (dependent variable);
RMC: raw material cost (independent variable);
LF: labor force (independent variable);
LW: labor wage (independent variable);

RND: research and development costs (independent variable);
MC: market condition (moderator);
LF × LW: interaction term between labor force and labor wage;
β1: RMC coefficient;
β2: LF coefficient;
β3: LW coefficient;
β4: RND coefficient;
β5: LF × LW interaction coefficient;
β6: MC coefficient;
β7: RMC × MC interaction coefficient;
β8: LF × MC interaction coefficient;
β9: LW × MC interaction coefficient;
β10: RND × MC interaction coefficient.

4. Analysis and Results

4.1. The Descriptive Statistics and the Correlation Matrix

A concise summary of the central tendency (mean), variability (standard deviation), and range (minimum and maximum) for the standardized variables, together with the correlation matrix, are presented in Table 2. The export-oriented production capacity (*EOPC*) exhibits substantial variability, with a mean of 0 and a range from −0.52 to 2.52 standard deviations, reflected in a standard deviation of 1.00. The raw material cost (*RMC*) shows a mean of 0, ranging from −0.41 to 2.89 standard deviations, and a standard deviation of 1.00. The labor wage (*LW*) averages 0, with a range from −0.47 to 3.88 standard deviations and a standard deviation of 1.00. The labor force (*LF*), with a mean of 0, spans from -0.16 to 4.75 standard deviations, accompanied by a standard deviation of 1.00. The R&D cost (*RND*), with a mean of 0, varies from −0.18 to 5.29 standard deviations, featuring a standard deviation of 1.00. These statistics provide a comprehensive overview of the central tendencies, variabilities, and ranges of each variable, essential for understanding the economic dynamics and strategic decision-making in the respective sectors.

Table 2. Descriptive statistics of variables and correlation matrix.

Variable	Mean	Std. Deviation	Minimum	Maximum	*EOPC*	*RMC*	*LW*	*LF*	*RND*
EOPC	0	1	−0.52	2.52	1.00				
RMC	0	1	−0.41	2.89	0.82	1.00			
LW	0	1	−0.47	3.88	0.70	0.10	1.00		
LF	0	1	−0.16	4.75	0.62	0.06	0.06	1.00	
RND	0	1	−0.18	5.29	0.73	0.06	0.03	0.03	1.00

The correlation matrix presented in Table 2 illustrates the pairwise correlations between all variables, facilitating an understanding of their relationships and potential multicollinearity issues in the regression analysis. This matrix provides insight into the linear associations among the variables under study. The results indicate a strong positive correlation between the export-oriented production capacity (*EOPC*) and raw material cost (*RMC*) (r = 0.82), labor wages (*LW*s) (r = 0.70), labor force (*LF*) (r = 0.62), and R&D costs (*RND*) (r = 0.73). These high values suggest that increases in the *RMC*, *LW*, *LF*, and *RND* are associated with increases in the EC. Additionally, the correlations among the predictor variables are generally low, with the highest being between *RMC* and *LW* (r = 0.10), indicating minimal multicollinearity concerns. This suggests that while each predictor variable independently correlates with the EC, their interactions do not pose significant multicollinearity risks, thereby ensuring the robustness and reliability of the regression analysis results.

4.2. Evaluation of Multicollinearity and Distribution Characteristics

Multicollinearity was assessed using the Variance Inflation Factor (VIF) for each predictor variable, providing insights into the degree of correlation among them. VIF values are indicators of how much the variance in a regression coefficient is increased due to collinearity among predictors, where a value of 1 indicates no correlation, values between 1 and 5 suggest moderate correlation that is generally not problematic, and values above 10 indicate significant multicollinearity that could inflate standard errors and affect the reliability of model estimates. The VIF values are presented in Table 3. All of them are below the threshold of 10, indicating that multicollinearity is not a concern, and the effects of each predictor can be estimated reliably. Additionally, skewness was analyzed to understand the asymmetry in the distribution of values, with skewness values presented in Table 3. These values indicate that the data are approximately normally distributed, with a slight positive skewness observed, especially in *RND*. Data transformation is not strictly necessary. This comprehensive analysis of VIF and skewness confirms that predictor variables are not highly correlated and exhibit nearly normal distributions, supporting the reliability and validity of the regression model for accurate predictions and interpretations.

Table 3. Output of the VIF and skewness analysis.

Variable	VIF	Skewness
RMC	1.394	0.534
LW	1.392	0.423
LF	1.006	0.125
RND	1.010	0.932

Multicollinearity diagnostics, including Variance Inflation Factors (VIFs) and correlation matrix analysis, revealed low intercorrelation among predictor variables, with the highest correlation being only 0.10 between the raw material cost (*RMC*) and labor wage (*LW*), confirming that multicollinearity is not a concern. This suggests that the predictors do not require standardization to address collinearity issues. Additionally, sensitivity analysis, which assessed the stability of coefficients across different data subsets and model specifications, consistently reinforced the robustness of our findings, indicating that the model's performance is not significantly affected by the scale of the data. The analysis method focuses on variables where the scale does not affect linear regression performance, supporting the use of the original data scale without losing result reliability.

4.3. Inclusion of Moderator on the Variables and Interaction Term

Another moderator was included to refine the predictive model through the raw material cost (*RMC*), labor wage (*LW*), and research and development (*RND*) of the export-oriented production capacity (*EOPC*). Building on theoretical justification, a potential moderator to include, market condition (*MC*), was identified. This moderator was defined with a hypothetical range from 1 to 10. For practical implementation, simulated data for this moderator were generated to reflect realistic variations. Using a normal distribution centered around 5 with a standard deviation of 2, a simulated moderator (starting at 1, capped at 10) was introduced, and interaction terms were calculated to explore their moderator effects. This approach allowed for an enhancement in the model's predictive accuracy and provided deeper insights into the contributions of these factors to the export-oriented production capacity. In addition, including the interaction term between labor wages and labor force captures their interdependent effect on production capacity, revealing how labor wages' impact varies with labor force size. This approach provides more accurate insights for policymakers and economists.

4.4. Preliminary MRA Output Evaluation

The output of the proposed regression analysis is presented in Table 4. The analysis indicates that raw material cost (*RMC*), labor wage (*LW*), labor force (*LF*), and research and development costs (R&D) significantly impact the export-oriented production capacity (*EOPC*). Specifically, *RMC* has a coefficient of 1.074 with a *p*-value of 0.0001, and R&D has a coefficient of 27.4355 with a *p*-value of 0.0042, both showing strong positive effects. *LW* and *LF* also positively influence the *EOPC*, with coefficients of 3.1634 and 0.82 and *p*-values of 0.0029 and 0.0149, respectively. The interaction term between *LW* and *LF*, with a coefficient of 0.0002 and a *p*-value of 0.6023, is not significant, indicating that labor wages do not significantly interact with the size of the labor force in affecting the export capacity. Market condition (*MC*) alone does not have a significant effect on the *EOPC* (coefficient = 432,703.942, *p*-value = 0.2599). However, the interactions between *MC* and *RMC* (coefficient = 0.0967, *p*-value = 0.0387) and *MC* and *LW* (coefficient = 0.2332, *p*-value = 0.0018) are significant, suggesting that favorable market conditions enhance the effects of raw material costs and labor wages on the export capacity. Terms such as $LW \times LF$, $MC \times LF$, and $MC \times$ R&D are not significant and should be excluded to simplify the model, focusing on the significant variables and their relevant interactions.

Table 4. The output of the proposed regression analysis.

Variable	Coefficient	Standard Error	t-Statistic	*p*-Value
RMC	1.074	0.0989	2.4882	0.0001
LW	3.1634	1.0486	3.0169	0.0029
LF	0.82	2.1233	1.6975	0.0149
R&D	27.4355	4.7594	9.0450	0.0042
$LW \times LF$	0.0002	0.0004	0.5221	0.6023
MC	432,703.942	382,752.5228	1.1305	0.2599
$MC \times RMC$	0.0967	0.0464	2.0839	0.0387
$MC \times LW$	0.2332	0.1718	1.3576	0.0018
$MC \times LF$	5.9791	1771.0384	0.6979	0.4862
$MC \times R\&D$	85.7723	44.0523	−1.9471	0.5321

4.5. Simplified MRA Output Evaluation

The high coefficient of determination (R^2) equal to 0.82 suggests that a significant portion of the variability in the dependent variable is explained by the predictors. Additionally, the statistics *p*-value is less than 0.01 and indicates that this relationship is statistically significant, reinforcing the model's reliability in explaining the observed data.

$$\begin{aligned} EOPC = 1.14\ (RMC) + 0.76(LF) + 3.58(LW) + 33.45(RND) \\ + 0.234\ (MC \times RMC) + 0.356\ (MC \times LW) \end{aligned} \quad (2)$$

where the *EOPC* = export-oriented production capacity, *RMC* = raw material cost, *LF* = labor force, *LW* = labor wage, *RND* = research and development, and *MC* = market condition.

The interpretation of the impact of each variable across the years based on the provided coefficients, standard errors, t-statics, and *p*-values is shown in Table 5.

In this MRA model, the coefficients, standard errors, t-statistics, and *p*-values of each variable are examined to assess their impact on the dependent variable. Raw material: The coefficient of 1.14 indicates that for each unit increase in raw material, the dependent variable increases by 1.14 units. The low standard error (0.07), t-statistic of 1.56, and very low *p*-value (4.35×10^5) signify that this variable is a significant predictor. Labor force number: With a coefficient of 0.76, a 1-unit increase in the labor force leads to a 0.76-unit increase in the dependent variable. The standard error of 1.34, t-statistic of 1.456, and

p-value of 3.11×10^{-6} suggest that this variable significantly influences the dependent variable. Labor wages: The coefficient of 3.58 shows that higher labor wages correspond to a notable increase in the dependent variable. Despite a larger standard error (1.87), the t-statistic of 2.954 and p-value of 6.55×10^4 confirm its significance. R&D costs: The most influential variable, R&D costs, has a coefficient of 33.45, indicating that increased R&D investment substantially boosts the dependent variable. The standard error of 3.8, t-statistic of 7.453, and p-value of 6.76×10^3 highlight its importance. The interaction terms $MC \times RMC$ (coefficient = 0.234, t-statistic = 2.234, p-value = 4.54×10^4) and $MC \times LW$ (coefficient = 0.3566, t-statistic = 1.235, p-value = 5.45×10^5) also show significant effects, demonstrating that the relationships between raw materials and labor wages with the dependent variable are moderated by these factors. The relatively low standard errors and significant p-values across the variables indicate the reliability and robustness of the model's estimates. A summary of the Goodness of Fit, multicollinearity, and residual analysis results are presented in Table 6.

Table 5. The coefficients, standard errors, t-statics, and p-values for all variables.

Variable	Coeff.	Standard Error	t-Static	p-Value
RMC	1.14	0.07	1.56	4.35×10^5
LF	0.76	1.34	1.456	3.11×10^6
LW	3.58	1.87	2.954	6.55×10^4
RND	33.45	3.8	7.453	6.76×10^3
$MC \times RMC$	0.234	0.0566	2.234	4.54×10^4
$MC \times LW$	0.3566	0.234	1.235	5.45×10^5

Table 6. Summary of Goodness of Fit, multicollinearity, and residual analysis results.

Test	Statistic	Values
Adjusted R-squared		0.81
Multicollinearity (VIF)		
RMC	VIF	1.394
LW		1.392
LF		1.006
RND		1.010
Sensitivity analysis	Consistent	Yes
Skewness	Skewness	
RMC		0.534
LW		0.423
LF		0.125
RND		0.932
MC	Moderator	-
p-value	p-value	
RMC		4.35×10^5
LW		3.11×10^6
LF		6.55×10^4
RND		6.76×10^3
MC	Moderator	4.54×10^4 for *RMC*; 5.45×10^5 for *LW*
Residual analysis		

Table 6. *Cont.*

Test	Statistic	Values
Homoscedasticity		Met
Residual scatter		Random
Systematic patterns		None

Residual analysis is conducted to validate the assumptions and performance of a regression model. Figure 3 shows the residuals versus the predicted values, exhibiting a random scatter around zero with no discernible pattern. This indicates that the model captures the underlying data structure well, meeting the assumption of homoscedasticity with constant residual variance. The absence of systematic patterns suggests a linear relationship between predictors and the response variable. Thus, the model provides a good fit to the data, making its predictions reliable and accurate.

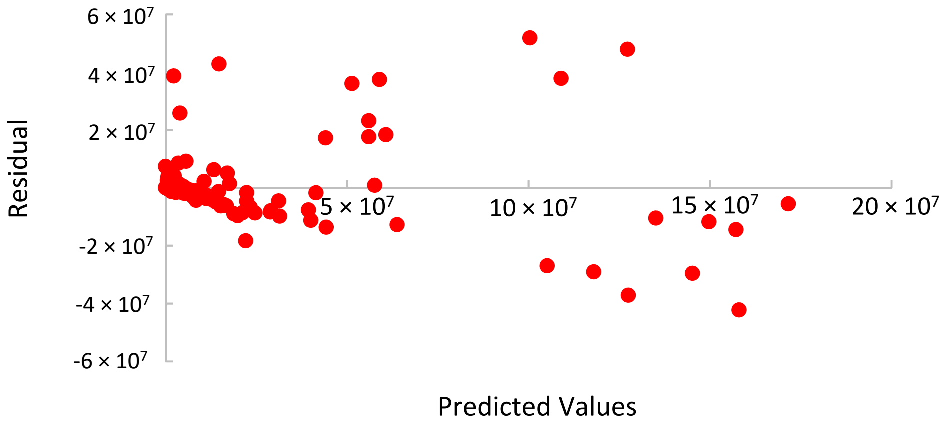

Figure 3. Relationship between the predicted values and the residual.

Overall, the proposed model provides a good starting point for understanding the relationships between the predictors and the dependent variable. Labor wages, raw material cost, and R&D spending are identified as strong predictors of the dependent variable due to their significant t-statistics and low *p*-values. In the meantime, the labor force also shows a significant relationship. The model seems like it can predict well. Moreover, residual analysis confirms the model's validity, showing a good fit to the data with homoscedasticity and no discernible patterns, indicating reliable and accurate predictions.

4.6. Hypotheses Testing

Based on the multiple regression analysis, raw material costs, labor wages, labor force, and R&D spending show statistically significant relationships with the export-oriented production capacity. The analysis confirms the acceptance of Hypotheses 1, 2, 3, and 5 and partially supports Hypothesis 6. Specifically, raw material costs exhibit a significant influence on the export capacity with a coefficient of 1.074, a t-statistic of 2.4882, and a *p*-value of 0.0001. Labor wages also have a notable impact, with a coefficient of 3.1634, a t-statistic of 3.0169, and a *p*-value of 0.0029. Labor force shows a significant relationship with export capacity, evidenced by a coefficient of 0.82, a t-statistic of 1.6975, and a *p*-value of 0.0149. R&D spending demonstrates a strong influence, with a coefficient of 27.4355, a t-statistic of 9.0450, and a *p*-value of 0.0042. However, Hypothesis 4, which posits an interaction between labor wages and labor force positively influencing the export-oriented production capacity, is rejected due to a non-significant coefficient (0.0002), a t-statistic of 0.5221, and a *p*-value of 0.6023. The moderating effect of market conditions is confirmed only for raw material costs and labor wages, aligning with Hypothesis 6, as indicated by significant interactions with market conditions for raw material costs (coefficient 0.0967, *p*-value 0.0387) and labor wages (coefficient 0.2332, *p*-value 0.0018). Table 7 presents the hypothesis results based on the regression analysis results.

Table 7. Hypothesis results based on regression analysis.

Hypotheses	Accept/Reject
Hypothesis 1: *The labor force positively influences the EOPC*	Accept
Hypothesis 2: *Raw material costs positively influence the EOPC*	Accept
Hypothesis 3: *R&D spending positively influences the EOPC*	Accept
Hypothesis 4: *Interaction between labor wages and labor force has a positive influence on the export-oriented production capacity*	Reject
Hypothesis 5: *Labor wages positively influence the EOPC*	Accept
Hypothesis 6: *Market condition moderates the relationship between the independent variables (raw material costs, labor force, labor wages, R&D spending) and the export-oriented production capacity*	Accept for variables "*RMC*" and "*LW*" only

4.7. Variable Adjustment Analysis

After validating the regression model, the impact of varying market conditions on export growth was explored; different scenarios were analyzed to determine the necessary adjustments in the cost factors presented in Table 8. To achieve a 20% increase in exports, different strategies and market conditions impact the required adjustments in costs. In Scenario 1, increasing the raw material cost (*RMC*) by 50%, labor wages (*LW*) by 40%, and research and development (*RND*) expenditure by 65%, each individually while keeping the other variables constant, is effective under neutral market conditions. Under favorable conditions, only a 12% increase in *RMC* and a 10% increase in *LW* are needed, while unfavorable conditions demand a 105% increase in *RMC* and an 84% increase in *LW*. Scenario 2 suggests a 25% increase in *RMC* and a 20% increase in *LW* for neutral conditions, with favorable conditions requiring just 7% and 4% increases, respectively, and unfavorable conditions needing 45% and 50% increases. Scenario 3 shows that increasing the labor force (*LF*) by 100% and *LW* by 40% works in neutral conditions, with favorable conditions needing a 25% increase in *RMC* and a 10% increase in *LW*, while unfavorable conditions require 250% in *RMC* and 100% in *LW*. Scenario 4 indicates that a 25% increase in *RMC* and a 37% increase in *RND* is effective in neutral conditions, while favorable conditions require 9% and 17% increases, respectively, and unfavorable conditions need 45% and 60% increases. Scenario 5 combines increases in *RMC* (15%), *LW* (13%), *LF* (20%), and *RND* (30%) for neutral conditions, with favorable conditions needing 5%, 4%, 10%, and 14% increases, respectively, and unfavorable conditions requiring 35%, 24%, 50%, and 50% increases. Among these, the fifth scenario is the most balanced and optimized approach, leading to the best improvement in the export capacity across various market conditions.

Table 8. Adjustment analysis results (Source: authors' own work.).

Scenario No.	Market Condition	*RMC* (%)	*LW* (%)	*LF* (%)	*RND* (%)
1	Neutral	* 50%	* 40%	* 325%	* 65%
	Favorable	12%	10%	-	-
	Unfavorable	105%	84%	-	-
2	Neutral	25%	20%	-	-
	Favorable	7%	4%	-	-
	Unfavorable	45%	50%	-	-

Table 8. *Cont.*

Scenario No.	Market Condition	*RMC (%)*	*LW (%)*	*LF (%)*	*RND (%)*
3	Neutral	-	40%	100%	-
	Favorable	-	10%	26%	-
	Unfavorable	-	100%	250%	-
4	Neutral	25%	-	-	37%
	Favorable	9%	-	-	17%
	Unfavorable	45%	-	-	60%
5	Neutral	15%	13%	20%	30%
	Favorable	5%	4&	10%	14%
	Unfavorable	35%	24%	50%	50%

* Refers to adjusting only one variable while keeping the others constant.

5. Discussion

5.1. Analysis of Input Variation Scenarios

The different scenarios of input variation are analyzed in the previous section. The analysis explores the effect of increasing one variable at a time—raw material cost, labor wages, R&D spending, and labor force—while keeping the others constant at different market conditions, to achieve 20% incremental export growth. For example, a manufacturing firm may find increasing raw material cost by 50% feasible if the supply chain is reliable and market demand justifies increased production, though it can burden financial resources and require careful cost management. Under favorable market conditions, a smaller increase of 12% in raw material costs might suffice, while unfavorable conditions could necessitate a steep rise of 105%, significantly impacting financial stability. In labor-intensive industries, increasing labor wages by 40% can improve productivity and exports but may not be workable without corresponding price increases due to fixed wage structures or labor laws. Favorable conditions may only require a 10% increase, whereas unfavorable conditions might force an 84% rise in wages, posing substantial challenges. Increasing R&D spending by 65% can drive significant innovations and export growth, aligning with theories of innovation-driven growth and providing long-term competitive advantages. However, this substantial increase in R&D spending is particularly relevant under neutral market conditions, as specific figures for favorable or unfavorable conditions were not provided. Expanding the labor force by 325% in sectors like manufacturing can increase output but requires effective recruitment and management strategies, with practical measures for training and integrating new workers and supporting labor productivity models. The neutral condition illustrates this significant labor force increase, while details for favorable or unfavorable conditions were not specified in this scenario. However, these scenarios may not be feasible, and further optimization is required to reach practical solutions.

5.2. Proposed Adjustment Models

In the second scenario, the proposed model suggests channeling spending towards raw materials and labor wages while keeping the labor force and R&D expenditures constant under different market conditions. This strategy aims to increase exports through incremental increases in raw material spending and labor wages by 25% and 20%, respectively, under neutral market conditions. Favorable conditions could see these percentages reduced to 7% and 4%, respectively, showing a more manageable financial impact. Unfavorable conditions could see these costs soar to 45% and 50%, highlighting potential challenges in cost management. For instance, increasing raw material spending involves allocating more funds towards acquiring essential resources like metals, chemicals, or agricultural products necessary for production. Similarly, raising labor wages entails paying workers higher wages or offering additional benefits to enhance workforce motivation and productivity. These increases in spending are aimed at achieving a 20% increment in export growth.

In the third scenario, the proposed model suggests directing spending solely towards increasing labor wages and expanding the labor force while keeping raw material expenditures and R&D spending constant under different market conditions. This strategy aims to enhance exports by increasing labor wages and the labor force by 40% and 100%, respectively, under neutral market conditions. Favorable conditions might reduce the increase in labor wages to 10% and the labor force to 26%, while unfavorable conditions could lead to a dramatic increase in labor wages to 100% and the labor force to 250%. Increasing labor wages involves raising the salaries and benefits provided to workers, potentially attracting skilled labor and improving employee satisfaction and retention. Additionally, expanding the labor force entails hiring additional workers to increase production capacity and meet growing demand. These adjustments are also designed to achieve a 20% increment in export growth.

In the fourth scenario, the proposed model suggests focusing spending on raw materials and R&D while keeping labor wages and the labor force constant under different market conditions. This strategy aims to raise exports by increasing raw material expenditure and R&D investments by 25% and 37%, respectively, under neutral market conditions. Favorable conditions might see these increases reduced to 9% for raw material costs and 17% for R&D spending, while unfavorable conditions could see these percentages jump to 45% and 60%, respectively. Increasing raw material spending involves allocating more resources towards acquiring essential materials like metals, chemicals, or agricultural products necessary for production. Simultaneously, increasing R&D spending requires allocating additional funds towards research activities aimed at improving product design, innovation, efficiency, and quality. These spending increases are intended to drive a 20% increment in export growth.

In the last scenario, after conducting a comprehensive analysis of all variables together, it is observed that to incrementally increase export amounts by 20%, specific adjustments in spending are required under different market conditions. Raw material, labor wages, labor force, and R&D spending should each be increased by 15%, 13%, 20%, and 30%, respectively, under neutral market conditions to achieve the same export increment. For instance, a 15% increase in raw material spending involves allocating an additional portion of the budget towards procuring essential resources crucial for production. Similarly, a 13% increase in labor wages leads to raising salaries and benefits, potentially improving employee morale and productivity. In parallel, a 20% increase in the labor force necessitates hiring additional labor to expand production capacity. Finally, a 30% increase in R&D spending involves allocating more resources towards research activities aimed at innovation and product improvement. In favorable conditions, these percentages might be reduced to 5% for raw material costs, 4% for labor wages, 10% for labor force, and 14% for R&D spending. However, unfavorable conditions could lead to increases to 35% for raw material costs, 24% for labor wages, 50% for labor force, and 50% for R&D spending, demonstrating significant financial and operational challenges. These adjustments are targeted to achieve a 20% increment in export growth.

These scenarios highlight the complexities of managing input variations under different market conditions and underscore the importance of strategic planning and optimization to achieve practical and sustainable growth solutions.

5.3. Consistency with the Existing Literature

The above results reveal consistency and complementarity with the existing literature. For example, our findings complement those of Rognes (2023), confirming that the efficient sourcing of raw materials enables firms to achieve substantial cost savings through strategies like negotiating better terms with suppliers, opting for bulk purchasing, and exploring alternative sources. We stress that pricing adjustment plays a pivotal role in enhancing export capacity, necessitating strategic considerations such as focusing on strategic raw material selection and conducting thorough market research to understand consumer needs and competitor pricing (Aharoni 2024; Teerasoponpong and Sopadang 2022; Dethine et al. 2020; Hool et al. 2022; Shabbir and Wisdom 2020). Similarly, our findings support the results concluded by other scholars that investing in skilled labor is identified as essential for maintaining high productivity and quality standards, with strategies like encouraging a positive work environment, providing career growth opportunities, and offering competitive wages and benefits packages being crucial (Salimova et al. 2022; Phan 2022; Al-Harthy et al. 2022; Huang et al. 2021). Our results also confirm the findings by other studies, underlining the vital role of R&D in enhancing production capacity and product quality, with investments in R&D facilitating innovation, understanding customer preferences, and improving product competitiveness (Edeh et al. 2020; Naradda Gamage et al. 2020). Our study not only adds empirical evidence to the existing literature and studies by analyzing different scenarios of input variation in production and their impact on export growth but also offers new insights on how specific adjustments in spending can help in realizing the potential export targets.

5.4. Theoretical Alignment

Conceptually, our findings are closely aligned with the theoretical foundations of the comparative advantage theory, the Heckscher–Ohlin model, and the resource-based theory in building export capacity. For example, the call for specialization in producing goods and services that the firm or the country has a comparative advantage in is clearly observed in this study, as we strategically adjusted spending on raw materials, labor wages, R&D, and the labor force to make the best use of resources and become more competitive in export markets. Similarly, our findings do not differ considerably from the assumption of the Heckscher–Ohlin model that countries or firms should export goods that make good use of their many resources such as skilled labor or natural resources, while our study focuses on adjusting labor force and raw material spending and aims to use resources wisely to improve export capacity. As the resource-based theory focuses on using internal resources effectively, our study stresses the importance of increasing R&D spending to drive innovation and improve product quality. Thus, our study not only matches these theoretical ideas but also offers new insights and practical means on how specific changes in different spending channels can increase exports, making these theoretical concepts more understandable and offering useful strategies for building export capacity.

5.5. Policy and Practical Implications

In terms of policy and practical implications, the analysis of various scenarios of input variation in this study highlights the critical role of strategic decisions in optimizing resource allocation to drive export growth. Policymakers can benefit from evidence-based research that enables them to focus on specific measures aimed at building export capacity. Governments can create policies tailored to support industries in accessing essential resources at competitive prices, hence improving production efficiency. Policymakers may consider measures such as reducing taxes on imported raw materials, making supply chains more efficient, and promoting exchange programs to enhance the skills and experiences of the labor force. The successful implementation of these measures can effectively reduce production costs, especially in industries that heavily rely on materials like steel, cement, or plastics, thereby improving firms' competitiveness in international markets. By creating an environment that encourages the use of innovation and technology, policymakers can empower firms to improve their export capacity through efficient resource utilization.

Firm executives and industry practitioners can also benefit from our findings in terms of optimizing resource allocation to maximize export growth while ensuring efficient cost management. They can optimize raw material costs to increase the cost capacity and hence build export capacity by investing in building factories that provide raw materials at target costs, establishing facilities that produce essential resources in-house, or through strategic partnerships with suppliers to stabilize costs and reduce reliance on external market fluctuations. They can also utilize R&D and innovation to manage and optimize their labor force effectively by investing in automation technologies and robotics to streamline production processes and reduce dependency on manual labor. By automating repetitive tasks and reallocating human resources to more value-added activities, firms can improve productivity and output quality while minimizing labor costs. In manufacturing, where labor wages constitute a significant portion of production costs, firms can address high wages by implementing performance-based incentive programs or profit-sharing schemes to align employee interests with firm goals and enhance productivity. This challenge can also be addressed by investing in technology-driven solutions such as AI-powered workforce management systems or remote work platforms that help optimize labor utilization and reduce overhead expenses, thereby improving export competitiveness.

6. Conclusions

This study explained the importance of factor cost adjustment in enhancing the export-oriented production capacity of manufacturing firms. More specifically, it examined in detail the impact of raw material costs, labor force, labor wages, and R&D spending on firms' export capacity using multiple regression analysis. It also highlighted the critical role of cost components in shaping firms' global expansion strategies when it comes to the export of manufactured goods and services. This study explained the importance of factor cost adjustment in enhancing the export-oriented production capacity of manufacturing firms. More specifically, it examined in detail the impact of raw material costs, labor force, labor wages, and R&D spending on firms' export-oriented production capacity using multiple regression analysis. It also highlighted the critical role of cost components in shaping firms' global expansion strategies when it comes to the export of manufactured goods and services. The empirical investigation revealed significant relationships between these cost factors and the export-oriented production capacity, with all the variables showing considerable impacts. The analysis highlighted that adjusting these cost components could directly enhance industrial output and improve the export-oriented production capacity. This study also demonstrated the significant impact of market conditions on these relationships, showing that market conditions moderate the effects of raw material costs and labor wages on the export-oriented production capacity. This emphasizes the importance of considering market conditions in the model to accurately reflect their influence. This study provides a foundational framework and proposed model for understanding and enhancing firms' export-oriented production capacities by effectively managing key variables and adapting strategies according to market conditions.

Moreover, our findings offer empirical validation and practical insights that extend beyond the theories of comparative advantage, the Heckscher–Ohlin model, and the resource-based theory. Specifically, while these theories outline the general principles of resource allocation and comparative advantage, our study determined specific adjustments in spending—on raw materials, labor wages and force, and R&D—to adjust the export-oriented production capacity. This study also offers practical implications for decisionmakers at the country and firm levels to instigate strategic decisions to adjust resource allocation for driving export growth. While policymakers are urged to design tailored policies supporting industries in accessing essential resources at competitive prices to increase production efficiency, firm executives should focus primarily on strategic spending decisions to effectively encourage export growth.

7. Study Limitations and Recommendations for Future Work

Finally, we acknowledge the limitations of our study that focused on a one-sector (manufacturing) one-country (Oman) case study and a short period of five years. We suggest further investigation to cover the long-term effects of cost adjustment strategies on export growth, considering dynamic market conditions and other external factors that impact firm performance. Further investigation into sector-specific challenges and opportunities beyond manufacturing can provide tailored insights for different industries.

While focusing mainly on internal factors affecting export performance within the manufacturing sector in Oman, we recognize the influence of external factors, such as international market demand, on exports. Future research should integrate these external factors, including market conditions, to provide a fuller picture of how both internal and external variables impact export performance. Future research could also account for the time lag between R&D expenditures and their impact on export performance by incorporating the delayed effects of R&D investments and considering external factors such as export flows and market demand to provide a more comprehensive analysis of export growth dynamics. As this study relies more on aggregate macro-economic data that may not capture the specific micro-economic challenges and opportunities faced by individual firms, we recommend further research that incorporates detailed micro-economic data to provide a more nuanced understanding of company-specific dynamics.

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