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The Manufacturing Sector and Global Market Integration: A Case of Jordan

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Abstract

Objective: This study aims to determine what factors affect the integration of Jordan's industrial sector with global markets by examining 85 industries (identified by ISIC Rev. 4) using four-digit codes from 2011 to 2021.

Methods: A simultaneous model of the endogenous variables (industrial production, exports, and value-added) is constructed to avoid the common issues of simultaneity and specification error using three-stage least squares (3SLS). The study categorizes industries into two groups based on their export-to-output ratios, classifying industries with ratios above 25% as high exporting industries and those with ratios between 3.8% and 25% as low exporting industries. This classification is based on output volume, and the number of sectors in each group should be similar. This classification helps clarify potential differences in strategies, competitiveness, innovation, and market access between the groups.

Results: The findings demonstrate the importance of intermediary goods in launching Jordanian industries into the global market by presenting their significant correlation with the variables of interest in most equations, such as industrial production and manufacturing value-added. Furthermore, compensation per worker typically has a positive correlation with manufacturing value-added. Particularly in the high export category, there is a positive correlation between improvement and development expenditures and manufactured exports.

Conclusion: The analysis reveals that none of the models empirically support the export-led development theory. This methodology highlights the pivotal significance of particular economic variables and provides perceptive data on the complex interplay that drives goods-market integration.

Keywords: Global market integration, Simultaneous equations, 3SLS, Industrial production.
JEL Classification: F15, C32, F14, L60, E23.

القطاع الصناعي والتكامل مع الأسواق العالمية: حالة الأردن

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ملخّص

الهدف: تهدف هذه الدراسة إلى التعرف على العوامل التي تؤثر على تكامل القطاع الصناعي في الأردن مع الأسواق العالمية من خلال دراسة 85 قطاع صناعي (حددها التصنيف الصناعي الدولي الموحد ISIC Rev.4) خلال الفترة 2011-2021.

المنهجية: تم استخدام العديد من المعادلات الآنية، ولا سيما تقدير المعادلات الآنية باستخدام طريقة المربعات الصغرى ذات الثلاث مراحل (3SLS). واختارت هذه الدراسة هذا المنهج لتجنب المشكلات الشائعة المتمثلة بالآنية وأخطاء التحديد في التحليلات المماثلة. وتقسم الدراسة القطاعات الصناعية إلى مجموعتين استناداً إلى نسب الصادرات إلى الإنتاج: صناعات عالية التصدير بنسب تزيد عن 25٪، وصناعات منخفضة التصدير بنسب تتراوح بين 3.8% و25%. ويستند هذا التصنيف إلى حجم الناتج، مع مراعاة أن يكون عدد الصناعات في كل مجموعة متساوٍ بشكل تقريبي. يساعد هذا التصنيف في توضيح الاختلافات المحتملة في الاستراتيجيات، والقدرة التنافسية، والابتكار، والوصول إلى الأسواق بين المجموعتين.

النتائج: أظهرت النتائج أهمية دور السلع الوسيطة في دمج الصناعات الأردنية مع السوق العالمية، حيث تُظهر هذه السلع ارتباطاً معنوياً على مختلف متغيرات الدراسة في معظم المعادلات، مثل الإنتاج الصناعي والقيمة المضافة الصناعية. بالإضافة إلى ذلك، تبين من الدراسة أن التعويضات لكل عامل لها ارتباط معنوي إيجابي بالقيمة المضافة الصناعية. وهناك ارتباط إيجابي، لا سيما في مجموعة الصناعات عالية التصدير بين الإنفاق على التطوير والتحسين والصادرات المصنعة.

خلاصة الدراسة: تُظهر الدراسة أن النماذج المستخدمة في التحليل لا توفر دعماً تجريبياً لنظريات التنمية القائمة على التصدير. إضافة إلى ذلك، تسلط هذه المنهجية الضوء على الأهمية الكبيرة لمتغيرات اقتصادية محددة، وتقدم رؤى قيمة حول التفاعلات المعقدة التي تسهم في دفع عجلة تكامل أسواق السلع.

الكلمات الدالة: تكامل الأسواق العالمية، المعادلات الآنية، 3SLS، الإنتاج الصناعي.

1. INTRODUCTION

Integration into the global goods market can significantly impact a country's economic growth. Opening markets to international trade and investment increases access to new technologies, capital, and expertise, boosting productivity, creating job opportunities, and expanding the range of available goods and services (IMF, 2008). Moreover, by achieving economies of scale through increased production levels, such integration enables the production of goods and services at lower costs. This enhances business competitiveness, attracts foreign investment, and increases exports (Incekara & Savrul, 2012).

A strategic approach is essential to ensure that the benefits of globalization are widely shared and sustainable. This approach involves supportive policies for domestic industries, infrastructure investments, and the protection of workers' rights and environmental standards (IMF, 2008). Industries such as manufacturing, agriculture, and mining have become interconnected through global value chains, which separate production stages across countries and facilitate international trade (Koreen & Cusmano, 2019).

However, challenges persist, especially for developing countries that need more resources and infrastructure to compete effectively. Policies promoting domestic industry growth and supporting small and medium-sized enterprises are vital for driving innovation and sustainable development, while fair trade practices and worker protections help distribute globalization's benefits (UNCTAD, 2021).

Jordan has made significant strides in integrating into the global market compared to regional peers, facilitated by several regional trade agreements and memberships in trade areas such as the Greater Arab Free Trade Area (GAFTA). Jordan's trade agreements with countries like the United States, Canada, and Turkey have opened its economy to foreign markets. In 2019, exports accounted for approximately 35.9% of Jordan's GDP (World Bank, 2019).

Despite these advancements, Jordan's industrial sector faces critical challenges, as detailed in the "Jordan Industrial Competitiveness Report 2022." From 2000 to 2008, the sector grew strongly, but this growth slowed significantly after 2009. The manufacturing value added (MVA) per capita has remained stagnant, while population growth has outpaced it. Low- and medium-technology industries primarily comprise the sector, and its production structures remained unchanged between 2010 and 2018. This stagnation, combined with strict limits on the types of products it can export, has held back its development.

Previous research, including the valuable 2021 study by Alkhatib and Alkhatib, has identified factors contributing to Jordan's industrial development. However, a gap exists in the research literature regarding studies that use the four-digit ISIC Rev. 4 classifications to examine the micro-level economic drivers of industrial production, exports, and manufacturing value added (MVA).

Importantly, no other study has used the Three-Stage Least Squares (3SLS) method with these specific industry classifications to analyze how these drivers affect each other in Jordan.

This presents a unique opportunity for this study to offer profound insights into how critical factors—such as the number of employees, compensation per employee, research and development expenditures, and the utilization of intermediate goods and services—impact the sector's productivity and global market integration. By utilizing the four-digit ISIC Rev. 4 codes and the analytical strength of 3SLS, this study has the potential to advance Jordanian industrial research significantly.

This study aims to fill the identified research gap by employing a detailed econometric analysis to assess how micro-level economic drivers influence the performance and competitiveness of Jordan's industrial sector on a global scale. The objectives are as follows:

- Identify the critical micro-level economic drivers influencing Jordan's industrial production, exports, and MVA.
- Employ the 3SLS method to analyze the interdependencies among these drivers, providing a robust statistical understanding of their impacts.
- Offer strategic recommendations based on empirical evidence to enhance the sector's integration into the global market and its competitiveness.

The study framework combines these goals with a methodological approach that uses four-digit ISIC Rev. 4 classifications to ensure accurate analysis. The 3SLS method, meanwhile, provides a comprehensive picture of how economic factors affect industrial outcomes in Jordan. Building on this foundation, the current paper focuses on the years 2011–2021 to explore the diverse opportunities and challenges facing Jordan's manufacturing sector, thereby extending and deepening the inquiry initiated by Alkhatib and Alkhatib in their 2021 study.

Alkhatib and Alkhatib's study covered 20 industrial sectors using the broader 2-digit ISIC Rev. 4 classifications, whereas this study examines 85 industrial sectors at the more detailed 4-digit level. This thorough approach offers clearer insights into the sector's complexities and the interconnections among its various parts.

Furthermore, this study extends the study period and introduces new variables, such as the number of workers and compensation per worker, which are critical for understanding the dynamics of industrial productivity and labor market impacts. These enhancements aim to provide a more detailed understanding of the role Jordan's industries play in integrating into the global goods market and to address the specific economic drivers influencing this process.

The study framework, illustrated in Figure 1.1, employs a panel data approach to examine a variety of industries. Its primary goal is to analyze the complex relationships between exogenous variables (such as labor inputs and compensation) and endogenous variables (industrial production, manufacturing exports, and manufacturing value added). Understanding these relationships is imperative for formulating targeted strategies that enhance the industry's global competitiveness. By focusing on these economic interactions, the study provides valuable insights instrumental in shaping targeted industrial policies and strategies.

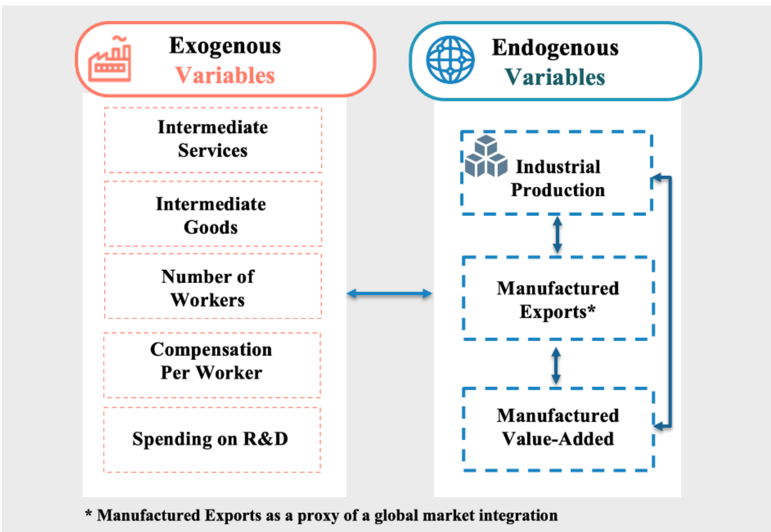

Figure (1.1): The Study Framework

Source: Developed by the researcher

The remainder of the study is divided into five main sections: Section 2 provides a literature review and theoretical background; Section 3 details the model and data, utilizing the ISIC Rev. 4 classification and the 3SLS method; Section 4 presents and discusses the empirical results; and Section 5 offers conclusions and recommendations.

2. THEORETICAL BACKGROUND AND LITERATURE REVIEWS

2.1 Theoretical Background

2.1.1 Market Integration Concept and Measurement

According to Lyu et al. (2023), market integration is a dynamic process that facilitates the movement of various goods and factors within a region, driven by institutional innovations that increase total factor productivity. Trade flows serve as a key indicator in this context, with researchers examining the volume and value of imports and exports between nations to measure market connectivity. These flows represent the exchange of goods and services across borders and reflect the degree of global market integration, as noted by Lyu et al. (2023), Iheanacho et al. (2023), Naughton (2000), and Andohol et al. (2024).

Understanding the dynamics of global integration and its impact on production and economic growth requires careful analysis of these metrics. This study employs the trade flow index as a proxy for global market integration (Lyu et al., 2023; Iheanacho et al., 2023; Naughton, 2000) and uses manufactured exports to measure trade flows (Andohol et al., 2024; Alkhatib & Alkhatib, 2021).

2.1.2 Trade and growth

Despite more than 200 years of theoretical research linking commerce and economic growth, discussions on their real-world applications continue. Classical economic theorists, beginning with Adam Smith, pioneered trade theories, while economists such as David Ricardo, James Mill, and John Stuart Mill further developed these ideas in the early 19th century. Economic studies have thoroughly examined and firmly established arguments supporting free trade and the advantages of international specialization for national productivity (Bhagwati, 1978; Krueger, 1978).

Trade-led growth strategies are crucial for driving economic growth in developing countries. The main objective of these strategies, as highlighted by Greenaway et al. (2002) and Nam et al. (2023), is to enhance export operations to stimulate economic growth. This approach encourages the development of manufacturing processes, fosters technological innovation, and propels overall economic expansion. When countries effectively adopt these strategies, they can integrate seamlessly into the global economy and access vast international markets.

This study suggests that exports play a significant role in boosting industrial production in developing nations. Exports provide multiple avenues for economic progress by maximizing resource use and facilitating entry into broader markets based on comparative advantage. Additionally, they promote technology transfer, foster competitive dynamics, and improve efficiency, all of which contribute to economic development.

2.1.3 Exports and Growth

This study provides a systematic framework for quantitatively evaluating multiple factors driving the dynamics observed in Jordan's export sector. It investigates the relationship between exports, output, and value added in Jordan's production industries.

A literature review has identified numerous variables that have significantly contributed to export growth across various industries over the past decade. Trade agreements constitute a crucial component. The Jordan Industrial Competitiveness Report (2022) indicates that Jordan's Free Trade Agreements (FTAs), particularly with the United States and Arab regions, have substantially influenced its export dynamics. These FTAs have led to an expansion in the variety of goods exported and an increase in export volume, especially in the textile and pharmaceutical sectors.

Another key driver of export growth has been the influx of foreign direct investment (FDI) into Jordan. Mukhtarov et al. (2019) employed the ARDL-bound test cointegration model to examine the influence of FDI on exports in Jordan. Their findings indicate a significant and positive correlation between FDI and exports, with a 1% increase in FDI resulting in a 0.13% increase in exports.

Innovation is also a critical driver of export performance, particularly for small and medium-sized enterprises (SMEs) in developing economies. According to Ortigueira-Sánchez et al. (2022), innovation fosters a sustainable competitive advantage and accounts for firm heterogeneity in export performance.

Theory of Production

This theory explores how businesses convert inputs such as labor and capital into outputs (goods and services). It emphasizes the relationship between input and output quantities, aiming to optimize production efficiency and cost-effectiveness. The production function, a central concept, mathematically describes this input-output relationship (Nickolas et al., 2022).

The **production function** is as follows: $Q = f\ [L, K]$, where Labor (L) and capital (K) are the main inputs used in production.

2.2 Literature Review

Bao et al. (2023) analyzed firm-level data from China spanning 2000 to 2011. Their research aimed to explore the impact of industrial accumulation on firm exports, focusing specifically on input-output linkages. The study's findings suggest that upstream accumulation increases the likelihood of exporting by supplying intermediate inputs that help companies improve their productivity.

In their 2022 study, Ramdani et al. identified three profiles of exporting SMEs based on innovation orientation, each with different drivers of export success. They found that business strategy, firm turnover, and industry were critical drivers across all profiles, while factors such as ICT adoption and business environment were less critical.

Policymakers in many countries aim to increase domestic value added through exports. Durongkaveroj (2022) examined the relationship between domestic value added and export indicators for 74 manufacturing sectors in Thailand. The study found no significant association between domestic value added and export indicators. While low-productivity industries saw a positive impact of domestic value added on export performance, this relationship remained consistent across industries with varying levels of engagement in global production networks.

In their 2021 study, Alkhatib and Alkhatib analyzed the impact of factors promoting global market integration on 20 Jordanian industries from 2009 to 2017. They found that workers' compensation positively impacted most factors for all industries and high-export groups. Additionally, spending on improvement and development positively affected the entire sample, while intermediate services showed no significant impact except for the high-exporting group.

Saeed and Ullah (2021) examined the link between productivity and export performance in emerging Asian economies such as China, India, Indonesia, South Korea, and Japan. Their findings show that Total Factor Productivity (TFP) positively affected the export performance of the agricultural and manufacturing sectors in these economies from 1990 to 2016, supporting the "learning by exporting" hypothesis.

Zhu's (2019) study analyzed China's participation in global value chains through the domestic value added (DVA) of its exports. It found a rising trend in China's DVA exports but identified lower DVA shares in high-technology manufacturing, indicating low competitiveness. The study also listed nine factors affecting DVA changes, including labor productivity and wages. It suggested that China should improve technology and labor productivity, especially in high-technology manufacturing, to increase its involvement in global value chains.

Coad and Vezzani's (2019) study discusses the decline of the manufacturing sector in Europe and North America and its potential impact on R&D, exports, and productivity. The study found a strong positive association between the manufacturing sector and R&D spending. However, the relationship between exports and productivity requires further clarification. An increased manufacturing value-added share may lead to higher R&D intensity.

In a 2019 study, Brunow et al. examined factors contributing to the export success of German establishments, focusing on productivity and workforce diversity. Using a German dataset that combined survey and administrative data, they found that productivity and workforce diversity positively affect export success, particularly among smaller manufacturing establishments. Additionally, localization and urbanization economies also play a role in export success, with smaller establishments benefiting most from externalities.

Reis and Forte (2016) studied how industry and firm characteristics, such as labor productivity and export orientation, influence a firm's export intensity. Their findings highlight the importance of prioritizing policies to improve efficiency and enhance competitiveness in foreign markets.

Tadesse and White (2015) analyzed data from 85 NAICS 4-digit industry classifications from 2004 to 2008. They investigated how changes in technical efficiency within an industry affected the percentage of firms that export. Their findings revealed a positive correlation between higher levels of industry-specific technical efficiency and an increased number of exporting firms.

Table 2.1 below presents a collection of previous studies investigating various factors affecting production, exports, value added, and innovation in different contexts:

Table (2.1): A summary of previous studies:

Authors & Year	Research area	Methodology	Results
Nam & Ryu (2024)	▪Trade Openness. ▪Economic Growth.	▪Fixed-effect two-stage least squares (FE-2SLS)	▪Higher trade volumes (total trade, exports, and imports) significantly promote GDP growth.
Durongkaveroj (2022)	▪Domestic value-added (DVC) ▪Export performance measures	▪Generalized Method of Moments (GMM)	▪Industries with greater DVA do not significantly perform better in terms of net-export earnings compared to those with lower DVA.
Herrero & Rial, (2023)	▪labor costs ▪export performance of manufacturing sectors	▪Input-output table	▪Labor costs have a negligible impact on export performance.
Istaiteyeh et al. (2023)	▪Economic growth (measured as GDP), exports, and imports ▪Export-Led Growth; Growth-Led Exports; Import-Led Growth	▪Vector Autoregressive (VAR) model	▪The analysis reveals that exports drive economic growth, and economic growth, in turn, stimulates exports.
Kadafi et al. (2023)	▪Role of exports in driving economic growth	▪Generalized Least Squares (GLS) model	▪There is a significant positive correlation between exports and economic growth.
Lee & Kwon (2023)	▪Research and development (R&D). ▪Export activity on the performance of US manufacturing firms.	▪Two-Stage Regression-Neural Network Approach	▪R&D and export activities significantly and positively affect the economic performance of US manufacturing firms,

Authors & Year	Research area	Methodology	Results
Sahoo et al. (2022)	▪Export activities. ▪Productivity, and competitiveness in the Indian manufacturing sector.	▪Generalized Method of Moments (GMM)	▪Exporting activities significantly enhance firms' productivity and competitiveness.
Saeed & Ullah (2021)	▪Productivity. ▪Export performance in the manufacturing sector.	▪Autoregressive Distributed Lag (ARDL) model	▪The results support the "learning by exporting" hypothesis, indicating that export activities significantly enhance firms' productivity.
Brunow et al. (2019)	▪workforce diversity ▪firms' export performance.	▪Fractional response model	▪A strong positive correlation between labor productivity, skills, and export performance.
Coad & Vezzani (2019)	▪Economic performance in manufacturing sector. ▪Research and development (R&D). ▪Exports and productivity growth.	▪Pooled ordinary least squares (OLS)	▪Productivity growth in manufacturing can spill over to other sectors, enhancing overall economic productivity.
Zhu (2019)	▪Domestic value-added (DVA) exports	▪Input-Output Tables	▪Labor productivity and wage per person have a positive impact on China's export DVA.
Naz & Ahmad (2018)	▪Globalization ▪Its driving factors: human capital, labor, transportation, communication, and financial development.	▪Dynamic Ordinary Least Squares ▪Generalized Method of Moments (GMM)	▪The labor force is considered to be a significant driver of globalization.
Negem, (2016)	▪Simultaneity problem in the relationship between exports and economic growth ▪Exports Led Growth (ELG); Growth Led Exports (GLE).	▪Three-stage least squares (3SLS) technique	▪A positive correlation exists between exports and economic growth in the EU, validating both the ELG and GLE hypotheses.
Tadesse et al. (2015)	▪Industry-level productivity differentials. ▪Firms' decisions to export	▪Stochastic Frontier Production Function	▪Higher levels of industry-specific technological efficiency positively correlate with more firms engaged in exporting.
Medina-Smith (2001)	▪Export-led growth hypothesis (ELGH). ▪Economic performance.	▪Augmented Cobb-Douglas production	▪The findings support the ELGH, indicating that export growth positively influences economic growth.

Table 2.2 presents the study’s hypotheses, developed through an extensive literature review and theoretical frameworks. Each hypothesis is clearly defined and testable, providing a focused direction for data collection and analysis. This study aims to offer fresh insights and address existing knowledge gaps.

Table (2.2): Study's hypotheses

Industrial Production	
H1	No statistically significant relationship exists between Industrial production and manufactured exports (as a proxy of global market integration) in Jordan's manufacturing industries.
H2	No statistically significant relationship exists between Industrial production and manufactured value-added in Jordan's manufacturing industries.
H3	No statistically significant relationship exists between industrial production and Intermediate services in Jordan’s manufacturing industries.
H4	No statistically significant relationship exists between industrial production and Intermediate goods in Jordan’s manufacturing industries.
H5	No statistically significant relationship exists between industrial production and the number of workers in Jordan’s manufacturing industries.
Manufactured Exports	

H6	No statistically significant relationship exists between manufactured exports (global market integration) and manufactured value-added in Jordan's manufacturing industries.
H7	No statistically significant relationship exists between manufactured exports (as a proxy of global market integration) and Intermediate services in Jordan's manufacturing industries.
H8	No statistically significant relationship exists between manufactured exports (as a proxy of global market integration) and Intermediate goods in Jordan's manufacturing industries.
H9	No statistically significant relationship exists between manufactured exports (as a proxy of global market integration) and the number of workers in Jordan's manufacturing industries.
H10	No statistically significant relationship exists between manufactured exports (as a proxy of global market integration) and Spending on improvement & development (R&D) in Jordan's manufacturing industries.
Manufactured Value-Added	
H11	No statistically significant relationship exists between manufactured value-added and manufactured exports (as a proxy of global market integration) in Jordan's manufacturing industries.
H12	No statistically significant relationship exists between manufactured value-added and Intermediate goods in Jordan's manufacturing industries.
H13	No statistically significant relationship exists between manufactured value added and the number of workers in Jordan's manufacturing industries.
H14	No statistically significant relationship between manufactured value-added and compensations per worker in Jordan's manufacturing industries.
H15	No statistically significant relationship exists between manufactured value-added and Spending on improvement & development (R&D) in Jordan's manufacturing industries.

3. THE MODEL AND THE DATA

In this section, the study develops a theoretical framework based on the work of Alkhatib and Alkhatib (2021) by incorporating new variables, such as the number of employees and compensation per employee. This enhanced model aims to facilitate the analysis of Jordanian industrial activity and its integration into global markets. By examining the effects of various endogenous and exogenous variables, the model seeks to improve domestic productive capacity and exports, which serve as proxies for integration with global goods markets.

This study employs the generalized Cobb-Douglas function, as it provides a robust foundation for assessing productivity and the utilization of production factors in employment within a simultaneous equations system (Negem, 2016; Amuka et al., 2018; Alkhatib & Alkhatib, 2021; Nickolas et al., 2022). These equations are:

$$\boldsymbol{Y_{1it} = a_1\, Y_{2it}^{\alpha_1}\, Y_{3it}^{\alpha_2} X_{1it}^{\beta_1} X_{2it}^{\beta_2} X_{3it}^{\beta_3}} e_{it}^{\varepsilon 1} \qquad i = 1,2,\dots n \quad t = 1, 2,\dots T \qquad \text{Equation (1)}$$

$$\boldsymbol{Y_{2it} = a_2\, Y_{3it}^{\alpha_3}\, X_{1it}^{\beta_4} X_{2it}^{\beta_5} X_{3it}^{\beta_6} X_{5it}^{\beta_7} e_{it}^{\varepsilon 2}} \qquad i = 1,2,\dots n \quad t = 1, 2,\dots T \qquad \text{Equation (2)}$$

$$\boldsymbol{Y_{3it} = a_3\, Y_{2it}^{\alpha_4} X_{2it}^{\beta_8} X_{3it}^{\beta_9} X_{4it}^{\beta_{10}} X_{5it}^{\beta_{11}}\, e_{it}^{\varepsilon 3}} \qquad i = 1,2,\dots n \quad t = 1, 2,\dots T \qquad \text{Equation (3)}$$

The symbol (t) represents the year, the symbol (i) indicates the industry, the symbol (n) represents the number of manufacturing sectors (4 digits ISIC Rev. 4), and the symbol (T) indicates the number of years.

The endogenous variables are (Y_1), which represents industrial production; (Y_2), which represents manufacturing exports; and (Y_3), which represents manufacturing value-added.

The exogenous variables are as follows: (X1) represents intermediate services; (X2) represents intermediate goods; (X3) represents the number of employees; (X4) represents compensation per employee; and (X5) represents spending on improvement and development. Table 3.1 below shows the definitions of the study variables and the references used in selecting them.

The methodology of this study involves collecting panel data for the years 2011–2021 across 85 manufacturing sectors in Jordan, classified according to the four-digit ISIC Rev. 4. Some industrial sectors, such as mining, electricity, gas, and air conditioning, were excluded due to their distinct characteristics and operational dynamics, which differ significantly from those of the manufacturing sectors.

Furthermore, this study excluded nine sectors from the sample because they have no exports. These nine manufacturing sectors include four industries producing exclusively for the domestic market (wood processing; manufacture of coke and refined petroleum products; vehicle maintenance and repairs; printing and reproduction of recorded media) and five utility industries (oil and natural gas extraction; metal mining; gas and electric supplies; water supply; and home trash and recycling pick-up).

The study used data from the United Nations Industrial Development Organization and the Jordanian Department of Statistics covering the period 2011 to 2021. During this time, the Department of Statistics conducted industry surveys, gathering data from 85 industries classified under the 4-digit ISIC Rev. 4, as shown in Appendix A.

The collected data include eight endogenous and exogenous variables. To ensure accurate model specification, rank and order conditions are checked to facilitate the construction of a system of three simultaneous equations. Following this, the study employs the following method to transform the nonlinear system of equations (1–3) into a log-linear model:

$$\log \boldsymbol{Y_{1it}} = c_1 + \alpha_2 \log \boldsymbol{Y_{2it}} + \alpha_3 \log \boldsymbol{Y_{3it}} \quad \beta_1 \log \boldsymbol{x_{1it}} + \beta_2 \log \boldsymbol{x_{2it}} + \beta_3 \log \boldsymbol{x_{3it}} + \epsilon_1 \qquad (4)$$

$$\log \boldsymbol{Y_{2it}} = c_2 + \alpha_4 \log \boldsymbol{Y_{3it}} + \beta_4 \log \boldsymbol{x_{1it}} + \beta_5 \log \boldsymbol{x_{2it}} + \beta_6 \log \boldsymbol{x_{3it}} + \beta_7 \log \boldsymbol{x_{5it}} + \epsilon_2 \qquad (5)$$

$$\log \boldsymbol{Y_{3it}} = c_3 + \alpha_5 \log \boldsymbol{Y_{2it}} + \beta_8 \log \boldsymbol{x_{2it}} + \beta_9 \log \boldsymbol{x_{3it}} + \beta_{10} \log \boldsymbol{x_{4it}} + \beta_{11} \log \boldsymbol{x_{5it}} + \epsilon_3 \quad (6)$$

Where i = 1, 2, 3, and c_i = log (α_i). Concerning the stochastic error term (ϵ_i), all explanatory and endogenous variables on the right-hand side are considered uncorrelated.

In this study, the simultaneous equations system (4-6) is estimated using the 3SLS approach, which is known for its effectiveness in such analyses. The study uses Stata 18, a statistical software, for all data analysis. 3SLS is preferred over OLS methods and is noted for its comparative efficiency compared to 2SLS.

Table 3.1: Study Variables

No	Term	Operational Definition	References
1.	Industrial Production Y_1	▪ Industrial production is the output of industrial enterprises, including mining, manufacturing, electricity, gas, steam, and air conditioning.	OCED, 2024a; Sahoo, et al., 2022 Alkhatib & Alkhatib, 2021
2.	Manufacturing Exports Y_2	▪ According to the OECD (2024), manufacturing exports are goods produced by the manufacturing sector and sold to other countries. ▪ It is used as a proxy variable to assess the level of	OECD, 2024b; Lyu et al., 2023; Iheanacho et al., 2023; Alkhatib & Alkhatib, 2021;

No	Term	Operational Definition	References
		integration of a country with the global market.	Negem, 2016 Naughton, 2000;
3.	Manufacturing Value Added Y_3	▪ The term Manufacturing Value Added (MVA), as defined by the OECD (2024), refers to the value generated from the manufacturing sector's production of goods. ▪ The MVA calculation entails subtracting the value of intermediate inputs used in the production process from the sector's output value.	OCED, 2024b; Durongkaveroj, (2022); Alkhatib & Alkhatib, 2021; Zhu, (2019)
4.	Intermediate Services X_1	▪ Those that serve as inputs in the production of other goods or services. ▪ The definition emphasizes the role of these services in supporting the production of final goods.	OCED, 2024b; Bao et al. (2023); Alkhatib & Alkhatib, 2021
5.	Intermediate Goods X_2	▪ These goods, which are shipped from one country to another, are materials or parts used in the manufacture of more complex products. ▪ The emphasis on intermediate goods reflects their importance in boosting domestic industries by using domestically produced inputs, enhancing the country's overall economic structure and capacity.	OCED, 2024b; Bao et al. (2023); Alkhatib & Alkhatib, 2021
6.	Number of Employees X_3	▪ The number of employees in each manufacturing sector.	Naz & Ahmad, 2018
7.	Compensations per Employee X_4	▪ The total remuneration an employee receives, including wages, salaries, bonuses, benefits, and other financial rewards for their work. ▪ This metric is often used as a proxy for the degree of skill of the labor force, as higher compensation generally correlates with higher skill levels, specialized knowledge, and greater productivity.	Herrero & Rial, 2023; Brunow et al., 2019
8.	Spending on Improvement & Development X_5	▪ It refers to the allocation of financial resources towards activities that enhance the capabilities, efficiency, and overall performance of an organization or sector. ▪ It is a proxy used for technological Advancement.	Lee & Kwon, 2023; Alkhatib & Alkhatib, 2021

Afterward, the study divides the manufacturing sectors into two equal groups based on the average export-to-output ratio for the entire sample from 2011 to 2021. Initially, industries in the low-exporting category (3.8 < export-to-output ratio ≤ 25) accounted for approximately 48% of the sample's total production. In contrast, industries classified as high exporters (export-to-output ratio > 25) accounted for around 52% of the total production during the same period, as shown in Table 3.2.

This classification is based on output volume, with the number of sectors in each group being roughly equal. By distinguishing between low- and high-exporting sectors, the study aims to better understand how export intensity influences industrial performance and development, enabling more targeted policy recommendations and strategic planning.

Table (3.2): Statistics for High and Low Exporting Groups

High Exporting Group		Low Exporting Group		Total	
Production	**No. Observations**	**Production**	**No. observations**	**Production**	**No. observations**
4,069,728	235	3,733,943	195	7,803,671	430

4. THE EMPIRICAL RESULTS

This section presents the study's results, estimated using the Three-Stage Least Squares (3SLS) method. First, the entire sample was analyzed using the three simultaneous equations model (Equations 4 to 6). Subsequently, the model was estimated separately for the high-export manufacturing sector group and then for the low-export manufacturing sector group.

Tables 4.1, 4.2, and 4.3 show the goodness-of-fit results for these three groups: the full sample of manufacturing sectors, the high-export manufacturing sectors, and the low-export manufacturing sectors, respectively.

The analysis for the Goodness-of-Fit Tests for all Sectors is shown in Table 4.1:

The estimation results for all manufacturing sectors indicate a robust fit for Equation 4, which models industrial production (Y_1). The R^2 of 0.9924 suggests that the model explains 99.24% of the variance in industrial production.

In contrast, Equation 5, modeling manufacturing exports (Y_2), exhibits a moderate fit with an R^2 of 0.5517 and a higher RMSE of 1.372387, indicating that the model explains only 55.17% of the variance.

Equation 6, which models manufacturing value-added (Y_3), demonstrates a substantial fit with an R^2 of 0.8250 and an RMSE of 0.6050441, explaining 82.50% of the variance.

Table (4.1): Goodness-of-Fit Tests for all Manufacturing Sectors

Equation	No. of Observation	Parameters	RMSE	R^2	Chi^2	P>Chi^2
Equation 4	430	5	0.12083	0.9924	54168.59	0.0000
Equation 5	430	5	1.372387	0.5517	538.91	0.0000
Equation 6	430	5	0.6050441	0.8250	2084.06	0.0000

The analysis for the Goodness-of-Fit Tests for High-Export Manufacturing Sectors is shown in Table 4.2:

For high-export manufacturing sectors, Equation 4 achieves an exceptionally high R^2 of 0.9949 and a low RMSE of 0.1065134, indicating a near-perfect fit for industrial production (Y_1).

Equation 5 shows an improved fit relative to the entire sample, with an R^2 of 0.7344 and an RMSE of 1.156507. This suggests that the model explains 73.44% of the variance in manufacturing exports (Y_2).

Equation 6 also performs well in this group, with R^2 of 0.9208 and a lower RMSE of 0.4413009, explaining 92.08% of the variance in manufacturing value added (Y_3).

Table (4.2): Goodness-of-Fit Tests for high-exports manufacturing sectors

Equation	No. of Observation	Parameters	RMSE	R^2	Chi^2	P>Chi^2
Equation 4	195	5	0.1065134	0.9949	38223.86	0.0000
Equation 5	195	5	1.156507	0.7344	538.79	0.0000
Equation 6	195	5	0.4413009	0.9208	2298.71	0.0000

The analysis for the Goodness-of-Fit Tests for Low-Export Manufacturing Sectors is shown in Table 4.3:

In the low-export manufacturing sectors, Equation 4 maintains a high R^2 of 0.9857 and an RMSE of 0.1514603, indicating a robust model fit for industrial production (Y_1).

However, Equation 5 shows a considerably lower R^2 of 0.4337 and an RMSE of 1.359014, suggesting the model explains only 43.37% of the variance in manufacturing exports (Y_2), notably weaker than the high-export sectors.

Equation 6 indicates a relatively strong fit with an R^2 of 0.7962 and an RMSE of 0.5923466, explaining 79.62% of the variance in manufacturing value added (Y_3).

Table (4.3): Goodness-of-Fit Tests for low-exports manufacturing sectors

Equation	No. of Observation	Parameters	RMSE	R^2	Chi^2	P>Chi^2
Equation 4	235	5	0.1514603	0.9857	15379.54	0.0000
Equation 5	235	5	1.359014	0.4337	191.98	0.0000
Equation 6	235	5	0.5923466	0.7962	917.25	0.0000

Based on previous results, when dividing the entire sample into two groups—the first representing high-export industrial sectors and the second representing low-export industrial sectors—the coefficient of determination (R^2) was higher for the first group. This indicates that the model explains the performance of high-export sectors better than that of low-export sectors. Additionally, this suggests that the model may require further refinement to more effectively capture the dynamics of low-export manufacturing sectors.

The analysis of the simultaneous equations model in Table (4.4), which represents all manufacturing sectors in the study sample, indicates the following:

- Industrial Production (Y1) is significantly positively correlated with manufacturing value-added (Y3) and shows a statistically significant positive correlation between intermediate goods (X2) and intermediate services (X1), consistent with the findings of Alkhatib & Alkhatib's study (2021).
- The correlation between manufacturing exports (Y2) and industrial production is statistically insignificant, consistent with (Istaiteyeh et al. 2023; Wan et al. 2022; Alkhatib & Alkhatib, 2021), but not with those of (Mohsen et al. 2015; Sahoo et al. 2022; Saeed & Ullah, 2021).
- Manufacturing Exports (Y_2) are positively correlated with intermediate services (X_2) and intermediate goods (X_2), consistent with Bao et al. (2023), but negatively correlated with the number of employees (X_3). This suggests that higher intermediate inputs drive exports, while increased employees may reduce efficiency.
- Manufacturing Value-Added (Y_3) is significantly correlated with the number of employees (X_3) and compensations per employee (X_4), indicating that human capital and compensation play crucial roles in adding value to manufacturing outputs.

Table (4.4): The Results of the Simultaneous Equations Model for the All Sectors

Equation	**Variable**	**All Industries**					
		Coef.	**St. Error**	**Z-statistic**	**Prob.**	**[95% Conf. Interval]**	
Equation 4 $\log \boldsymbol{Y_1}$	$\boldsymbol{C_1}$	1.030978	.1947895	5.29	0.000*	0.6491977	1.412759
	$\boldsymbol{log\ Y_2}$	0.0088959	0.0862536	0.10	0.918	-0.160158	0.1779498
	$\boldsymbol{log\ Y_3}$	0.3995648	0.0497832	8.03	0.000*	0.3019916	0.4971381
	$\boldsymbol{log\ X_1}$	0.0653509	0.0290585	2.25	0.025*	0.0083973	0.1223045
	$\boldsymbol{log\ X_2}$	0.5431511	0.0529073	10.27	0.000*	0.4394548	0.6468474
	$\boldsymbol{log\ X_3}$	-0.0349343	0.0282591	-1.24	0.216	-0.0903211	0.0204525
	$\boldsymbol{R^2}$	**0.9924**			**RMSE**		**0.12083**
	N	**430**					
Equation 5 $\log \boldsymbol{Y_2}$	$\boldsymbol{C_2}$	-1.860367	0.6962044	-2.67	0.008*	-3.224903	-.4958313
	$\boldsymbol{log\ Y_3}$	0.3591351	0.3230624	1.11	0.266	-.2740555	0.9923257
	$\boldsymbol{log\ X_1}$	0.3247029	0.1521091	2.13	0.033*	0.0265744	0.6228313
	$\boldsymbol{log\ X_2}$	0.6322782	0.2137571	2.96	0.003*	0.2133219	1.051234
	$\boldsymbol{log\ X_3}$	-0.3033972	0.1040772	-2.92	0.004*	-0.5073847	-0.0994098
	$\boldsymbol{log\ X_5}$	0.0386665	0.0378803	1.02	0.307	-0.0355776	0.1129107
	$\boldsymbol{R^2}$	**0.5517**			**RMSE**		**1.372387**
	N	**430**					
Equation 6 $\log \boldsymbol{Y_3}$	$\boldsymbol{C_3}$	0.7634338	0.476984	1.60	0.109	-0.1714377	1.698305
	$\boldsymbol{log\ Y_2}$	0.161331	0.1800457	0.90	0.370	-0.1915522	0.5142142
	$\boldsymbol{log\ X_2}$	0.3329417	0.1598852	2.08	0.037*	0.0195725	0.6463109
	$\boldsymbol{log\ X_3}$	0.4502762	0.0589926	7.63	0.000*	0.3346527	0.5658996
	$\boldsymbol{log\ X_4}$	0.5992963	0.1196866	5.01	0.000*	0.3647149	0.8338777
	$\boldsymbol{log\ X_5}$	0.0208609	0.0180494	1.16	0.248	-0.0145152	0.056237
	$\boldsymbol{R^2}$	**0.8250**			**RMSE**		**0.6050441**
	N	**430**					

(*) & (**) Significant at (5%) and (10%) significance levels, respectively.

The analysis of the simultaneous equations model in Table (4.5), which represents high-export sectors, indicates the following:

- **Industrial Production (Y_1)** is primarily correlated with manufacturing value-added (Y_3), intermediate goods (X_2), and intermediate services (X_1).
- **Manufacturing Exports (Y_2)** are positively correlated with intermediate goods (X_2) and spending on improvement and development (X_5) but not significantly correlated with other variables.
- **Manufacturing Value-Added (Y_3)** is significantly correlated with the number of employees (X_3) and compensations per employee (X_4).

Table (4.5): The Results of the Simultaneous Equations Model for the High Export Sectors

Equation	Variable	Industries in the High Exporting Group					
		Coef.	St. Error	Z-statistic	Prob.	[95% Conf. Interval]	
Equation 4 $\log Y_1$	C_1	0.8670184	0.1730229	5.01	0.000*	0.5278997	1.206137
	$log\ Y_2$	-0.0338539	0.0464596	-0.73	0.466	-0.124913	0.0572052
	$log\ Y_3$	0.3768982	0.0357684	10.54	0.000*	0.3067935	0.447003
	$log\ X_1$	0.0823237	0.0195746	4.21	0.000*	0.0439581	0.1206893
	$log\ X_2$	0.5978721	0.0424904	14.07	0.000*	0.5145924	0.6811519
	$log\ X_3$	-0.0256281	0.0155509	-1.65	0.099**	-0.0561074	0.0048511
	R^2	**0.9949**			**RMSE**		**0.1065134**
	N	**195**					
Equation 5 $\log Y_2$	C_2	-2.840505	0.7899241	-3.60	0.000*	-4.388728	-1.292282
	$log\ Y_3$	0.0597068	0.3737337	0.16	0.873	-0.6727977	0.7922113
	$log\ X_1$	0.267919	0.1807668	1.48	0.138	-0.0863775	0.6222154
	$log\ X_2$	0.9691721	0.22244	4.36	0.000*	0.5331976	1.405146
	$log\ X_3$	-0.1528455	0.1370778	-1.12	0.265	-0.421513	0.1158221
	$log\ X_5$	0.0943149	0.0475773	1.98	0.047*	0.0010651	0.1875646
	R^2	**0.7344**			**RMSE**		**1.156507**
	N	**195**					
Equation 6 $\log Y_3$	C_3	0.6720324	0.8514343	0.79	0.430	-0.9967481	2.340813
	$log\ Y_2$	0.1769176	0.2398542	0.74	0.461	-0.2931881	0.6470233
	$log\ X_2$	0.165681	0.2563244	0.65	0.518	-0.3367057	0.6680676
	$log\ X_3$	0.6527504	0.0656106	9.95	0.000*	0.5241561	0.7813447
	$log\ X_4$	0.6804489	0.1038691	6.55	0.000*	0.4768693	0.8840286
	$log\ X_5$	-0.0003496	0.0285336	-0.01	0.990	-0.0562744	0.0555752
	R^2	**0.9208**			**RMSE**		**0.4413009**
	N	**195**					

(*) & (**) Significant at (5%) and (10%) significance levels, respectively.

The analysis of the simultaneous equations model for low-export sectors indicates the following:

- **Industrial Production (Y_1)** is primarily correlated with manufacturing value-added (Y_3) and intermediate goods (X_2). The correlation between manufacturing exports (Y_2) and industrial production is insignificant.
- **Manufacturing Exports (Y_2)** positively correlated with intermediate services (X_1), intermediate goods (X_2), and spending on improvement and development (X_5), but the correlation with other variables is insignificant.
- **Manufacturing Value-Added (Y_3)** is significantly correlated with intermediate goods (X_2), the number of employees (X_3), and compensations per employee (X_4), highlighting the importance of labor quality and compensation in adding value to manufacturing outputs.

Table (4.6): The Results of the Simultaneous Equations Model for the Low Export Sectors

Equation	Variable	Industries in the Low Exporting Group					
		Coef.	St. Error	Z-statistic	Prob.	[95% Conf. Interval]	
Equation 4	C_1	1.003124	0.1051803	9.54	0.000*	0.7969749	1.209274
	$log\ Y_2$	0.0805689	0.1502073	0.54	0.592	-0.2138319	0.3749697
	$log\ Y_3$	0.4962903	0.0654804	7.58	0.000*	0.3679511	0.6246296

Equation	Variable	Industries in the Low Exporting Group					
		Coef.	**St. Error**	**Z-statistic**	**Prob.**	**[95% Conf. Interval]**	
$\log Y_1$	$log\ X_1$	0.0187407	0.0713499	0.26	0.793	-0.1211025	0.158584
	$log\ X_2$	0.4094425	0.1736397	2.36	0.018*	0.0691149	0.7497701
	$log\ X_3$	-0.0059172	0.0687096	-0.09	0.931	-0.1405855	0.1287512
	R^2	**0.9857**			**RMSE**		**0.1514603**
	N	**235**					
Equation 5 $\log Y_2$	C_2	0.1582569	0.9771492	0.16	0.871	-1.75692	2.073434
	$log\ Y_3$	-0.3721994	0.3403875	-1.09	0.274	-1.039347	0.294948
	$log\ X_1$	0.4431499	0.2022201	2.19	0.028*	0.0468058	0.8394939
	$log\ X_2$	1.112435	0.2731338	4.07	0.000*	0.5771024	1.647767
	$log\ X_3$	-0.4237744	0.1713412	-2.47	0.013*	-0.759597	-0.0879517
	$log\ X_5$	0.0364783	0.0491644	0.74	0.458	-0.0598821	0.1328386
	R^2	**0.4337**			**RMSE**		**1.359014**
	N	**235**					
Equation 6 $\log Y_3$	C_3	0.8302138	0.3774386	2.20	0.028*	0.0904477	1.56998
	$log\ Y_2$	0.0547167	0.1979449	0.28	0.782	-0.3332481	0.4426815
	$log\ X_2$	0.4567122	0.2003163	2.28	0.023*	0.0640995	0.8493249
	$log\ X_3$	0.3598202	0.075426	4.77	0.000*	0.2119879	0.5076524
	$log\ X_4$	0.9018816	0.1055076	8.55	0.000*	0.6950905	1.108673
	$log\ X_5$	0.0019159	0.0229583	0.08	0.933	-0.0430816	0.0469134
	R^2	**0.7962**			**RMSE**		**0.5923466**
	N	**235**					

(*) & (**) Significant at (5%) and (10%) significance levels, respectively.

5. CONCLUSIONS AND RECOMMENDATIONS

The findings demonstrate that, according to this model, there is no direct correlation between manufacturing exports and industrial production. Additionally, there is no significant relationship between manufacturing exports and the manufacturing value-added of exported industries within Jordan's manufacturing sector.

This can be attributed to several factors. Jordanian manufacturing may be more oriented toward domestic consumption than exports, with local market dynamics and consumer preferences exerting greater influence on production than export activities. This domestic focus reduces reliance on global market trends and export demands in shaping production processes and output.

According to the 2022 Jordan Industrial Competitiveness Report, Jordanian goods must integrate into global markets to enhance their competitiveness. However, trade restrictions, limited access to advanced technologies, and intense global competition present significant challenges. Issues such as meeting international quality standards, high production costs, and less competitive pricing can inhibit industrial production growth driven by exports. Empirically, this study does not support the export-led development theory.

Moreover, the study indicates that the manufacturing sector heavily relies on intermediate goods and services, which are crucial inputs for production. The significant correlation between human capital and manufacturing value-added underscores the importance of labor quality and compensation in driving sectoral growth. This suggests that investments in human capital can substantially boost the manufacturing sector by increasing productivity and innovation.

Based on these findings, the study proposes the following recommendations to enhance industrial production and export performance for better integration into the global market:

1. Provide targeted support for export-oriented manufacturing sectors through financial assistance, export promotion programs, and capacity-building initiatives. Export-oriented sectors play a vital role in manufacturing, and their growth can significantly enhance export performance and global market integration.
2. Promote policies aimed at improving compensation for manufacturing workers, which could directly contribute to higher productivity. This may involve minimum wage adjustments, incentives for performance-based pay, and improved working conditions.
3. Strategically allocate development funds to high-export sectors that are responsive to such investments. This may include subsidies for technology upgrades, research and development credits, and support for adopting advanced manufacturing technologies.
4. Recognize that this study does not address broader challenges such as digital transformation and the implementation of green supply chain practices, which are critical for the manufacturing sector's sustainable growth and high-tech integration. Further research is recommended to explore these areas in greater detail.

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