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# The Role of the Health-Care Sector in Malaysia's National Economy: An Input-Output Analysis

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## ABSTRACT

Driven by rising non-communicable diseases and demographic changes, Malaysia's growing health-care demand and the unprecedented challenges of the COVID-19 pandemic necessitate a greater focus on the sector. Yet, the economic impact of the sector remains underexplored. In this study, we estimate the economic importance of the health-care sector in the Malaysian economy. Utilizing Malaysia's input-output tables for 2010 and 2015, the study disaggregates health-care into private and public sectors and assesses inter-industry linkages, employment, value-added, and output multipliers. The analysis reveals that an additional MYR 1 million investment in public health contributed MYR 1.4405 million to the national economy in 2010, increasing to MYR 1.4539 million by 2015. Private health investments showed similar trends, with contributions increasing from MYR 0.9558 million to MYR 0.9693 million. The health-care sector demonstrates increasing forward linkages and positive economic effects through value-added and employment multipliers, indicating its potential to significantly contribute to Malaysia's economic growth. These insights underscore the need for policies that support health-care investment, highlighting its pivotal role in economic development.

## ملخص

مدفوعًا بزيادة الأمراض غير السارية والتغيرات الديموغرافية، فإن الطلب المتزايد على الرعاية الصحية في ماليزيا والتحديات غير المسبوقة لجائحة كوفيد-19 تستلزم تركيزًا أكبر على هذا القطاع. ومع ذلك، لا يزال التأثير الاقتصادي للقطاع غير مستكشف بشكل كاف. في هذه الدراسة، نقدر

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الأهمية الاقتصادية لقطاع الرعاية الصحية في الاقتصاد الماليزي. باستخدام جداول المدخلات والمخرجات لماليزيا لعامي 2010 و2015، تصنف الدراسة الرعاية الصحية إلى القطاعين الخاص والعام وتقيّم الروابط بين الصناعات والتوظيف والقيمة المضافة ومضاعفات الانتاج. يكشف التحليل أن استثمارًا إضافيًا بقيمة مليون رينغيت ماليزي في الصحة العامة أسهم بمقدار 1.4405 مليون رينغيت ماليزي في الاقتصاد الوطني في عام 2010، وزاد إلى 1.4539 مليون رينغيت ماليزي بحلول عام 2015. أظهرت الاستثمارات الصحية الخاصة اتجاهات مشابهة، حيث زادت المساهمات من 0.9558 مليون رينغيت ماليزي إلى 0.9693 مليون رينغيت ماليزي. يظهر قطاع الرعاية الصحية روابط متزايدة للأمام وآثار اقتصادية إيجابية من خلال مضاعفات القيمة المضافة والتوظيف، مما يدل على إمكاناته الكبيرة في الإسهام بشكل ملحوظ في نمو الاقتصاد الماليزي. تؤكد هذه الرؤى على الحاجة إلى سياسات تدعم الاستثمار في الرعاية الصحية، وتسلط الضوء على دورها المحوري في التنمية الاقتصادية.

## RÉSUMÉ

Sous l'effet de l'augmentation des maladies non transmissibles et des changements démographiques, la demande croissante de soins de santé en Malaisie et les défis sans précédent posés par la pandémie de COVID-19 nécessitent une plus grande attention à ce secteur. Pourtant, l'impact économique de ce secteur reste sous-exploré. Dans cette étude, nous estimons l'importance économique du secteur des soins de santé dans l'économie malaisienne. En utilisant les tableaux d'entrées-sorties de la Malaisie pour 2010 et 2015, l'étude décompose les soins de santé en secteurs privé et public et évalue les liens interindustriels, l'emploi, la valeur ajoutée et les multiplicateurs de production. L'analyse révèle qu'un investissement supplémentaire d'un million de MYR dans la santé publique a contribué à hauteur de 1,4405 million de MYR à l'économie nationale en 2010, pour atteindre 1,4539 million de MYR en 2015. Les investissements privés dans le secteur de la santé ont connu des tendances similaires, avec des contributions passant de 0,9558 million de MYR à 0,9693 million de MYR. Le secteur des soins de santé présente des liens croissants vers l'avant et des effets économiques positifs grâce à la valeur ajoutée et aux multiplicateurs d'emploi, ce qui indique qu'il peut contribuer de manière significative à la croissance économique de la Malaisie. Ces observations soulignent la nécessité de mettre en place des politiques qui soutiennent les investissements dans le secteur des soins de santé, en mettant en évidence son rôle essentiel dans le développement économique.

**Keywords**: Input-Output analysis, health-care, multipliers, Malaysia

**JEL Classification:** C67, I15, I18

## 1. Introduction

The importance of health-care to the global economy has never been greater since the coronavirus outbreak put the health-care systems under enormous strain two years ago. Global health spending had been steadily increasing even prior to the COVID-19 pandemic, reaching US$8.5 trillion in 2019, accounting for 9.8% of global GDP (WHO,2021). As a result of the COVID-19 pandemic, health spending increased significantly in 2020, more than in prior years, culminating in the greatest growth rates in a decade[1]. Consequently, health spending as a share of GDP in 17 high-income nations grew from 9.2 percent in 2019 to 10.1 percent in 2020 on average. Because of the COVID-19 pandemic, policymakers now recognise the importance of health-care systems and the consequences of their failure. Countries ought to learn from the pandemic experience and implement significant reforms, particularly in strengthening their primary health-care (World Bank, 2022).

The growing trend in health spending is transforming health-care into a significant sector in economies, creating an even stronger connection with economic growth. Due to their vast size, health-care systems are becoming major macroeconomic drivers with significant macroeconomic effects, such as on output and employment (Darvas et al., 2018). The increased spending in health-care is able to increase the economy's output through its positive impact on labour productivity as a result of improved health (Bloom et al., 2004). The health-care industry has a significant job-creation potential as well. The number of persons employed in the health-care sector increases along with their total income as a result of increasing health spending, would in turn stimulate overall spending and aggregate demand.

Like other countries, Malaysia has seen a continuous increase in health spending over the recent decades. Total expenditure on health in Malaysia ranged from RM8,550 million in 1997 to RM64,306 million in 2019, leading to more than double rises in per capita health expenditure from RM706 in 1997 to RM1,974 in 2019 (MOH,2021). In the first year of the pandemic, the total expenditure on health rose by 4.2% to RM67.02 billion and totalled 4.7% of gross domestic product. In its 12th Malaysia

[1] Based on preliminary estimates provided by 22 countries, mainly high-income economies. World Health Organization. (2021). Global expenditure on health: public spending on the rise?

Plan, the Malaysian government is committed to improving the health-care system in order to maintain a productive and healthy population in light of the potential for a COVID-19 mutation and the growing prevalence of non-communicable diseases (NCDs). The government has allocated the Health Ministry (MOH) RM32.4 billion for operations and development costs in Budget 2022, second largest after the education sector, in order to prioritise public health-care and increase national resilience in the face of COVID-19's endemic phase (MOF,2021). These developments imply the necessity to quantify the impact of health-care sector on the development of the national economy.

To assess the impact of the health-care sector on the economic development, the interaction between the health-care sector and other economic sectors need to be examined. The most widely used model for assessing these relationships empirically is input-output (IO) analysis, which was developed by Professor Wassily Leontief in the late 1930 (Baumol, 2000). An input-output model is a set of linear equations that, taken together, represent how the output of one industry is distributed across the economy (Miller & Blair, 2022). The IO model has been used extensively globally for many years and is still useful in analysing the interdependence of industries in an economy. However, IO analysis has not been used widely in evaluating the roles of the health-care sector in national economies particularly for emerging countries like Malaysia. Studies in Korea (Kim et al., 2017) and Japan (Yamada & Imanaka, 2015) revealed that the health-care sector has a significant production-inducing effect. Additionally, for European nations, the value of income and the multiplier for value added are higher than the national average, favourably affecting economic growth (Bekő et al., 2019; Jagrič et al., 2021). In a recent study on European Union by Gutiérrez-Hernández and Abásolo-Alessón (2021), the health-care sector has lower direct backward and forward linkages implying lack of dependence from the rest of the productive structure in the region. To the best of our knowledge, the health-care sector of the Malaysian economy has not yet been the subject of an input-output framework analysis.

## 2. Overview of the health-care sector in Malaysia.

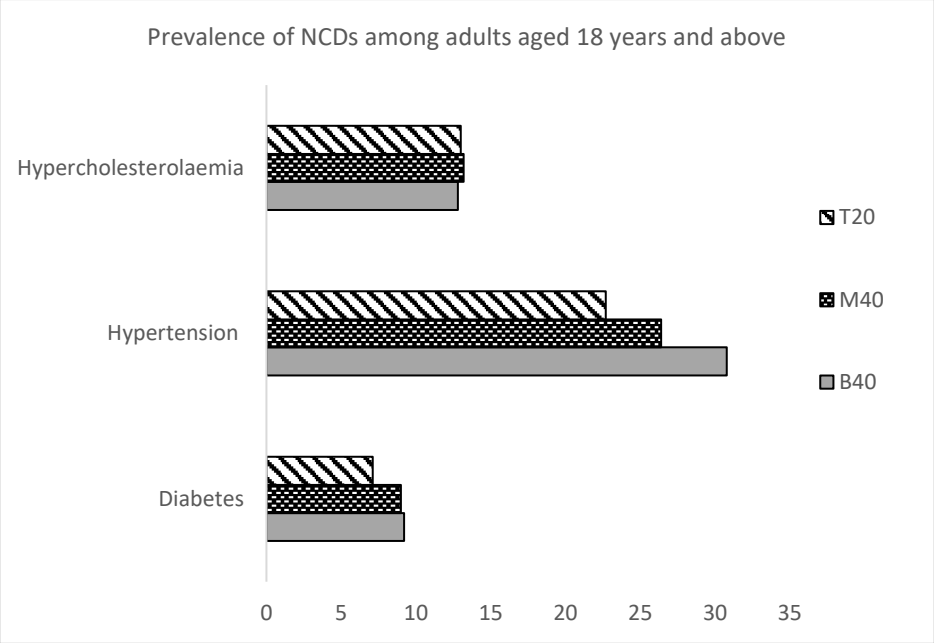
The health-care system in Malaysia operates as a dual-tiered model, comprising a government-funded public sector and a growing private

sector. The government has played a crucial role in delivering affordable and accessible health-care, particularly for the economically disadvantaged, leading to significant improvements in public health over recent decades. From 1970 to 2021, the average lifespan increased by 11.6 years for males and 12.7 years for females. Additionally, infant mortality has decreased by over 90%, from 6.4 deaths per 1,000 live births in 2019, and the maternal mortality ratio has dropped significantly, from 140.8 deaths per 100,000 live births in 1970 to 21.1 deaths per 100,000 live births in 2019—an 85% reduction. These advancements are attributed to intensive immunization and health programs, as well as improvements in child nutrition, immune system strength, and environmental conditions.

Despite these achievements, Malaysia faces escalating health expenditure driven by a surge in non-communicable diseases (NCDs) and deteriorating health conditions. Rapid urbanization, population ageing, and changes in societal behavior are significant contributors to this trend. While NCDs affect countries at all income levels, over 75% of global NCD deaths occur in low and middle-income countries. The economic loss from premature NCD deaths over the next twenty years is projected to exceed USD 30 trillion, nearly half of the global GDP in 2010 (Bloom et al., 2012).

Malaysia reflects this global trend, with NCDs accounting for 74% of total deaths, predominantly from cardiovascular diseases (WHO,2018). Alarmingly, 35% of these deaths occur among the working-age population, and more than 60% of adults aged 18 and above have at least one NCD risk factor (IPH,2015). High rates of undiagnosed NCD risk factors, especially among the B40 income group, exacerbate these issues, leading to late diagnoses and increased health-care costs. Figure 1 illustrates the prevalence of diabetes, hypertension, and hypercholesterolemia across different household income groups. The National Health Morbidity Survey 2019 highlights Malaysia's growing diabetes incidence and high prevalence of hypertension and hypercholesterolemia, raising concerns about the nation’s ability to meet United Nations Sustainable Development Goal 3.4, which aims to reduce premature mortality from NCDs (IHSR,2020).

**Figure 1:** Prevalence of NCDs among adults aged 18 years and above




Note: The Household Income and Basic Amenities Survey conducted in 2016 by the Department of Statistics of Malaysia describes an M40 household as one with a median monthly household income of RM6,275, while the Bottom 40% (B40) households have a median monthly household income of RM3,000 and the Top 20% (T20), RM13,1488

Source: National Health and Morbidity Survey (NHMS) 2019

In comparison to other regional nations, Malaysia's health indicators reflect both achievements and challenges. Health indicators in Malaysia are comparable with those of neighboring countries such as Indonesia, the Philippines, and Thailand. Table 1 provides intercountry comparisons of current health expenditure (CHE) per capita and life expectancy. In 2021, Malaysia's per capita health-care expenditure was $487, surpassing only by Singapore, which spent $3,970. However, Malaysia's life expectancy is lower than Thailand's and similar to Vietnam's, despite their lower health-care spending.

**Table 1:** Current Health Expenditure (CHE) per capita and life expectancy

| Country | Life expectancy, Male (Years) | Life expectancy, Female (Years) | Life expectancy, Average (Years) | Health-care spending per capita (US dollar) |
|---|---|---|---|---|
| Malaysia | 72.6 | 77.1 | 74.7 | 487.0 |
| Singapore | 81.0 | 85.5 | 83.2 | 3,970.0 |
| Indonesia | 69.4 | 73.3 | 71.3 | 160.6 |
| Philippines | 67.4 | 73.6 | 70.4 | 203.2 |
| Thailand | 74.4 | 81.0 | 77.7 | 364.4 |
| Vietnam | 69.6 | 78.1 | 73.7 | 172.6 |

Therefore, given the recent issues of rising expenditures, an ageing population, and increasing rates of NCD prevalence, Malaysia needs to reform its health-care system (Aspalter et al., 2017). The country's public health system was jolted by the COVID-19 outbreak in early 2020, prompting the government to reassess its public health-care spending. During the first year of the pandemic, the health system struggled with a lack of designated hospital beds, manpower shortages, and inadequate personal protective equipment (PPE) supplies. Additionally, a lack of psychological support at work and direct involvement in COVID-19 screening or treatment contributed to high burnout rates among health-care professionals (Roslan et al., 2021). Although the health-care system managed to control the disease's spread, minimize fatalities, and reduce risk through vaccination, there are still important lessons to be learned from COVID-19. The government is committed to implementing medium to long-term reforms in the health-care system while gradually increasing health-care spending each year.

## 3. Data and Methodology

### 3.1. Data sources

To investigate the contribution of Malaysia's health-care sector, we utilise Malaysia's Input-Output tables for 2010 and 2015, compiled by the Department of Statistics Malaysia (DOSM) every five years. The sector rankings have been adjusted based on the ranking on the 2010 and 2015 I-O table and the Standard of Industrial Classification of All Economic Activities (ISIC) 2008 revised version 4. Additionally, commodities adhere to the Malaysia Classification of Products by Activity (MCPA) 2009 aligned with the Central Product Classification (CPC) Version 2.0. The I-O tables distinguished into 125 sectors, with the health-care sector further disaggregated into public and private health. This detailed disaggregation in the 2010 and 2015 Malaysian I-O tables is crucial for our impact study. The data complies with the Malaysian Standard Industrial Classification (MSIC) 2008. This study has aggregated the I-O table into 23 sectors for straightforward analysis.

Another key data source is the Labour Force Survey for 2010 and 2015 with detailed labour market information based on educational attainment. The labour market data is disaggregated into local and foreign according to the Malaysian Standard Classification of Occupations (MASCO) 2013. Skills are classified into three types of skills, skilled or professionals, semi-skilled and low-skilled. Disaggregating the labour market data helps identify the quantity, quality and stability of employment in various sectors, particularly in health-care sector.

### 3.2. Methodology

Input-Output analysis focuses on the interdependencies among production sectors within an economy. The Input-Output (I-O) Table, updated every five years, provides a comprehensive view of the demand and supply for goods and services across the economy. The I-O table details the purchases made by each sector to produce their own output, including domestically produced inputs, imported commodities and factors of production such as labour and capital. The I-O analysis facilitates the allocation of economic-wide impacts along the production and supply chain to the final demand component. It stands as the primary empirical method for addressing large-scale, multi-sectoral problems.

This analysis is not only widely used by researchers and academicians globally, but also extensively employed by planning agencies in numerous countries. Notably, organisations such as the World Bank and United Nations rely on I-O analysis for planning and policy-making.

### 3.2.1. General framework of the I-O model

In the Input-Output table, the rows represent the demand for inputs from other sectors, while the columns represent the demand from the sectors for the outputs (Miller and Blair, 2022). Assuming an I-O table able to categorises $n$ sectors within the economy, $b_i$ denotes the total output for sector $i$; $f_i$ represent the total final demand for sector in sector $i$. The variables $x_{ij}$ denotes the sector-between direct input coefficients matrix (from each sector $i$ to each sector $j$); $m_{ij}$ denotes the sector-between direct output coefficient matrix (from each sector $i$ to each sector $j$). Additionally, $a_j$ denotes the total output value of sector $j$; and $v_j$ denotes the added value of sector $j$. The key assumption is linked to the basic Leontief model, which can serve as an index to evaluate the contribution of a specific sector over a particular period. The I-O models can be expressed as follows (Wang & Wang, 2019):

$$X_i = \sum_{j=1}^{n} x_{ij} a_j + f_i \quad (1)$$

$$X_{j=} \sum_{i=1}^{n} m_{ij} b_i + v_j \quad (2)$$

There are no distinct health sub-sectors in Malaysia's 124 sector I-O table, which is publicly available for download. To analyse the I-O model of the health-care industry, we need to disaggregate the two major health sub-sectors from the I-O table. We have collected comprehensive statistical data for these two health sub-sectors from the Department of Statistics Malaysia. The disaggregated data, which includes the proportions of each health sub-sectors' added values in its and other affiliated sectors, is utilised to compute the I-O model analysis. The value-added multiplier, as detailed in Table 2, illustrates the multipliers for production and value added within its affiliated sector.

### 3.2.2. Inter-industry linkages model

A complete industrial demand and supply chain, industrial linkages can be analysed within the input-output framework. There are two kinds of interdependence measures which are the backward and forward linkages. For example, when there is an increase of demand from sector *j* (purchaser) on the sectors where goods are used as inputs in the production *j*, it's identified as backward linkages. Meanwhile, an increase in the output of sector *j* means additional amounts of product *j* are available and will increase supplies from sector *j* (seller), termed as forward linkages.

The index is to measure the backward linkages in equation (3) and forward linkages in equation (4) as follows (Bekő et al., 2019; Miller & Blair, 2022; Wang & Wang, 2019):

$$B_i = \left( {(1/n)\sum_i l_{ij}} \Big/ {(1/n^2)\sum_i \sum_j l_{ij}} \right) \quad (3)$$

$$F_i = \left( {(1/n)\sum_i b_{ij}} \Big/ {(1/n^2)\sum_i \sum_j b_{ij}} \right) \quad (4)$$

Where *n* is the number of sectors (in this study is 124 sectors), $\sum_i l_{ij}$ and $\sum_i \sum_j l_{ij}$ represent the column of sum for sector j and the sum of elements of the Leontief inverse matrix. Meanwhile, $\sum_i b_{ij}$ and $\sum_i \sum_j b_{ij}$ denotes the row sum for sector *j* and the elements of Ghoshian inverse matrix. If both the forward and backward linkages indices with greater than value one, the sector is considered as a key sector[1].

### 3.2.3. Demand-driven model

The relationship between the output, intermediate inputs and final demand are involved in the demand-driven model. The equation (5) shows that the total output of sectors is equivalent to the intermediate input and final demand.

[1] A key sector is a sector which largely dependent on other industries and plays important roles in supporting and boosting other sectors in a region (Saari, 2014).

$$x = Z_i + (c + i + g + e) = Z_i + f \quad (5)$$

Where *x* is the vector of gross output. *Zi* is the summation vector for intermediate matrix input, *f* is the vector for the final demand. Meanwhile, the economy components are private consumption (c), investment (i), government (g) and exports (e).

$$\text{x} = \begin{bmatrix} x_1 \\ \vdots \\ x_{10} \end{bmatrix}, \text{Z} = \begin{bmatrix} z_{1,1} & \cdots & z_{1,10} \\ \vdots & \ddots & \vdots \\ z_{10,1} & \cdots & z_{10,10} \end{bmatrix}, \text{f} = \begin{bmatrix} f_1 \\ \vdots \\ f_{10} \end{bmatrix} \quad (6)$$

Indicating, Z is the matrices, x and f are the vectors as well as x, z, f as the scalar. The diagonal matrix with the elements of a vector, x on the main diagonal and other entries are equal to zero. Moreover, the summation of the vector is represented by i. Therefore, the summation of intermediate input Z is written as

$$\text{Zi} = \begin{bmatrix} z_1 \\ \vdots \\ z_{10} \end{bmatrix} \quad (7)$$

As in model, assumption related to production is needed. Therefore, endogenous component in the input-output is the intermediate input meanwhile the exogeneous component is the final demand. The standard input-output model is,

$$x = A_x + (c + i + g + e) = A_x + f \quad (8)$$

Where A is the input-output coefficient. Equation (8) is then transformed into (9).

$$x = (I - A)^{-1} = Lf \quad (9)$$

Where I is the identity matrix and (I-A)-1 is known as the Leontief inverse matrix. Overall, it shows that output is obtained by multiplying the endogenous matrix of the Leontief inverse matrix with the exogenous vector of the final demand. Therefore, model (8) and (9) is the core model of input-output of the analysis of this study.

### 3.2.4. Decomposition of multiplier model

Since the input-output model is linear, thus this allows for a decomposition analysis. As mentioned, the Leontief inverse matrix shows the total effects of any final exogenous demand, therefore, if Leontief inverse matrix is decomposed into several effects, the effects of output, value-added and employment can be separated. To decompose the multiplier effects, the Leontief inverse matrix is expanded through a power series approximation approach (Miller & Blair, 2009) in equation (10).

$$(I - A)^{-1} = (I + A + A^2 + A^3 + \cdots)f \qquad (10)$$

which equals to,

$$(I - A)^{-1} = f + Af + A^2f + A^3f + \cdots = f + Af + A(Af) + A(A^2f) \qquad (11)$$

This interactive approach is a detailed approach of obtaining the total effects of the exogenous final demand that increases when the output increases as well, with the different sectors. Therefore, equation (10) and (11) is furthered simplified as,

$$(I - A)^{-1} = L^{-ini} + L^{-dir} + L^{-ind} \qquad (12)$$

where, $L^{-ini}$ = I that gives the initial effects, $L^{-dir}$ = A is the direct effects and $L^{-ind}$ =A2 + A3 +… is the sum of all the indirect effects. The Leontief inverse matrix is decomposed into direct and indirect effects as the initial effects are equal to the final demand. Thus, the decomposition of multipliers equals to:

$$\Delta x^{-dir} = A\Delta f \qquad (13)$$

$$\Delta x^{-ind} = (I - A)^{-1}\Delta F - A\Delta F \qquad (14)$$

### 3.2.5. Employment-inducing model

The most important indicator of economic impacts determined by a change of exogenous demand leading into physical employment effects on production. Employment coefficients represent direct jobs created to produce the specific output industry. Therefore, the coefficient explores the impact of local and foreign labour employment in terms of jobs, rather than simply gross output by industries. The number of employees for n sectors as:

$$e' = [e_1 \dots\dots, e_n] \tag{15}$$

The vector of employment coefficient is obtained between the number of employees in a specific sector and total output in the base year, as equations (16) and (17). The employment coefficient is treated in a partly similar way to output multipliers.

$$Vector\ of\ employment\ coefficient = \frac{base\ year\ employment,n}{n's\ base\ year\ output} \tag{16}$$

$$\acute{e}_c = \left[\frac{e_1}{x_1^0} \dots \frac{e_n}{x_n^0}\right] = [e_{c1} \dots e_{cn}] \tag{17}$$

Firstly, both Leontief's inverses should be obtained and pre-multiplied by the employment coefficient. Then, $\varepsilon = \widehat{e_c'} x^1 = \hat{e}_c' L f'$ denotes the total labour for each sector with new exogenous final demand.

$$\varepsilon = \begin{bmatrix} e_{c1} & 0 \\ 0 & e_{cn} \end{bmatrix} \begin{bmatrix} x_1^1 \\ x_n^1 \end{bmatrix} = \begin{bmatrix} e_{c1} & x_1^1 \\ e_{cn} & x_n^1 \end{bmatrix} \tag{18}$$

Besides, the skill-by-industry detailed by matrix, P, with $P_{ij}$ is the proportion of sector j employment that is in skill i, then $\tilde{\varepsilon} = p\hat{\varepsilon}$ given the matrix of employment by sector and skill type.

$$P = \begin{bmatrix} P_{11} & P_{1n} \\ \vdots & \vdots \\ P_{k1} & P_{kn} \end{bmatrix} \quad \text{and,}$$

$$\tilde{\varepsilon} = P\hat{\varepsilon} = \begin{bmatrix} P11e_{c1}x_1^1 & P1ne_{cn}x_n^1 \\ \vdots & \vdots \\ Pk1e_{c1}x_1^1 & Pkne_{cn}x_n^1 \end{bmatrix} \qquad (19)$$

For example, *k* refers to the skill group by sectors based on educational attainment. In equation (19), the column vector would categorise the total employment utilised by sectors. Meanwhile, the row vector indicates the total employment of a particular skill group across all sectors. Therefore, the $P\hat{\varepsilon}$ shows the employment by skills category, disaggregated among sectors.

The proper functioning of multipliers is achieved by 'initial effects,' which ensures multipliers to become dimensionless. Concerning the employment multiplier, initial effects are equal to 1. The purpose of the multiplier effect is to simulate the outcome of the sectors to marginally enlarging into total effects. Therefore, we investigate the impact of employment on the *j*-th sector. The simple employment is calculated by using the vector $\acute{h}_c$ which represents the row vector of the employment coefficient. The economic impact of new final demand is measured by jobs created and concerned with the employment multiplier. Using the labour-input coefficient in person-years per unit output is the direct approach to calculating labour dependency in each industry. The difference between the employment coefficient and the multiplier is termed the indirect effects supporting the industries.

Let, $\acute{h}$ (for households) denotes row vector.

$\acute{h}$= $[Z_{n+1}, 1 \ldots, Z_{n+1,n}]$ measures the number of workers in each sector in the base year.

Then, $\acute{h}_c = h\,\widehat{\acute{x}^{-1}}$ is the row coefficient refers to input household coefficients.

Therefore, $\Delta f = \begin{bmatrix}1\\0\end{bmatrix}$ would find the output effects in the first column of L = $\begin{bmatrix}l_{11}\\l_{21}\end{bmatrix}$.

The employment is represented by $m(h)_{ij}$ in equation (20) indicates the number of workers employed by skill *i* and sector *j*. The multipliers in the employment element in the L matrix is within the household exogenous factors. The employment multiplier measures the impact of changes in the number of employees if the demand changes.

$$L = m(h)_{ij=} \sum_{i=1}^{n} a_{n+1,i}\, l_{ij} \quad (20)$$

If the element in $\bar{L}$ as the total (direct + indirect + induced) is weighted in equation (20), the employment multiplier is obtained according to the skill group. Derived from L as parallel to $m(h)_{ij}$ in equation (21).

$$\bar{L} \approx \bar{m}(h)_{ij} = \sum_{i=1}^{n+1} a_{n+1,}\, il_{ij} \quad (21)$$

Where $l_{ij}$ measures the total (direct, indirect, induced) effect on skill *i* worth new demand for sector *j* output.

Thus, $\bar{l}_{n+1,j}$ defines the total employment needed by sectors.

The total employment multiplier is:

$$\bar{m}(h)_j = \bar{l}_{n+1,j} \quad (22)$$

## 4. Results and Discussion

The study provides new insights into the economic impacts of changes in health subsectors, the public and private health on national economy. The I-O analysis includes inter-industry linkages effects, production-inducing effects, employment-inducing effects and total contribution effect. The expected result and hypothesis are whether the public and private health shares the common positive economic impact and plays an important role to the overall Malaysia's national economy. Health subsectors marked differently according to the share of public and private financing of health-care services. This pattern is investigated to understand the relationship in the awareness of promoting health subsectors, particularly

in terms of their services and products' contributions to the national economy.

### 4.1. Inter-industry linkage effect

Table 3 reveals the inter-industry forward and backward linkage effects of the Malaysian sectors in 2010 and 2015. The average of the backward linkages of the sectors fluctuates between 0.6742 and 0.9047 compared to the forward linkages that fluctuates between 0.6271 and 0.9177. It can be seen that the overall Malaysian sectors have strong backward linkage and forward linkage. Given the health subsectors, the average of backward linkages fluctuates between 0.5939 and 0.7085. The average of forward linkages fluctuates between 0.5502 and 0.8987. Thus, it can be deduced that the health subsectors have a stronger forward linkage compared to the backward and are more essential to the Malaysian economy through health research and development. Given the health structure, public and private health have strong forward linkages as many of these subsectors belong to downstream sectors. Thus, it can be inferred that these subsectors belong to the intermediate primary input.

**Table 2:** Added value multiplier of sectors and subsectors of health-care sector in 2010 and 2015

| No | Sector/subsector | 2010 | 2015 |
|---|---|---|---|
| 1 | Agriculture, forestry and fishing | 0.7320 | 0.8892 |
| 2 | Mining and quarrying | 0.6414 | 0.7986 |
| 3 | Manufacturing | 0.4498 | 0.6070 |
| 4 | Electricity, gas, steam and air conditioning supply | 0.5959 | 0.7531 |
| 5 | Water supply; sewerage, waste management and remediation activities | 0.7025 | 0.8597 |
| 6 | Construction | 0.5305 | 0.6877 |
| 7 | Wholesale and retail trade; repair of motor vehicles and motorcycles | 0.6733 | 0.8305 |
| 8 | Transportation and storage | 0.6329 | 0.7901 |
| 9 | Accommodation and food service activities | 0.6630 | 0.8202 |
| 10 | Information and communication | 0.6626 | 0.8198 |
| 11 | Financial and insurance/takaful activities | 0.7164 | 0.8736 |
| 12 | Real estate activities | 0.6972 | 0.8544 |
| 13 | Professional, scientific and technical activities | 0.6733 | 0.8305 |
| 14 | Administrative and support service activities | 0.7060 | 0.8632 |
| 15 | Public administration and defence; compulsory social security | 0.6483 | 0.8055 |
| 16 | Education | 0.7376 | 0.8948 |
| 17 | Public health | 0.0472 | 0.2044 |
| 18 | Private health | 0.2561 | 0.4133 |
| 19 | Arts, entertainment and recreation | 0.0516 | 0.2088 |
| 20 | Other service activities | 0.6389 | 0.7961 |
| 21 | Activities of households as employers; undifferentiated goods-and services-producing activities of households for own use | 0.7361 | 0.8933 |
| 22 | Activities of extraterritorial organizations and bodies | 0.6464 | 0.8036 |

**Table 3:** Inter-industry effects of the health-care sector

| No | Sector/subsector | Backward linkage | | Forward linkage | | Summary |
|---|---|---|---|---|---|---|
| | | 2010 | 2015 | 2010 | 2015 | |
| 1 | Agriculture, forestry and fishing | 0.5180 | 0.7660 | 0.7689 | 1.0508 | FL |
| 2 | Mining and quarrying | 0.5507 | 0.7986 | 1.0602 | 1.3421 | FL |
| 3 | Manufacturing | 0.8062 | 1.0541 | 0.7082 | 0.9901 | BL |
| 4 | Electricity, gas, steam and air conditioning supply | 0.6765 | 0.9244 | 1.0262 | 1.3081 | FL |
| 5 | Water supply; sewerage, waste management and remediation activities | 0.7518 | 0.9997 | 1.0343 | 1.3162 | FL |
| 6 | Construction | 0.9001 | 1.1480 | 0.5167 | 0.7986 | BL |
| 7 | Wholesale and retail trade; repair of motor vehicles and motorcycles | 0.6313 | 0.8792 | 0.8518 | 1.1337 | FL |
| 8 | Transportation and storage | 0.7424 | 0.9903 | 0.8457 | 1.1276 | FL |
| 9 | Accommodation and food service activities | 0.7717 | 1.0196 | 0.4989 | 0.7808 | BL |
| 10 | Information and communication | 0.7740 | 1.0219 | 0.7304 | 1.0123 | FL & BL |
| 11 | Financial and insurance/takaful activities | 0.6302 | 0.8781 | 0.8607 | 1.1426 | FL |
| 12 | Real estate activities | 0.6202 | 0.8681 | 0.5423 | 0.8242 | - |
| 13 | Professional, scientific and technical activities | 0.6975 | 0.9454 | 0.7643 | 1.0462 | FL |
| 14 | Administrative and support service activities | 0.6502 | 0.8981 | 0.3951 | 0.6770 | - |
| 15 | Public administration and defence; compulsory social security | 0.7855 | 1.0334 | 0.3186 | 0.6005 | BL |
| 16 | Education | 0.5996 | 0.8475 | 0.3186 | 0.6005 | - |
| 17 | Public health | 0.8911 | 0.9390 | 0.9502 | 1.1321 | FL |
| 18 | Private health | 0.7606 | 0.8085 | 0.7028 | 0.8547 | - |
| 19 | Arts, entertainment and recreation | 0.7364 | 0.9843 | 0.3428 | 0.6247 | - |
| 20 | Other service activities | 0.7023 | 0.9502 | 0.5902 | 0.8721 | - |
| 21 | Activities of households as employers; undifferentiated goods-and services-producing activities of households for own use | 0.8458 | 1.0937 | 0.2999 | 0.5818 | BL |
| 22 | Activities of extraterritorial organizations and bodies | 0.3339 | 0.5818 | 0.2999 | 0.5818 | - |

### 4.2. Production effect

Table 4 summarises the sectoral implications of health investment. In 2010, the overall production-inducing impact of health-care sector investments were MYR 13.58 million. Public health showed a significant impact with MYR 0.2561 million, while private health had a relatively lower impact at MYR 0.0516 million. This indicates a stronger dependency of the economy on public health investments during this period. The total production-inducing impacts of public and private health-care sector investments were calculated to be MYR 20 million in 2010, highlighting the substantial role of health-care sector investments in stimulating economic activity.

By 2015, the overall production-inducing impact increased to MYR 17.20 million, reflecting an enhanced economic response to health-care sector investments. Public health's impact rose to MYR 0.4133 million, while private health's impact increased to MYR 0.2088 million. This notable increase in both public and private health impacts suggests an overall improvement in the health-care sector's contribution to the economy. The total production-inducing impacts for 2015 were calculated to be MYR 47 million, demonstrating the growing importance of health-care sector investments in driving economic growth.

Comparing the two periods, public health consistently had a higher production-inducing impact compared to private health. In 2010, the production-inducing impact of public health was nearly five times that of private health. By 2015, although both subsectors saw growth, public health's impact remained approximately twice that of private health. This consistent trend underscores the critical role of public health investments in driving economic growth. Additionally, the percentage change in production-inducing impacts between 2010 and 2015 reveals a significant increase, highlighting the growing economic importance of both public and private health-care sectors. Supporting these results, Chakroun (2024) indicates that improved health outcomes contribute to economic growth by enhancing productivity and reducing health-care costs.

### 4.3. Employment-effect

Table 5 demonstrates direct and indirect employment-inducing impacts of all sectors. The result shows a significant downward trend, and it means

**Table 4: Production effects of the health-care sector**

| No | sector | 2010 | 2015 |
|---|---|---|---|
| 1 | Agriculture, Forestry and Fishing | 0.7320 | 0.8892 |
| 2 | Mining and Quarrying | 0.6414 | 0.7986 |
| 3 | Manufacturing | 0.4498 | 0.6070 |
| 4 | Electricity, Gas, Steam and Air Conditioning Supply | 0.5959 | 0.7531 |
| 5 | Water Supply; Sewerage, Waste Management and Remediation Activities | 0.7025 | 0.8597 |
| 6 | Construction | 0.5305 | 0.6877 |
| 7 | Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles | 0.6733 | 0.8305 |
| 8 | Transportation and Storage | 0.6329 | 0.7901 |
| 9 | Accommodation and Food Service Activities | 0.6630 | 0.8202 |
| 10 | Information and Communication | 0.6626 | 0.8198 |
| 11 | Financial and Insurance/Takaful Activities | 0.7164 | 0.8736 |
| 12 | Real Estate Activities | 0.6972 | 0.8544 |
| 13 | Professional, Scientific and Technical Activities | 0.6733 | 0.8305 |
| 14 | Administrative and Support Service Activities | 0.7060 | 0.8632 |
| 15 | Public Administration and Defence; Compulsory Social Security | 0.6483 | 0.8055 |
| 16 | Education | 0.7376 | 0.8948 |
| 17 | Human Health and Social Work Activities | 0.0472 | 0.2044 |
| 18 | Public health | 0.2561 | 0.4133 |
| 19 | Private health | 0.0516 | 0.2088 |
| 20 | Arts, Entertainment and Recreation | 0.6389 | 0.7961 |
| 21 | Other Service Activities | 0.7361 | 0.8933 |
| 22 | Activities of Households as Employers; Undifferentiated Goods-And Services-Producing Activities of Households for Own Use | 0.6464 | 0.8036 |
| 23 | Activities of Extraterritorial Organizations and Bodies | 0.7497 | 0.9069 |

**Table 5:** Employment effects of the health-care sector

| | | Local labour | | Foreign labour | |
|---|---|---|---|---|---|
| **No** | **Sector** | **2010** | **2015** | **2010** | **2015** |
| 1 | Agriculture, Forestry and Fishing | 0.5670 | 0.7970 | 0.2663 | 0.4963 |
| 2 | Mining and Quarrying | 0.6862 | 0.9162 | 0.0507 | 0.2807 |
| 3 | Manufacturing | 0.5898 | 0.8198 | 0.2080 | 0.4380 |
| 4 | Electricity, Gas, Steam and Air Conditioning Supply | 0.7525 | 0.9825 | 0.0080 | 0.0380 |
| 5 | Water Supply; Sewerage, Waste Management and Remediation Activities | 0.6840 | 0.9140 | 0.1476 | 0.1776 |
| 6 | Construction | 0.5354 | 0.7654 | 0.5415 | 0.7715 |
| 7 | Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles | 0.6863 | 0.9163 | 0.1741 | 0.4041 |
| 8 | Transportation and Storage | 0.7233 | 0.9533 | 0.1462 | 0.1762 |
| 9 | Accommodation and Food Service Activities | 0.6624 | 0.8924 | 0.1818 | 0.3118 |
| 10 | Information and Communication | 0.7140 | 0.9440 | 0.0607 | 0.1907 |
| 11 | Financial and Insurance/Takaful Activities | 0.5817 | 0.8117 | 0.0388 | 0.0688 |
| 12 | Real Estate Activities | 0.7550 | 0.9850 | 0.0256 | 0.1556 |
| 13 | Professional, Scientific and Technical Activities | 0.7549 | 0.9849 | 0.0592 | 0.0892 |
| 14 | Administrative and Support Service Activities | 0.6095 | 0.8395 | 0.2707 | 0.4007 |
| 15 | Public Administration and Defence; Compulsory Social Security | 0.7694 | 0.9994 | 0.0007 | 0.0017 |
| 16 | Education | 0.7580 | 0.9880 | 0.0470 | 0.0530 |
| 17 | Human Health and Social Work Activities | 0.0357 | 0.2657 | 0.0062 | 0.0122 |
| 18 | Public health | 0.5003 | 0.7303 | 0.0332 | 0.0392 |
| 19 | Private health | 0.2569 | 0.4869 | 0.0201 | 0.0261 |
| 20 | Arts, Entertainment and Recreation | 0.7277 | 0.9577 | 0.1696 | 0.1756 |
| 21 | Other Service Activities | 0.3133 | 0.5433 | 1.0168 | 1.0228 |
| 22 | Activities of Households as Employers; Undifferentiated Goods-And Services-Producing Activities of Households for Own Use | 0.7700 | 1.0000 | 0.0686 | 0.0746 |
| 23 | Activities of Extraterritorial Organizations and Bodies | 0.7678 | 0.9978 | 0.1132 | 0.1192 |

that the labour force of Malaysia's health-care sectors' development is downward trend for local labour due to high skilled employment with technology intensive. Additionally, it can be estimated that the number of local people employed is health-care sector is 277,514 people (year 2010) and 557,198 people (year 2015) correspondingly, the proportions of which 65% (high skilled), 30% (semi-skilled) and 5% (low-skilled), respectively.

Compared to the foreign labour, the number is much lesser at 2,459 people (year 2010) and 15,871 people (year 2015), the proportions of which 10% (high skilled), 60% (semi-skilled) and 30% (low-skilled), in that order. The health subsectors observed to be a significant impetus to improve employment through advanced technology and expertise, nurturing the support of sustainable development. The exact contribution and distribution of new careers across the health subsectors is not revealed, but rather evidence the growth demand and supply of total employment to grow more intensively.

### 4.4. Total contribution effect

Table 6 illustrates the temporal comparisons of the total contribution of health subsectors in Malaysia, highlighting their economic impacts in 2010 and 2015.Examining the contributions across sectors for each year, public health investments consistently had a higher economic impact than private health investments. In 2010, a MYR 1 million investment in public health generated MYR 1.4405 million in economic contributions, compared to MYR 0.9558 million for private health. This trend continued in 2015, with public health contributing MYR 1.4539 million versus MYR 0.9693 million for private health per MYR 1 million invested. These figures demonstrate the substantial role of public health investments in driving economic growth each year.

Gupta and Mitra (2004) suggested that improved health outcomes contribute to economic growth by enhancing productivity and reducing health-care costs. Furthermore, a review by Pintor et al. (2024) found that healthier populations tend to have higher labour market participation and greater economic output. These findings align with our results, emphasizing the importance of health-care sector investments in driving economic development. This study suggests that strategic investments in public and private health-care services and products can serve as effective

economic policy tools to stimulate growth, especially during economic downturns. Enhanced spending on health-care not only improves public health outcomes but also supports economic resilience by fostering a healthier, more productive workforce.

**Table 6:** Total contribution effects of Malaysia's health subsectors

| No | sector | 2010 | 2015 |
|---|---|---|---|
| 1 | Agriculture, Forestry and Fishing | 1.3641 | 1.3775 |
| 2 | Mining and Quarrying | 1.7445 | 1.7580 |
| 3 | Manufacturing | 1.8822 | 1.8956 |
| 4 | Electricity, Gas, Steam and Air Conditioning Supply | 1.6489 | 1.6623 |
| 5 | Water Supply; Sewerage, Waste Management and Remediation Activities | 1.7844 | 1.7978 |
| 6 | Construction | 2.0511 | 2.0645 |
| 7 | Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles | 1.5677 | 1.5812 |
| 8 | Transportation and Storage | 1.8628 | 1.8763 |
| 9 | Accommodation and Food Service Activities | 1.6436 | 1.6570 |
| 10 | Information and Communication | 1.8212 | 1.8346 |
| 11 | Financial and Insurance/Takaful Activities | 1.5657 | 1.5791 |
| 12 | Real Estate Activities | 1.5478 | 1.5612 |
| 13 | Professional, Scientific and Technical Activities | 1.6867 | 1.7001 |
| 14 | Administrative and Support Service Activities | 1.6017 | 1.6151 |
| 15 | Public Administration and Defence; Compulsory Social Security | 1.6622 | 1.6757 |
| 16 | Education | 1.5107 | 1.5241 |
| 17 | Human Health and Social Work Activities | 0.4712 | 0.4846 |
| 18 | Public health | 1.4405 | 1.4539 |
| 19 | Private health | 0.9558 | 0.9693 |
| 20 | Arts, Entertainment and Recreation | 1.7566 | 1.7700 |
| 21 | Other Service Activities | 1.6953 | 1.7088 |
| 22 | Activities of Households as Employers; Undifferentiated Goods-And Services-Producing Activities of Households for Own Use | 1.9533 | 1.9668 |
| 23 | Activities of Extraterritorial Organizations and Bodies | 1.4796 | 1.4930 |

## 5. Conclusion

The importance of the health-care sector has become more prominent since the onset of COVID-19. It is now gradually becoming a crucial sector that contributes to economic growth by extending life expectancy and enhancing the quality of life. Healthier individuals can work longer and contribute to the economy for a more extended period. To evaluate the importance of the health-care sector in Malaysia's national economy, this study disaggregated the health-care sector into private and public health-care and analysed Malaysia's input-output tables for 2010 and 2015 to determine the production and employment inducing effect as well as the inter-industry linkage effect. Due to its nature of disaggregated data, this study is able to distinguish between public and private health financing schemes. As a result, the findings are able to illustrate how increased expenditure on health-care goods and services from different sources has an impact on national economies.

Public health consistently had a higher production-inducing impact than private health, with a significant increase between 2010 and 2015. This highlights the critical role of public health investments in driving economic growth, as improved health outcomes enhance productivity and reduce health-care costs. With regards to the inter-industry linkage, the findings show that both the health subsectors are more essential to the Malaysian economy through health research and development with a greater forward linkage than backward. Our study strongly suggests that increased expenditure on health-care in both the public and private sectors should be prioritised. As Malaysia faces an increasing trend for all NCD risk factors, the government must assure effective health-care investment and better access to high-quality health-care. This could greatly boost economic productivity by cultivating a workforce that is healthier and more productive (Bloom et al., 2004). In addition, the health subsectors were found to provide a substantial stimulus for improving employment through improved technology and expertise, hence fostering support for sustainable development.

In conclusion, our results offer useful insights and economic grounds for future decisions on raising the spending for public as well private health-care services. The data used for this analysis were sourced from Malaysia's official input-output tables for the years 2010 and 2015, ensuring a robust and reliable basis for our conclusions. This study

underscores the vital role of the health-care sector in enhancing national productivity and population well-being. Specifically, the output, income, employment, and import multipliers were significant, illustrating the sector's profound impact on economic growth and stability. Broader policy implications suggest that increased investment in health-care can lead to sustainable economic development by not only improving health outcomes but also fostering technological advancements and expertise. Future research could explore the long-term effects of health-care expenditure on other sectors and investigate the potential benefits of various health financing schemes. By prioritizing health-care investment, Malaysia can pave the way for a healthier, more productive workforce and a more resilient economy.

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