Asian Development Policy Review
ISSN(e): 2313-8343
ISSN(p): 2518-2544
DOI: 10.55493/5008.v14i1.5837
Vol. 14, No. 1, 58-80

URL: www.aessweb.com

Input-output based analysis of intersectoral linkages for economic diversification in Oman

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Article History
Received: 13 June 2025
Revised: 17 December 2025
Accepted: 29 December 2025
Published: 23 January 2026

Keywords
Diversification
Input-output
Intersectoral linkages
Multiplier
Oman economy
Structural analysis.

ABSTRACT

The paper aims to quantify the intersectoral linkages that facilitate economic diversification in the Omani economy. The input-output analysis is used to assess the effects of inter-sectoral transactions for policy changes. The analysis is employed in development planning, impact assessment, and measuring external shocks. The short-run projected demand is forecasted through hypothetical positive and negative changes in final demand in each sector to predict changes in final demand. Income multipliers are derived by transposing the third-degree power series generation of the Leontief inverse matrix. The results suggest that the non-mining and quarrying sectors are strongly linked, with significant forward and backward linkages in determining value addition, output growth, and employment levels. The wholesale retail, fishing, public services, defense, health, and education sectors are creating employment opportunities. However, the employment and income multipliers indicate strong links with non-mining and services sectors. Policymakers should consider focusing on industries with strong connections. The robust linkages in the non-mining and quarrying sectors suggest that interventions in these sectors could help diversify the economy. The Omani economy requires an in-depth understanding of structural patterns, sectoral-level interventions, and consistency in policy measures.

Contribution/ Originality: The paper quantifies the intersectoral linkages in input-output analysis for the diversification of the Oman economy. It offers insights into intersectoral linkages, the impact of short-run hypothetical policy changes on demand in different sectors. It generates the multiplier impact through third-degree power generation methods of the Leontief inverse matrix on output growth, employment, and income.

1. INTRODUCTION AND BACKGROUND

Oman, like other GCC economies, is an oil-exporting economy eager to diversify its resource base away from a single mining and quarrying resource. Vision 2040 and the development plan documents aim to diversify the economic base of the Omani economy by increasing the share of non-mining and quarrying sectors without compromising the welfare and living standards of the population (see, for example, (Fattouh, Luciani, Moerenhout, & Sen, 2019; Shehabi, 2019)). However, the nature of diversification may differ across countries and regions. Oil price stability is crucial; fluctuations in oil prices and the COVID-19 pandemic have exerted significant pressure on various sectors of the economy. Most governments in the region have adjusted their fiscal space, as many are heavily dependent on oil revenues for their expenditures. Fluctuating oil prices slow down output growth, and the public sector faces fiscal

and external imbalances, a sharp decline in private sector activities, and vice versa. Oil price fluctuations have impacted government spending, affecting output growth and employment opportunities.

Historically, diversification has been primarily driven by mineral and mining resources, and this sector remains the main source of fiscal governance and economic development (Fattouh & Sen, 2021). Fiscal constraints limit diversification efforts, affecting adjustments in output and growth targets. Recently, mineral and mining prices have rebounded, contributing to economic recovery and stability in the post-pandemic period. The Omani economy exemplifies this trend, reshaping its intersectoral demands to achieve the goals outlined in Vision 2040. Transitioning toward diversification necessitates a careful approach to enhance productivity, output growth, and the shift toward human and physical capital, alongside developing physical infrastructure. This process involves industry and productivity innovation, an improved regulatory environment, and efficient institutions (see, e.g., Dabla-Norris and Srivisal (2013)). Ensuring resources within and across sectors are allocated effectively can lead to increased productivity and output growth, provided the process is driven by technological change and efficient resource allocation (see, for example, (Hausmann, Hidalgo, Bustos, Coscia, & Simoes, 2014; McMillan, Rodrik, & Verduzco-Gallo, 2014)). For effective resource allocation, understanding the structural dynamics of the economy, including backward-forward linkages and intersectoral transactions, is crucial for implementing targeted policy interventions.

A vast body of literature exists that studies sectoral links and diversification. For example, Subramaniam and Reed (2009) studied Romania and Poland, establishing sectoral links and confirming that sectors move together, with growth rates in output being interdependent. The activities of the industrial sector are influenced by the growth of the agriculture sector, and the services sector contributes positively. Long-term resource-dependent countries employ various strategies and policies to transform their economies and achieve success. Oman's economy exemplifies this phenomenon. Vision 2040 aims to identify non-hydrocarbon sectors that can increase their contribution to output growth. The target for the non-oil output sector was 70 percent of total GDP by 2020 (Al-Mawali, Al Lawati, & Ananda, 2019). Based on 2020 data, the oil and gas sector accounted for 26.2 percent of GDP, 60 percent of exports, and three-quarters of the revenue share in GDP.

Literature, such as Boughanmi, Zaibet, Al-Jabri, and Al-Hinai (2002), derives from SAM matrix coefficients and simulates various policy effects. Their results suggest that an overall multiplier effect on oil price production has resulted in increased revenue impact, alongside positive effects on the external trade balance and higher savings rates. The study by Lashitew, Ross, and Werker (2021) confirmed that Oman's economy has performed well in terms of human development and public capital over time. However, the economy lags in tertiary education, R&D, credit access, and openness. Oman's economy remains oil-dependent; nonetheless, diversification efforts over the years have shown nominal progress by increasing the contribution of manufacturing, agriculture, and services sectors to GDP (CBO, 2020). The CBO data indicate that between 2016 and 2020, the share of GDP from petroleum activities was 26 percent, while non-petroleum activities accounted for 77 percent. However, the services sector is projected to drive the diversification process. The tourism, transportation, logistics, and services sectors are eager to contribute to the country's 2040 vision. Moody's (2022) GDP data from 2010 to 2020 show that the agriculture sector contributed 2.35 percent, the industry sector contributed 53.72 percent, and the services sector contributed 44.13 percent.

Literature suggests that, barring a few exceptions, hardly any attempt has been made to establish sectoral linkages using input-output tables of the Oman economy, partly due to the unavailability of these tables earlier. Second, the Omani economy has heavily invested in tourism, logistics, and the services sector for diversification to achieve the Vision 2040 goals. Therefore, establishing the inter-sectoral linkages and interdependencies of various sectors is exceptionally critical in understanding the structural features of the economy. For this, input-output analysis of transaction tables, short-run projected changes in demand in targeted sectors, and the multiplier impact of income and employment are important for policymakers to target investment, output, and employment activities in leading sectors. The input-output data set 2022 is available now, and it uncovers the extent to which technical transactions of different sectors, value addition, and the structure of output, employment, and intersectoral

transaction demand are involved. The structural intersectoral links help in understanding the magnitude of economic activities, final demand, and thereby determining the investment, production, demand, and multiplier effects.

The study contributes to policy debate by identifying the extent of structural transactions, technical coefficients, and multiplier impact. The policy recommendations may highlight important interventions towards diversification and the achievement of the strategic goals of Vision 2040. The study has limitations in determining the baseline short-run structural changes in domestic demand using single-year data. Long-run fluctuations or external shocks are not considered at this stage in the analysis due to the limited availability of input-output data. The policy implications arising from input-output analysis will help in understanding the structural nature of intersectoral transactions, demand for inputs, supply use, and final demand in each sector, allowing for the targeting of strongly linked sectors that may generate output, investment, and value-added activities to diversify the economy.

The findings are likely to contribute to the debate on the structural dynamics of the Oman economy, diversification of leading sectors, and provide fresh evidence and policy analysis on the nature of intersectoral linkage transactions, short-run projected demand, and multiplier impact for the diversification of the Oman economy. The policy recommendations highlight the need to target specific sectors and policies, given the significant magnitude of transaction activities in sectors that can generate economic value, output changes, investment, and employment opportunities.

2. REVIEW OF LITERATURE

The literature emphasizes the structural transformation and presents an argument about the probable competitiveness of the country, as well as its advancement in growth and capability with respect to trade-related data. However, research on the internal domestic structure of the economy's behavior allows for better targeting of policy for specific sectors, leading to changes in demand and supply for those sectors.

The GCC economies are such cases, being heavily dependent on a single sector, such as mining and quarrying, or a sole source for the production and exports of oil and minerals. These economies are eager to diversify their resource base away from a sole source. The national plans and policies are pursuing diversification strategies. The literature on diversification, for example, Mercer-Blackman, Foronda, and Mariasingham (2017) used input-output data on various agglomeration indicators to measure the economic diversification of Bangladesh's economy and found that diversification occurs at a slower pace than the expected level of development. This is due to prevailing rigidity and sectoral responses that generate low demand. Sonis, Guilhoto, Hewings, and Martins (1995) describe macro, micro, and meso-level perspectives of changes in direct coefficients of direct synergetic changes through the additive components of the Leontief inverse result transmission, indicating that structural change penetrates complex web interactions that characterize an economy. Xu and Liang (2019) utilized an input-output (IO) network to provide insights into the structure of different economic sectors using the WIOD 2009 data, offering a deeper understanding of sectoral transactions. Input-output tables are essential for measuring these transactions. Fathi (2014) employed an input-output model of the oil-dependent Iranian economy, incorporating a hypothetical extraction method framework, and found that the low value of the oil and gas sector's forward and backward linkages indicates weak sectoral independence and a strong push from these sectors. This suggests that sectors exhibit strong backward and forward linkages within the Iranian economy. Madgazieva and Inaba (2019) studied the economic structure of Uzbekistan and other Central Asian countries using input-output tables generated by the EORA global database of the multi-regional input-output table (MRIOT) between 2005 and 2015, showing that agriculture plays a leading role in Uzbekistan's industrial output, followed by mining, which is the most influential sector. The leading sectors have strong linkages with other sectors. Mubeen, Kumar, and Nazneen (2017) examined the effects of oil prices and their link with diversification plans of the Sultanate of Oman amidst oil price crises, suggesting increased diversification through promoting the industrial sector, creating demand for non-oil products, and marketing tourism. Mandras and Salotti (2020) used input-output data for Western Balkan economies' multipliers, indicating the

potential impact of changes in final demand on products and sectors, with indirect and induced effects of sectoral interdependencies. Sectoral changes and multiplier impacts influence various sectors, the magnitude of inter-sectoral transactions, value addition, production, and consumption patterns. Valentini (2021) reveals that input-output relationships are significant for aggregate TFP and output. Measuring factor productivity using input-output analysis establishes the relationship between output and factor income. Abdullah (2021) suggests that output growth is driven by capital investment and labor accumulation, with less influence from technology. The main sectors agriculture, manufacturing, financial intermediation, and tradeable goods contribute to the economy. The mining and quarrying sectors operate in isolation, while non-mining tradable sectors, especially manufacturing, have the most robust linkages. The author recommends reallocating resources from mining to non-mining tradable and productive sectors. Norbu, Tateno, and Bolesta (2021) examine backward and forward linkages for Asia-Pacific LDCs using the input-output analysis framework developed by Mercer-Blackman et al. (2017), finding that the agricultural sector sustains job creation and stronger production linkages. McMillan, Rodrik, and Sepulveda (2017) analyze growth patterns using a unifying framework based on structural transformation and growth fundamentals among seven key countries from 1990 to 2010, noting that Vietnam's rapid growth was significantly driven by export industrialization. Özçam (2009) applied an econometric procedure on the technical production coefficients of the Turkish IO table, using the Maximum Entropy method to estimate production coefficients directly. Marconi, Rocha, and Magacho (2016) assessed sectoral performance and its effects on upstream supply chains using input-output tables, finding that in Brazil, agricultural and mineral commodities have limited capacity to boost the economy due to low linkage indices, whereas manufacturing sectors can stimulate other sectors and services with high linkage effects. Haddad, Perobelli, and De Araújo (2020) used a partial hypothetical extraction approach to analyze Brazil and Colombia's input-output systems under different lockdown strategies, designing sectoral and territorial policies based on simulated scenarios. Hirschman (1958) proposed that developing one sector could trigger intermediate demand for inputs from other sectors, fostering investment and output activities that stimulate demand across the economy. Conversely, Davis (2002) suggested that sectoral spin-off activities can spur production and innovation. Acemoglu, Antràs, and Helpman (2007) and Jones (2011) identified various distortions in input markets within their theoretical models, indicating the presence of rigidities at all levels. Bartelme and Gorodnichenko (2015) emphasized that the strength of industry linkages is crucial for overall productivity. Hausmann and Hidalgo (2011) characterized the network of structural features connecting countries to their export products, non-tradable inputs, or capabilities. Most studies find significant heterogeneity in capabilities across countries, implying that increased diversification is linked to the capacity to accumulate capabilities, which results in small gains for countries with few capabilities and larger gains for those with more.

The evidence suggests that the use of input-output tables for understanding the structural features of economic dynamics, linkages, and demands in different sectors. In most countries, case studies establish the structural features of the economy, targeting one sector as a leading sector, and projecting the pace and short-run changes in demand and economic activities are valuable insights provided by input-output analysis. The input-output analysis is used by policymakers for targeting demand, investment, and the backward-forward linkages among sectors. Diversification as a policy also focuses on the tangible benefits of structural transformation, such as increased labour productivity, production capacities, or competition. Most economies face policy challenges to increase productivity, production capacities, and improve their competitiveness index. The GCC economies are not an exception to this phenomenon. For example, several regional organizations have championed economic diversification to realize the economic objectives of stability and growth. Diversity, as defined, applies only to the distribution of employment among sectors. Wagner and Deller (1998) derived increased stability from the input-output model through a higher degree of diversification, which is associated with a transport technical coefficient matrix. However, structural transformation or diversification refers to the intentional change in the production structure of a typical economy, such as the Omani economy, which is of particular interest to policymakers as they seek to advance the economy away from dependence

on oil and gas towards non-oil, tradable goods. For instance, Beutel (2021) employed input-output tables for Kuwait and Saudi Arabia in his research on the GCC diversification experience, measuring them against a reference case of Norway, which had successfully diversified its economy. The author concluded that GCC countries, contrary to expectations, collectively performed well in terms of diversification, but their performance on sustainability varies from country to country[1]. The literature is quite rich in both content and evidence, indicating that input-output analysis is widely used across different countries' contexts and policy purposes. The analysis is very significant in measuring various structural features of the economy, intersectoral transactions, and the pace of transformation and diversification. In the case of the Omani economy, hardly any studies are ever conducted using input-output tables. The case employs the input-output model for analysis, investigating various structural features and intersectoral linkages to understand the dynamic nature of production, demand, and the economy's stylized characteristics. Understanding the structural features will help policymakers to measure the magnitude of intersectoral transactions, dependency, and which sectors require targeting for better policy outcomes and changes. However, with the evidence and data to establish such links for Oman's economy, hardly any study is conducted on the input-output tables. The input-output data set tables have recently been released for researchers to study the structural features of the Oman economy and to establish the short-run and long-run changes in demand. Therefore, this study contributes to filling the gap by measuring and investigating intersectoral translations, short-run demand, and multiplier effects.

3. RESEARCH METHODOLOGY

The literature indicates that linkages are derived from input-output models and can be expressed within the framework of partitioned matrices (Eurostat, 2008; Mahajan et al., 2018). Beutel (2017) confirms that input-output tables are the most effective way to measure the relationship between intermediate consumption, gross value added, and final demand. Miller and Blair (2009) and Miernyk (2020) describe the assumption that the economy is categorized into *n* sectors. We may categorize xi as the total production of sector *I* and fi as the total final demand for the sector's product.

$$x_i = z_{i1} + \cdots + z_{ij} + \cdots + z_{in} + fi = \sum_{j=1}^{n} z_{ij} + f_i \quad (1)$$

The z_{ij} interindustry transactions by sector *i* to all other sectors *j*. This equation represents the distribution of sector I output. This will be extended to all sectors.

$x_i = z_{i1} + \cdots + z_{ij} + \cdots + z_{in} + fi$

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$x_i = z_{i1} + \cdots + z_{ij} + \cdots + z_{in} + fi$

Let

X can be extended to all the Z matrices. F and X (X' would be the corresponding row vector) as in the Z matrix. The distribution of sales among the sectors is noted.

$$x = Z_i + f \quad (2)$$

This summation vector and the multiplication of a matrix by I create a column vector whose elements are the row sums of the matrix. All the primary inputs of value-added in sector J are considered with imported goods and purchased by sector J. These value-added and imports are called payment sectors. The inventory stock can be

[1] The GCC share of intermediate and gross value added to total output was constant during the last 20 years. The share of intermediate consumption of goods and services is the key element of economic diversification, in which Oman's share of intermediate and gross value added in total output growth is 7.7 per cent a year. This is a very low magnitude. This is one area in which Oman is performing better but lower than expected.

subtracted from the total gross output to obtain adjusted output. The technical coefficients are calculated from the basic input-output table's direct purchase of one sector per RO output, which can be expressed.

$$\alpha_{ij} = X_{ij}/X_j \quad (3)$$

The αij is the creation of a particular sector's share of the total product. The direct and indirect effects of the input-output table are transposed by multiplying the matrix by an identity, which may be the inverse of (I-A) -1_T. Any changes in final demand could be adjusted as policy adjustments with inter-industry transactions by making changes in the sector's demand.

$$\sum_{jn=1} X_{fii\,Tij/} = X_{ij} \quad \text{then} \quad (4)$$

$$\alpha ij = X^i j = T^i \quad (5)$$

By multiplying the above equation by each column (I − A) −1, T can generate new demand for each sector of an economy.

3.1. Data Sources

Input-output data tables of Oman's economy were recently published for the first time in 2022 by the NCSI (2022). The tables contain information on the intermediate and final use of domestic and imported goods and services. They cover products on both the input-output side, processing, and payment sectors, including imports and exports, inventory, discounts, consumption, demand, and export and import data across all value-added sectors of industries and production. The tables detail cost structures of industries and the final demand categories in all consumption, investment, and export sectors, presented in both buyer and consumer prices. On the output side, they include sales and output structures of goods and services, with components of value added by factors, taxes, production, consumption, fixed capital, and net operating surplus. The satellite system of the national accounts system is integrated with these tables. The matrix form provides a comprehensive source of information, illustrating inter-sectoral relationships within the transaction table. From this, technical coefficients and multipliers are constructed at the sectoral level. These technical transactions are evaluated to determine the impact of economic changes and analyze their effects on the economy. The general inter-industry relation measure is derived, capturing the quantitative trends among related sectors. All input-output studies are conducted at the national economy level and are essential for resource allocation. Working with different sectors is crucial for creating job and income-generating opportunities. Policymakers can utilize these tables as powerful tools to guide policy decisions. However, the data availability for a single year limits the scope of analyzing long-term trends, structural features, or fluctuations. Nonetheless, the results may serve as a unique baseline for understanding intersectoral linkages.

The following thirteen sectors of the economy are used in the analysis: Agriculture, Fisheries, Mining and Quarrying, Manufacturing, Electricity, Gas and Water Utilities, Construction, Wholesale and Retail Trade, Transport, Storage and Communication, Hotels and Restaurants, Information and Communication, Financial, Insurance and Intermediation, Real Estate and Renting, Public Administration and Defense, Education, Health and Social Welfare, and Other Economic and Social Activities. The variables are used for total output based on the baseline prices and total gross output at market prices. The final demand is calculated with the final output. The original demand and changes in projected and final demand are calculated. The multiplier impact is derived by using the wages.

4. RESULTS AND ANALYSIS

All sectors of the economy are represented in a transaction form of an input-output matrix table that consists of the producing sectors on the vertical axis and the purchasing sectors on the horizontal axis (see Table 1). The tables contain ninety-nine major economic activities constructed within a double-counting system. For simplicity, the table is condensed into sixteen standard major sectors as outlined in the IMF and the national accounting system of Oman. The values are measured in million Rials Omani, with base year prices on production and current prices on the demand

side. The gross output is adjusted by subtracting the previous year's stock or inventory to obtain the total gross output, thereby avoiding double-counting. Table 1 displays the output of each economic sector in horizontal lines and the inputs to each sector or industry from other sectors vertically. The transaction values are expressed in millions of Omani Rials.[2]

The transaction values are in millions of Omani Rials. At the output side of the table, the agriculture-to-agriculture sector's intersectoral transaction is a total of 22.3 million RO. The agriculture sector also contributes 219 million RO worth of goods sold to manufacturing and beverages, and 91.9 million RO worth of goods sold by agriculture to hotels and restaurants. Similarly, the mining and quarrying sector sold its output to its sector worth 616.9 million Omani Rials, 3.5 billion worth of goods to the manufacturing industry, particularly chemical, pharmaceutical, and refined petroleum products, and 341.8 million to the electricity, gas, and water sectors. This indicates the predominance of the sector and its level of linkages with other sectors. It encompasses manufacturing activities, chemical, pharmaceutical, and petroleum products, and even utility sectors. Similarly, the manufacturing industry sells its products to its industry worth 1.036 billion RO. The industry also sold its products to agriculture worth 68.5 million RO, 17.7 million to the fisheries sector, 454.6 million RO, 334.7 million RO in electricity, gas, and water, 1 billion RO, and 75.9 million to construction, 413.1 million to transport, communication, and storage. Wholesale and retail sold their outputs worth 21.9 million RO to agriculture, 5.3 million RO to fisheries, 98.3 million RO to mining and quarrying, 703 million RO to manufacturing, and 541.6 million RO to construction. Additionally, 379 million RO worth of inventory is pending in the mining and quarrying sector. Agriculture sold 51 million RO worth of products, 13 million RO to fisheries, and almost eight billion RO from mining and quarrying sectors (oil and gas sector, six billion RO; manufacturing goods, one billion RO; transport, storage, and communication). From the input side, agriculture purchased goods worth 22.3 million RO from its own sector, 21.9 million from wholesale and retail, 2.9 million from transport, storage, and communication, 68.5 million from manufacturing, 10.8 million from electricity, gas, and water, and 21.9 million from wholesale and retail. Similarly, oil and gas purchases from its own sector activity are worth 616.9 million RO, 454.6 million from manufacturing, almost 98.3 million from wholesale and retail, and 114.2 million RO from transport, storage, and communication. The manufacturing industry buys 219.6 million RO from agriculture, 3.58 billion RO from oil and gas, 1.0366 billion RO from its manufacturing industry, 703 million RO from wholesale and retail, 143.4 million RO from transport, storage, and communication, and 239.5 million RO from other economic activities. The wholesale and retail, hotel, and real estate property activities paid forty-two million RO in taxes. It paid taxes of two million RO and set aside one million RO in depreciation allowances. Finally, the industry paid out seven billion RO in wages and salaries. These individual items must add up to a 40-billion RO amount entered in the Total Gross Outlay row. The interested reader can repeat this process for any industry or sector shown in the table to determine their forward selling and backward input purchases. Manufacturing pays 260 million RO in taxes, and seventeen million RO are paid as subsidies to the manufacturing of petroleum products. Six hundred twenty million RO worth of subsidies are provided for electricity, water, and sanitation. A total of 34 million RO comes from the hotel, food, and accommodation services. Twenty-six million RO provides subsidies to the insurance and financial sector. Oman imports 13.6 billion RO worth of goods and services across different sectors against the production of 59.1 billion RO at base prices. Almost 9.5 billion RO of imports are of agriculture, food, and manufacturing goods. The inter-industry transactions are based on processing and purchasing industry categories that determine the final demand for goods and services in each sector collectively. The major activities include manufacturing, mining, and quarrying, construction, hotel and restaurant, public administration and defense, education, and wholesale and retail markets.

[2] The demand side table shows the columns of intermediate, government, and final consumption along with the capital formation, inventory, and exports. At the same time, the payment sectors show the intermediate consumption, value addition at base prices, and production by each sector activity with workers' compensation.

Table 1. Transaction table (millions of RO).

Output/Input	Agriculture	Fisheries	Mining and quarrying	Manufacturing	Electricity, gas, and water	Construction	Wholesale and retail	Transport, storage and communication	Hotel and restaurants	Information and communication	Insurance	Real estate	Public administration and defense	Education	Health and social work	Other economic activities	Output (Buyers prices
Agriculture	22.3	0.0	0.0	219.6	0.0	0.0	0.3	0.0	91.9	0.0	0.0	0.0	0.0	0.0	0.1	0.0	604
Fisheries	0.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0	23.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	265
Mining and quarrying	0.0	0.0	616.9	3,500.8	341.8	80.7	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	13,077.0
Manufacturing	68.5	17.7	454.6	1,036.6	334.7	1,075.9	107.9	413.1	117.8	13.4	1.8	9.3	140.8	8.9	14.0	39.6	11,340.4
Electricity, Gas, and Water Utilities	10.8	0.0	15.8	170.7	104.8	52.5	58.6	68.9	32.6	19.6	20.9	21.4	103.1	38.5	5.0	82.3	2,115
Construction	0.0	0.0	0.5	0.0	35.2	464.0	19.1	16.5	12.8	11.7	0.5	0.0	255.3	12.9	0.0	2.0	8,274
Wholesale and Retail	21.9	5.3	98.3	703.0	150.8	541.6	178.4	214.9	76.1	30.8	0.2	2.2	90.6	4.9	33.4	9.8	3,906
Transport, storage, and communication	2.9	0.3	114.2	143.4	17.8	151.1	138.4	44.3	13.0	4.4	7.7	0.1	84.1	11.9	2.9	26.5	3,024.5
Hotel and Restaurants	0.0	0.0	7.1	3.2	1.9	21.0	0.0	50.7	31.3	0.8	1.8	0.0	55.5	8.6	0.4	34.9	1,435
Information and communication	0.2	0.0	9.5	17.0	6.2	104.5	8.6	9.4	9.8	198.7	107.8	39.7	35.9	10.3	0.9	20.9	1,086
Financial, insurance, and intermediation	0.0	0.0	25.8	44.3	3.5	363.5	205.2	26.9	27.9	57.6	99.4	0.0	0.8	1.3	1.2	27.7	2,346
Real Estate and Renting	0.0	0.0	26.9	48.3	0.8	3.3	58.6	21.3	64.1	49.1	15.4	33.1	73.7	18.8	26.2	164.8	1,552
Public administration and defense	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4,631
Education	0.0	0.0	0.2	3.4	0.8	1.0	0.0	2.2	0.1	0.1	1.4	0.2	7.1	3.7	0.0	2.2	1,892

Health and social welfare	0.0	0.0	0.0	12.5	0.0	46.0	0.0	0.0	1.0	0.0	4.4	0.0	0.0	1.1	0.1	9.4	1,062
Other Economic and Social Activities	21.5	0.0	17.4	239.5	66.1	339.4	66.9	79.0	17.7	46.2	67.2	27.8	100.2	61.2	13.6	115.1	2,500
Total Output baseline prices	604.3	265.0	13,077.0	11,340.4	2114.9	8274.3	3905.6	3,024.5	1435.1	1086.3	2345.8	1551.7	4631.2	1892.1	1061.6	2500.3	
Wages	60	61	738.8	792.4	233	1,373	837	348.4	204	185	418	60	3,313	1,451	738	806	
Total Gross Output (Market prices)	1191.24	300.37	13,436.6	23,809.2	1497.75	8752.346	1175.18	3,840.1	1807.992	1214.32	2624.452	1551.72	4631.201	1898.985	1175.99	3444.798	

4.1. Technical Coefficients and Direct and Indirect Purchases

Through the transaction table, technical coefficients can be constructed. Table 2 indicates the technical coefficient, which is the amount of input required from each industry to produce one RO worth of output in each industry. The calculation of technical coefficients involves the magnitude of inter-sectoral and across-sector interactions, represented in the diagonal matrix. Technical coefficients or inter-sectoral linkages are then determined by the amount of input required from each industry to produce each RO's worth of output in a given industry. The table shows the amount of additional goods and services directly purchased by producing sectors from each of the processing industries. For example, the agriculture sector's inter-sectoral industry shows an additional demand from within agriculture at 0.019 million, followed by the manufacturing sector at 0.044 million, utilities at nearly 0.07 million, and the retail sector, with 0.0152 million, along with 3.3 million for other economic activities. The technical coefficient indicates the direct purchase of each RO from each industry, as shown on the left side of Table 2. When there is an increase or decrease in output, the technical coefficient suggests that if output in the mining industry increases by one Omani rial, the direct input from each industry would also increase accordingly. An increase of an additional RO would result in different industries such as agriculture, fisheries, wholesale, retail, real estate, property, hotels and restaurants, electricity and gas, and health and social services experiencing growth. The technical coefficients illustrate that the agriculture sector typically purchases its direct inputs from other industries, contributing to its total production. They show the first-round effects and changes in output resulting from an additional RO, as well as the inputs purchased from other sectors. For example, the agriculture sector buys its inputs from agriculture, manufacturing, wholesale, transport, and other economic activities, totaling 0.019 million in output activity. Conversely, the fisheries sector purchases inputs from manufacturing, wholesale, retail, and transport sectors. Mining and quarrying activities have their own intersectoral transactions with manufacturing, wholesale, finance, and real estate sectors, with one RO activity generating approximately 0.203 million activities from other sectors. Similarly, the manufacturing sector purchases inputs from agriculture, mining, quarrying, manufacturing, transport, and other economic activities, generating 1.348 million activities. It also purchases inputs from manufacturing, wholesale, and transport sectors, increasing to approximately 0.078 million. Electricity, gas, utilities, construction, and wholesale sectors exhibit strong intersectoral activities, with around 5 to 6 million Omani rials of additional RO output. The transport, communication, information and communication, finance and banking, health, and education sectors demonstrate robust inter-industry linkages (see the last row of Table 2). This indicates that each industry is aware of how much it needs to increase its output through direct purchases from supply industries when expanding its production. Intersectoral activities are particularly high in non-mining service sectors such as utilities, manufacturing, construction, wholesale and retail, banking, information, education, and financial sectors.

4.2. Direct and Indirect Purchases

Table 2 shows direct requirements for additional output in each sector with a technical coefficient for each sector. The output of each sector depends on its inter-industry sectors to buy the input for the output. Each sector sells its output, which shows the rows of the other sectors where its sector output is demanded. For example, the manufacturing sector, wholesale, construction, information, and communication have the most significant intersectoral transactions, indicating sectoral interdependence. The manufacturing, raw material, industry, wholesale, and retail sectors interact with each other or involve substantial labour input. When household wages are not included in the processing sector, the industry usually exhibits weak interdependence. Let us assume an increase in output (RO) in any sector, for example, the Hotel and Restaurant sector, where every RO output results in input from other sectors: 0.051 (1 x 1.37) from the agriculture sector, 0.013 (1 x 1.375) from manufacturing, and 0.065 from wholesale; additionally, 0.042 (1 x 1.37) results from increased activities in other sectors. This indirect effect does not stop here; in sectors like construction, wholesale, or retail industries, their additional output may increase the final demand for products in hotels and residential activities, and the increased demand may be generated in other processing sectors

such as manufacturing. The analysis and calculation could be repeated for each industry in the processing sector, and all figures could be summed to gradually build a comprehensive picture of the total requirements for direct and indirect activities resulting from a 1 RO increase in the production of products in each industry within the processing sector, ultimately contributing to final demand.

Diagonally, Table 2 shows that direct output is purchased from each sector, either directly or indirectly, at the top table, resulting in an additional RO output or an increase in the demand of the sector. Table 2 provides the input-output system, which illustrates the interdependence of the sectors. The demand for output increases in one sector, stimulating production in other sectors. The feedback loop affects these sectors accordingly. The dynamics of input-output analysis demonstrate the level of interdependency through direct and indirect purchases or increases in demand of each sector.

4.3. Structural Analysis

The Transaction Table shows the final demand of input-output sectors' interaction and the magnitude of transactions but does not indicate the level of efficient allocation of resources or full or less than full employment in an economy. The table does tell the nature of structural interdependencies in inter-industry transactions. It is important to trace down the real functioning and then to address the production capacity, output growth, and value-added through management of increasing or decreasing the level of demand in targeted sectors, thereby producing more output, and achieving full employment and efficiency gains.

In Table 3, the columns correctly display the final demand in the agriculture sector as 270 million RO, the fishing sector's total demand as 236 million RO, and both sectors' final demand is roughly 500 million RO. The demand for mining and quarrying activities is 8.5 billion RO, followed by manufacturing and construction, each with 7.5 billion RO. Electricity and gas demand is 1.3 billion RO, transport and communication demand is two billion RO, and almost seven to eight billion RO is attributed to public sector defense activities.

For example, policymakers want to alter the final demand in any sector through investment, increasing the output of the sector, and demand in any sector to stimulate overall demand. The table can utilize projections for forecasting. Table 3 indicates that every additional 100 million RO activity may result in a change in the technical coefficient of the intersectoral links.

Table 2. Technical coefficient (Million RO).

Output/Input	Agriculture	Fisheries	Mining and quarrying	Manufacturing	Electricity, gas, and water	Construction	Wholesale and retail	Transport, storage, and communication	Hotel and Restaurants	Information and communication	Finance Insurance	Real estate	Public administration and defense	Education	Health and social work	Other economic activities
Agriculture	0.019	0	0	0.009	0	0	0	0	0.051	0	0	0	0	0	0	0
Fisheries	0	0	0	0	0	0	0	0	0.013	0	0	0	0	0	0	0
Mining and quarrying	0	0	0.046	0.147	0.228	0.009	0	0	0	0	0	0	0.001	0	0	0
Manufacturing	0.058	0.059	0.034	0.044	0.223	0.123	0.092	0.108	0.065	0.011	0.001	0.006	0.03	0.005	0.012	0.012
Electricity, gas, and water utilities	0.009	0	0.001	0.007	0.07	0.006	0.05	0.018	0.018	0.016	0.008	0.014	0.022	0.02	0.004	0.024
Construction	0	0	0	0	0.023	0.053	0.016	0.004	0.007	0.01	0	0	0.055	0.007	0	0.001
Wholesale and Retail	0.018	0.018	0.007	0.03	0.101	0.062	0.152	0.056	0.042	0.025	0	0.001	0.02	0.003	0.028	0.003
Transport, storage, and communication	0.002	0.001	0.009	0.006	0.012	0.017	0.118	0.012	0.007	0.004	0.003	0	0.018	0.006	0.002	0.008
Hotel and Restaurant	0	0	0.001	0	0.001	0.002	0	0.013	0.017	0.001	0.001	0	0.012	0.005	0	0.01
Information and communication	0	0	0.001	0.001	0.004	0.012	0.007	0.002	0.005	0.164	0.041	0.026	0.008	0.005	0.001	0.006
Financial, insurance, and intermediation	0	0	0.002	0.002	0.002	0.042	0.175	0.007	0.015	0.047	0.038	0	0	0.001	0.001	0.008
Real Estate and Renting	0	0	0.002	0.002	0.001	0	0.05	0.006	0.035	0.04	0.006	0.021	0.016	0.01	0.022	0.048
Public administration and defense	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Education	0	0	0	0	0.001	0	0	0.001	0	0	0.001	0	0.002	0.002	0	0.001
Health and social welfare	0	0	0	0.1	0	0.5	0	0	0.1	0	0.2	0	0	0.1	0	0.3
Other Economic and Social Activities	1.8	0	0.1	1	4.4	3.9	5.7	2.1	1	3.8	2.6	1.8	2.2	3.2	1.2	3.3
Total	1.906	0.078	0.203	1.348	5.066	4.726	6.36	2.327	1.375	4.118	2.899	1.868	2.384	3.364	1.27	3.721

Table 3. Structural analysis.

Input/Output	Other economic activities	Final Demand	Output (Buyer Prices)
Agriculture	0.02	270	604
Fisheries	0.00	236	265
Mining and quarrying	0.00	8534.3	13,077.0
Manufacturing	1.99	7485.8	11,340.4
Electricity, Gas, and Water Utilities	0.31	1309	2,115
Construction	0.00	7444	8,274
Wholesale and Retail	0.64	1743	3,906
Transport, Storage, and Communication	0.08	2261.3	3,024.5
Hotel and Restaurants	0.00	1218	1,435
Information and Communication	0.01	507	1,086
Financial, Insurance, and Intermediation	0.00	677	2,346
Real Estate and Renting	0.00	947	1,552
Public Administration and Defense	0.00	4631	4,631
Education	0.00	1870	1,892
Health and Social Welfare	0.00	987	1,062
Other Economic and Social Activities	0.62	1222	2,500
Total Output baseline prices	2500.3		
Wages	806		

Table 4. Change in demand and projected final demand.

Input/Output	Original demand	Percentage change (percent)	Projected final demand	New demand
Agriculture	270	+20	604	324
Fisheries	236	+30	265	307
Mining and quarrying	8534.3	+25	13,077.0	10668
Manufacturing	7485.8	+10	11,340.4	82344
Electricity, Gas, and Water Utilities	1309	+15	2,115	20944
Construction	7444	-20	8,274	5955
Wholesale and Retail	1743	+10	3,906	1917
Transport, Storage, and Communication	2261.3	+25	3,024.5	2827
Hotel and Restaurants	1218	-15	1,435	1401
Information and Communication	507	+10	1,086	558
Financial, Insurance, and Intermediation	677	+15	2,346	542
Real Estate and Renting	947	+20	1,552	1136
Public Administration and Defense	4631	+15	4,631	5326
Education	1870	+10	1,892	2057
Health and Social Welfare	987	+25	1,062	1135
Other Economic and Social Activities	1222	+10	2,500	1344

Table 4 specifies the hypothetical positive or negative changes in final demand in each sector that resulted in a change in projected final demand. The new demand is calculated in each sector on the right-hand side of the column. The projections forecasted in each of the sectors are based on each sector's trends in demand. The forecast for each sector adds up to a projection of the final output or increase in gross output. The structural intersectoral relationship has not significantly changed in sectors over the period. However, anticipated changes occur because of policy projections. The increase in investment, employment, and changes in final production, output, consumer demand, government trend and expenditure, and available consumption patterns of the economy. Based on the assumed change

in the sector's function and interrelationship between and across the sector, the technical coefficients change due to changes in the demand or projected demand. With changes in projections of final demand, the output of sectors tends to increase or decrease. The sector's output is expected to increase, and others to decline. Dynamically, the new transaction Table 5 suggests that demand and the projected transaction table are brought to the level of the processing and purchasing sectors. Table 5 disaggregates the projected final demand column, assuming short-run projections for three to five years based on the current final demand and an additional RO 100 million output increase. The technical coefficients, technology, and nominal change in prices are assumed to remain the same, and the results of the intra-industry transactions change due to policy interventions at the upper part of each cell. The original entries' technical coefficients are given in parentheses. The table specifies the nature and type of economic activities in the sectors that change because of changes in demand. Some activities might have a substitute effect. The mining, quarrying, and gas industries could substitute natural gas, coal, or clean energy resources and other energy sources. Fossil fuels are increasingly being replaced with clean energy. The substitution of fuel and gas with clean energy may result in a projected decline in demand or growth in the final demand sector related to oil and gas. There are forthcoming activities in the transport, logistics, mining, financing, travel, and tourism sectors with increasing demand for education and health capital, with basic improvement in health and social services and activities. The projections in final demand assumed that the intersectoral transaction coefficient, prices, and technology factors are stable and constant. The projected inter-industry transactions in the upper part of each cell are shown diagonally to show the inter-industry transactions. The projections increase demand for output, resulting in an increase in demand in the new processing sector and an increase in gross output figures. The projected demand vector is disaggregated into original components with technical coefficients, and rows are in the payment sector.

Table 5. Disaggregate final demand and technical coefficients.

Output/Input	Agriculture	Fisheries	Mining and quarrying	Manufacturing	Electricity, gas, and water	Construction	Wholesale and retail	Transport storage and communication	Hotel and restaurants	Information and communication	Insurance	Real estate	Public administration and defense	Education	Health and social work	Other economic activities	Original and projected demand.
Agriculture	4.4 (22.3)	0.0	0.0	21.9 (219.6)	0.0	0.0	0.03 (0.3)	0.0	13.7 (91.9)	0.0	0.0	0.0	0.0	0.0	0.1	0.0	54 (270)
Fisheries	0.0	0.0	0.0	0.6 (6.0)	0.0	0.0	0.0	0.0	3.4 (23.0)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	71 (236)
Mining and quarrying	0.0	0.0	154 (616.9)	3.50 (3500.8)	51.2 (341.8)	-16.14 (80.7)	0.0	0.0	0.0	0.0	0.0	0.0	0.37 (2.5)	0.0	0.0	0.0	2134 (8534.3)
Manufacturing	13.7 (68.5)	5.3 (17.7)	113 (454.6)	103 (1,036.6)	50.2 (334.7)	-215.1 (1,075.9)	10.7 (107.9)	103 (413.1)	176 (117.8)	1.3 (13.4)	-0.36 (1.8)	1.86 (9.3)	21.12 (140.8)	0.89 (8.9)	2.1 (14.0)	3.9 (39.6)	74858 (7485.8)
Electricity, Gas and Water Utilities	2.16 (10.8)	0.0	3.8 (15.8)	17 (170.7)	15.7 (104.8)	-10.5 (52.5)	5.8 (58.6)	17.2 (68.9)	4.89 (32.6)	1.9 (19.6)	-4.8 (20.9)	4.28 (21.4)	15.46 (103.1)	3.85 (38.5)	5.0	8.23 (82.3)	19635 (1309)
Construction	0.0	0.0	0.5	0.0	5.28 (35.2)	-92.8 (464.0)	1.9 (19.1)	4.12 (16.5)	1.9 (12.8)	1.1 (11.7)	0.5	0.0	38.29 (255.3)	1.2 (12.9)	0.0	2.0	-1489 (7444)
Wholesale and Retail	4.38 (21.9)	1.5 (5.3)	24.5 (98.3)	70 (703.0)	22.6 (150.8)	-108.3 (541.6)	17.8 (178.4)	53.7 (214.9)	11.4 (76.1)	3.0 (30.8)	0.2	2.2	13.59 (90.6)	0.49 (4.9)	5.0 (33.4)	9.8	174 (1743)
Transport, storage and communication	0.58 (2.9)	0.3	28.55 (114.2)	14 (143.4)	2.6 (17.8)	-30.2 (151.1)	13.8 (138.4)	11.0 (44.3)	1.9 (13.0)	0.4 (4.4)	7.7	0.1	12.61 (84.1)	1.19 (11.9)	0.4 (2.9)	2.6 (26.5)	565 (2261.3)
Hotel and Restaurants	0.0	0.0	1.7 (7.1)	0.32 (3.2)	0.28 (1.9)	-4.0 (21.0)	0.0	12.6 (50.7)	4.6 (31.3)	0.8	1.8	0.0	8.3 (55.5)	0.86 (8.6)	0.4	3.49 (34.9)	183 (1218)
Information and communication	0.2	0.0	2.3 (9.5)	1.7 (17.0)	0.9 (6.2)	-20.9 (104.5)	0.86 (8.6)	2.3 (9.4)	1.4 (9.8)	19.8 (198.7)	-21.5 (107.8)	7.94 (39.7)	5.3 (35.9)	1.0 (10.3)	0.9	2 (20.9)	51 (507)
Financial, insurance, and intermediation	0.0	0.0	6.4 (25.8)	4.4 (44.3)	0.5 (3.5)	-72.7 (363.5)	20.6 (205.2)	6.7 (26.9)	4.1 (27.9)	5.7 (57.6)	-19.8 (99.4)	0.0	0.8	1.3	0.18 (1.2)	2.7 (27.7)	-135 (677)
Real Estate and Renting	0.0	0.0	26.9	4.8 (48.3)	0.8	0.6 (3.3)	5.8 (58.6)	5.3 (21.3)	9.6 (64.1)	4.9 (49.1)	-3.8 (15.4)	6.64 (33.1)	11.0 (73.7)	1.88 (18.8)	3.93 (26.2)	16.4 (164.8)	189 (947)
Public administration and defense	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	695 (4631)
Education	0.0	0.0	0.2	0.34 (3.4)	0.8	1.0	0.0	0.55 (2.2)	0.1	0.1	1.4	0.2	1 (7.1)	3.7	0.0	2.2	187 (1870)

Health and social welfare	0.0	0.0	0.0	1.2 (12.5)	0.0	-9.2 (46.0)	0.0	0.0	1.0	0.0	4.4	0.0	0.0	1.1	0.1	9.4	148 (987)
Other Economic and Social Activities	4.3 (21.5)	0.0	4.35 (17.4)	23.9 (239.5)	9.915 (66.1)	-67.88 (339.4)	6.69 (66.9)	19.7 (79.0)	2.6 (17.7)	4.6 (46.2)	-13.44 (67.2)	5.56 (27.8)	15 (100.2)	6.12 (61.2)	2 (13.6)	11.5 (115.1)	122 (1222)
Total Output baseline prices	604.3	265.0	13,077.0	11,340.4	2114.9	8274.3	3905.6	3,024.5	1435.1	1086.3	2345.8	1551.7	4631.2	1892.1	1061.6	2500.3	
Total Gross Output (market prices)	1191.24	300.37	13,436.6	23,809.2	1497.75	8752.346	1175.18	3,840.1	1807.992	1214.32	2624.452	1551.72	4631.201	1898.985	1175.99	3444.798	

4.4. Multiplier Analysis

The projected changes in final demand have a direct impact on the level of income, employment, and output. However, the aggregate impact on employment and income multipliers derives from the overall effect. For example, stimulating economic activities in the non-mining sector, such as five-year plan activities across different sectors or priority sectors to increase investment in development, roads, ports, public works, or the construction industry, will affect the relevant sector and induce economy-wide changes in investment, output growth, and employment opportunities. Similarly, a reduction or increase in public wages or specific spending would have an overall impact on different sectors and industries. Measuring this kind of impact economy-wide could be challenging, but it is possible to trace the interdependency of economic activities. The sectoral multiplier is derived from the input-output model in Table 2, and the basic transaction table with households' wages is completed. Table 6: employment and household consumption expenditure are derived from the original Table 2, with household wages in a row at the last as a processing sector, and household consumption expenditure on the column demand side. The table shows the payment sector to households and the demand sector from the expenditure side. The basic transaction table or technical coefficients would remain the same. Concerning households and their characteristics for the processing sector, with a relative level of labour intensity. Table 6 shows the labor-intensive sectors with the highest wage payments. The employment row of Table 6 shows that for every hundred million RO activity, the highest employment level is in the education sector with a wage level of 76.5 million, followed by the public sector and defense at 71.5 million, and then wholesale retail, which has the highest wage employment level at 71.2 million. Other economic activities pay wages at 62.8 million, followed by fisheries at 20.2 million, basic utilities at 15.5 million, and finance and insurance, information, and communication, each around 15 to 16 million in wage rates. Mining, oil and gas, manufacturing, transport, and real estate are capital-intensive sectors. The wage activity is five million for each of the RO invested in agriculture. In the fisheries sector industry, activity is almost zero, and the highest activity is in manufacturing at 5.9, with twenty million wage earners. Mining and quarrying have 4.6 inter-sector activity, followed by manufacturing at 3.9 million, with low water activity. Manufacturing has the highest activity with mining at 14.7, followed by utilities at 4.4. The utility sector has the highest inter-sectoral activities with mining, manufacturing, construction, and wholesale. Wholesale has major activities within its own sector, manufacturing, oil and gas, and transport, storage, and communication. The finance, insurance, and intermediaries sector also show significant activity. Transport, communication, and warehousing have major activities in manufacturing, wholesale, and hotel sectors, including manufacturing, wholesale, and real estate. The information and communication sector has highly linked activities, followed by real estate, insurance, and finance. The public sector exhibits the highest activities in construction, manufacturing, and utilities.

Table 6. Employment multiplier with technical coefficients, household wages, and expenditures.

Output Input	Agriculture	Fisheries	Mining and quarrying	Manufacturing	Electricity, gas, and water	Construction	Wholesale and retail	Transport, storage, and communication	Hotel and restaurants	Information and communication	Insurance	Real estate	Public administration and defense	Education	Health and social work	Other economic activities	Private consumption
Wages	5	20.2	5.5	3.3	15.5	15.7	71.2	9.1	11.3	15.2	15.9	3.8	71.5	76.5	62.8	23	0

Table 7. Employment multiplier at Leontief inverse matrix of power series (Level three approximation).

Output/Input	Agriculture	Fisheries	Mining and quarrying	Manufacturing	Electricity, gas, and water	Construction	Wholesale and retail	Transport, storage, and communication	Hotel and restaurants	Information and communication	Insurance	Real estate	Public administration and defense	Education	Health and social work	Other economic activities	Private consumption
Wages	0.04	0.03	24.13	0.84	0.05	0.00	0.03	0.06	0.02	0.01	0.06	0.03	71.54	0.12	109	565	514

To measure the multiplier effect of any additional increase in output or demand, the direct and indirect impacts of changes in final demand are analyzed by adding the new household processing sector. This approach involves deriving a general solution of the new transaction table through the transposition of the Leontief inverse matrix, which is calculated as the difference between the employment table coefficient and the identity matrix. The resulting table demonstrates that every RO invested directly in any industry, at the top of the table, indicates the production required from that industry either directly or indirectly for each RO delivered in final demand. The transposed inverse matrix, generated from the difference between the technical coefficient and the identity matrix, is used to produce the employment multiplier via the third-degree power series generation method. Table 7 illustrates that the direct and indirect effects of RO changes in final demand provide the solution. Each entry in this table reflects the total RO production activity, either directly or indirectly, necessary at the industry level due to one RO change in output or final demand. The changes in employment wages are shown in the last row, while the demand side is represented in the second last column. Some diagonal values, from the upper left to the lower right, are greater than one, indicating sectors with higher than one multipliers, while other demand-side sectors show values less than one. This variation reflects the interaction of households through consumption and wage dynamics. From this data, it is possible to calculate the income multiplier, which considers the total direct and indirect income changes resulting from increased output across processing sectors. Similarly, the type two multiplier effect is derived from changes in income induced by increased consumer spending. Both policy options can be modeled through adjustments in the income side of the technical coefficient and the multiplier effect. This area remains open for further research by future scholars.

4.5. Key Results and Discussions

The results indicate that the non-mining and quarrying sectors, construction, hotel and restaurant, public administration, defense, education, wholesale, and retail sectors are the leading sectors generating economic activities. These sectors have stronger linkages, particularly the services and production sectors, which propel economic activities into other sectors. The stronger the linkages that generate local demand, the less dependency there is on imports, with increased production, demand-driven services, and input-output interactions. Consequently, direct changes in output, employment, and responses to increased final demand result in higher multipliers. The technical coefficient determines relations and projections for changes in final demand. The magnitude of the technical coefficient suggests that non-mining quarrying, services sectors such as utilities, manufacturing, construction, retail, banking, information, education, and financial sectors generate demand in other sectors. However, manufacturing, raw material, industry, wholesale, and retail sectors indicate an elevated level of interaction with substantial labor input. Employment in these sectors shows high intensity, with employment levels being significant. Sectors such as education, defense, health, and retail have higher income levels, and changes in the large multiplier for all additional output result in modifications to the input-output table; other sectors are capital-intensive. A labor-intensive sector produces larger incomes than capital-intensive sectors. The fisheries sector is four times more labor-intensive than agriculture, mining, and manufacturing; these sectors have a larger impact on incomes than other capital-intensive sectors. This suggests the transmission of structural changes that influence the complex interactions within the economy, and the results indicate a strong interaction among these sectors. The non-mining and quarrying sectors, such as manufacturing, wholesale, retail, and services, along with the public sector, play a key role. The results are consistent with Mubeen et al. (2017) and Abdullah (2021). Our findings suggest that changes in final demand induce sectoral interdependencies within the Oman economy. Investment in sectors and projected activities in transport, logistics, mining, financing, travel, and tourism indicate increasing demand, especially in service sectors such as education and health, where significant activity and demand changes reflect improvements in health and social services. The demand is reflected in the transaction coefficient, prices, and other factors, which are treated as constant. The projected interindustry demand shows interindustry transactions and the resultant increase in output in the processing sector and gross output figures. These demand changes directly impact income and employment

multipliers; they are crucial for overall productivity and output growth. Increased activities in non-mining sectors, service sectors, health, education, logistics, and tourism influence other activities. The expansion over the five-year plan in various sectors creates opportunities for investment, infrastructure development, and construction activities, driving broad economic changes in output, investment, and job creation. Similarly, increased wage activities may positively impact different sectors, illustrating the interdependency of economic activities. Labor-intensive sectors generate large wage activities, directly inducing demand; the education sector, for example, accounts for 76 million wage activities, followed by defense with 71.5 million, wholesale and retail with 71.2 million, fisheries with 20 million, and utility, banking, and information and communication sectors also show significant wage activities. Manufacturing, construction, and wholesale sectors have the highest wage activities, around 15 million RO. The multiplier impact from table Y indicates the direct and indirect effects of every RO change in demand and production activities, influencing final demand, wages, and overall economic output. The sectors with the highest wage activity, particularly education, health, defense, and services, show the most substantial multiplier effects. While output growth is primarily driven by mining and quarrying, manufacturing, wholesale and retail, transport, storage, hotel and restaurant, and the public sector are also dominant, with technology-intensive sectors. The health, education, public sector, retail, wholesale, and fishing sectors are heavily labor-intensive. These non-mining and quarrying sectors exhibit the most substantial linkages within the economic services sectors.

5. SUMMARY, CONCLUSION, AND RECOMMENDATIONS

This study has established intersectoral transactions, technical coefficients with forward and backward linkages of intersectoral purchases, hypothetical policy projections in demand, and the Leontief inverse multiplier to derive the multiplier effect in each economic sector. The results indicate that non-mining quarrying sectors drive output activities. The policy changes and income, output, and employment effects suggest a stronger reaction in the non-mining and quarrying sectors. The transaction tables derive the technical coefficients of intersectoral transactions and identify sectors with strong linkages to spur output growth, changes in income, and employment opportunities. The mining and quarrying sectors have weak intersectoral linkages and need to be more flexible. However, the public, manufacturing, and services sectors particularly health, education, and defense dominate output, job creation, and wage activities, as well as the wholesale, retail, and fishing sectors.

Oman is a resource-based economy; most manufacturing and mining sectors are capital-intensive. However, the employment multiplier suggests strong linkages with non-mining and services sectors, and policymakers may consider targeting the sectors that are intensively linked and can produce output activities with backward and forward linkages. This approach could help diversify the economy away from a single source toward sectors that exhibit more forward and backward linkages, with labor intensity and higher value added to achieve diversification goals. The structural changes in demand indicate significant shifts in technical coefficients and multipliers. It is recommended that sectoral policies focus on areas where stronger linkages and employment multipliers are high to generate higher multipliers. These policies need to be aligned with the structure of the economy. The study recommends further use of input-output data analysis at a sectoral level to derive meaningful insights. Stronger linkages reduce dependency on imports, enhance production, demand-driven services, and input-output interactions. The direct changes in output, employment, and response to increased final demand result in higher multipliers. The technical coefficient determines relations and projections for changes in final demand. Employment in such sectors shows high intensity, with elevated employment levels. Sectors such as education, defense, health, and retail have higher income, and changes to the large multiplier for all additional output result in modifications to the input-output table. Other sectors are capital-intensive.

Labor-intensive sectors produce larger incomes than capital-intensive sectors for households. The fisheries sector is four times more labor-intensive than agriculture, mining, and manufacturing; these sectors significantly impact incomes more than other capital-intensive sectors. This suggests the transmission of structural changes that

penetrate the complex interaction of the economy, and the results indicate a strong interaction among these sectors. The non-mining and quarrying sectors, such as manufacturing, wholesale, retail, and services, along with the public sector, play a key role. Our results suggest that changes in final demand induce sectoral interdependencies within the Oman economy. The income and employment multipliers are important for total factor productivity and output growth. However, output growth is primarily driven by mining and quarrying, manufacturing, wholesale and retail, transport, storage, hotels and restaurants, and the dominant public sector primary capital-intensive sectors with technology-intensive sectors. Meanwhile, health, education, the public sector, retail and wholesale, and fishing are heavily labor-intensive sectors. These non-mining and quarrying sectors have the most substantial linkages within the economic services sectors. Policymakers may focus on these strong linkages to target sectors with high-value output, employment, and demand-generating capacity. The stronger links of the non-mining quarrying and services sectors, as targeted in Vision 2040, such as tourism, logistics, and expanding wholesale services, may boost output, employment, and investment opportunities, thereby supporting the strategic objectives of diversifying the Omani economy.

The study has limitations because it uses data from a single year, 2022, as the only available data to determine the domestic intersectoral linkages of various sectors of Oman's economy. The study is limited in scope to capturing the basic features of sectoral linkages and does not account for long-term trends, fluctuations in oil prices, international shocks, or the impact of the pandemic (words 9370).

Funding: This study received no specific financial support.
Institutional Review Board Statement: Not applicable.
Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
Data Availability Statement: Upon a reasonable request, the supporting data of this study can be provided by the corresponding author.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: Both authors contributed equally to the conception and design of the study. Both authors have read and agreed to the published version of the manuscript.

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