Contribution of investment in health and cancer control to economic growth in Commonwealth countries

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Summary

Background There are three broad mechanisms through which health investments yield economic benefits. First, health investments in cost-effective innovations help improve health outcomes and reduce healthcare costs in a health system. Second, investments in health can help improve health and wellbeing of individuals. A healthier population is economically more productive, with a longer productive life and reduced absenteeism and presenteeism. Third, an important but often-overlooked mechanism is the benefit of health investments on the broader economy through influences on supply and demand across various other sectors of a country's economy. We examine the third mechanism in selected Commonwealth countries.

Methods We provide an analysis and estimates of GVA growth and employment effects of the Health Economy for four Commonwealth countries, namely India, Nigeria, Malaysia and the United Kingdom in 2022. Drawing on a conservative 'static estimation approach', whose bases are on the Health Economy Reporting, to provide country-specific assessment of the return on investment in cancer services and cancer prevention in the UK, for which data are available, as an illustrative 'use case'. For cancer prevention, we examine investments in vaccination for Human Papilloma Virus.

Findings In our analysis, the Gross Value Added (GVA) generated by the Health Economy in the UK amounted to about US$295 billion (8.9% of GDP; the largest sector by size) in 2022, with around US$171 billion of GVA (5.2% of GDP) generated in adjacent sectors, and through these two effects generating additional induced consumption of US$217 billion of GVA (6.6% of GDP). In India, Malaysia, and Nigeria, in 2022, total GVA generated by the Health Economy, adjacent sectors and through induced income accounted for 9.9%, 9.8% and 7.0% of the GDP respectively. In the UK, US$134 million of investment in HPV vaccination generated US$247 million of GVA in total and 2000 jobs. Whereas in India US$756 million of investment in HPV vaccination produced US$ 1149 million in total GVA and generated 155,000 jobs.

Interpretation The assessment of four Commonwealth countries reveals that the Health Economy contributes substantially to economic growth and generates substantial employment. These contributions extend beyond the health sector itself, reaching adjacent sectors along the health value chain and inducing effects throughout the broader economy. Investment in cancer prevention generates high returns with substantial addictions to GVA and employment.

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Keywords: Cancer; Health economy; Health economics; Investment in health; Health systems; Commonwealth countries

Introduction

Evidence underscores the contribution of health investment to substantial improvement in life expectancy, quality of life, and economic growth through productivity of human capital.[1–4] Economic downturns that followed the COVID-19 pandemic and worldwide concerns on fiscal and economic sustainability, has reignited the debate on the role of health investments in

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Research in context

Evidence before this study

Evidence underscores the contribution of health investment to substantial improvement in life expectancy, quality of life, and economic growth through productivity of human capital. Earlier studies have identified three mechanisms through which health investments yield economic benefits: first, by improving health outcomes and reducing direct healthcare costs in a health system; second, improving health and wellbeing of individuals to be economically more productive, with a longer productive life, and; third, an often-overlooked mechanism, by influencing supply and demand across various other economic sectors within the country.

Added value of this study

The study provides a holistic view of the Health Economy by broadening the traditional concept of the Health Economy by including the Healthcare Economy, Industrial Health Economy, and Service and Support sectors. This expanded perspective allows for a more comprehensive understanding of how health investments influence broader economic indicators, including Gross Domestic Product (GDP) and employment rates.

The study provides a novel quantitative analysis using Input-Output Models. The utilisation of input-output models to estimate the Gross Value Added (GVA) growth and employment effects provides a robust quantitative basis for evaluating the direct and indirect economic impacts of health investments, offering valuable insights into the multiplier effects within the economy.

The study is the first to quantify in selected Commonwealth countries the contribution of the Health Economy, including investments in cancer control, to the broader economy and compare this contribution with those from Finance, IT and Manufacturing sectors.

Implications of all the available evidence

Financial outlays for the health sector are currently considered a 'cost', an 'expenditure', or an 'economic burden' rather than an 'investment' that yields substantial health, economic and societal benefits. The findings quantify substantial contributions of health investment to the Health Economy and to the broader economy, as a motor of economic growth and well-being of societies. By positioning health investments as strategic tools for economic growth, the study provides actionable advice for policymakers for resource allocation decisions.

promoting economic growth and stability, and on the risk of fiscal retrenchment with austerity measures that lead to health budget cuts.[5,6] As a result, there are renewed efforts to better articulate the mechanisms through which health investments yield economic gains and to quantify broader health and economic benefits of these investments.

Earlier studies have identified three mechanisms through which health investments yield economic benefits. First, health investments in cost-effective innovations help improve health outcomes and reduce direct healthcare costs in a health system.[7–11] These savings can help ease financial pressures on health systems and be redirected to areas where they are most needed. Second, investments in health can help improve health and wellbeing of individuals and therewith reduce indirect costs. A healthier population is economically more productive, with a longer productive life and reduced absenteeism and presenteeism.[2,4,10,11] Thus, health investments produce health capital and in consequence human capital. Third, an often-overlooked mechanism is the benefit of health investments on the broader economy by influencing supply and demand across various other economic sectors within the country. While the health sector is commonly associated with healthcare services, we broaden this perspective assessing the entire 'Health Economy' that includes three subsectors, namely: the Healthcare Economy (circumventing inpatient and outpatient care, doctors, and hospitals), Industrial Health Economy (pharma, medtech, research and development [R&D]), and Service and Support (health insurance, retail trade; Fig. 1).

Recent studies indicate that the Health Economy substantially contributes to Gross Domestic Product (GDP) of a country. For instance, in 2021, this contribution accounted for 12.0% in Germany, 7.2% in Brazil, 5.3% in Mexico, and 8.8% of GDP in Argentina.[12] In that sense, every resource allocation to the Health Economy, i.e., any budget injection to one of the considered subsectors, generates benefits. These benefits directly occur on the balance sheet of the Health Economy and can be expressed in GDP contribution and job creation.

As every sector is interconnected with other economic sectors through the value chains of production, the effects within the Health Economy also spread to the overall economy in terms of spillover effects through the absorption of intermediate goods and services.[13,14]

In the case of the Commonwealth countries the Industrial Health Economy subsector is a major contributor to domestic GVA and employment (Panel 1). However, this contribution has not been quantified systematically and comprehensively.

A new study, indicates that, in 2020, there were an estimated 1,610,000 new cancer cases in the Commonwealth countries [95% UI 1,556,000–1 674,000].[19] These accounted for an estimated 14.3% of global diagnosed

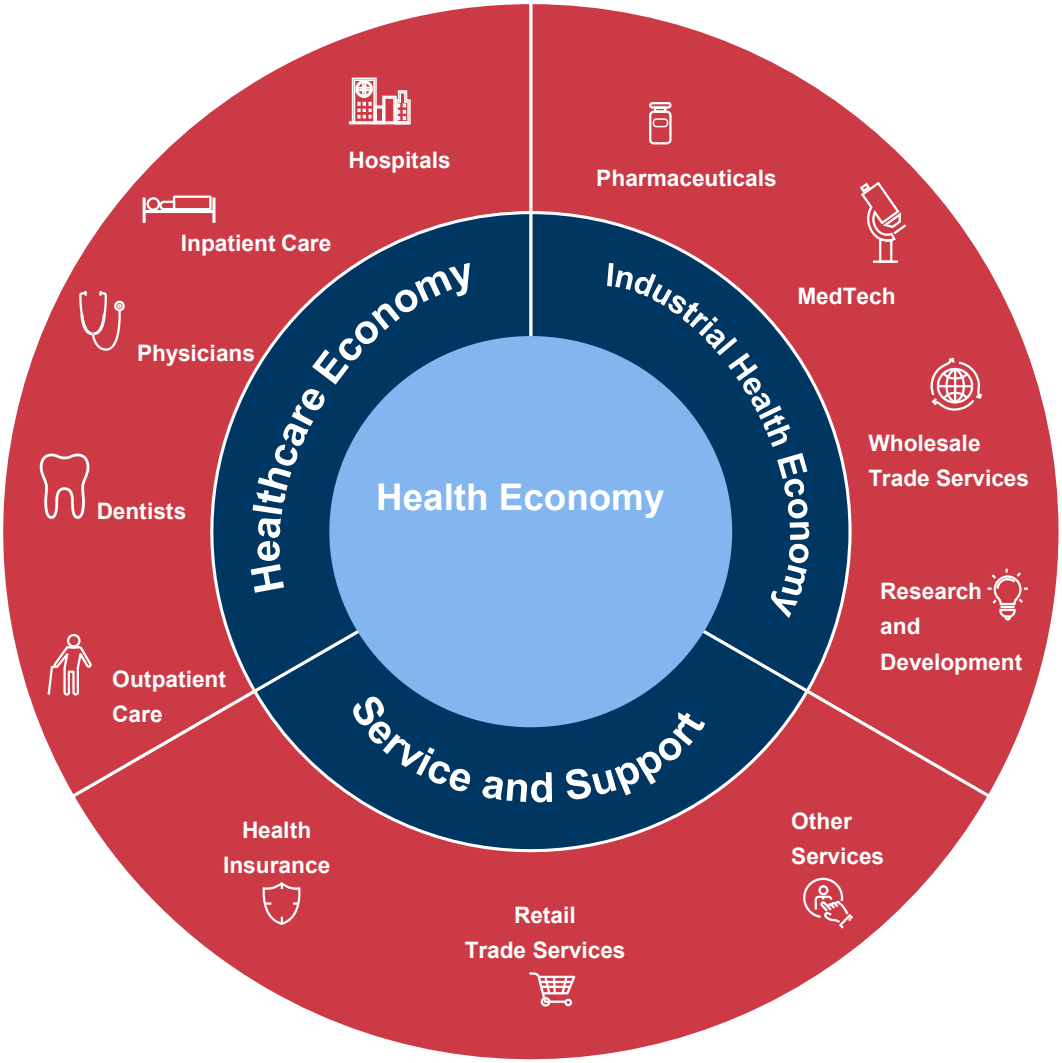

Fig. 1: Health economy and its three sub-sectors.

cancer cases in 2020 among the 11 commonest adult cancers in the world.[19] The study projected that the number of cancer cases in the Commonwealth will increase to reach an estimated 3,330,000 cases [3,154,000–3 539,000] in 2050, accounting for 17.3% of the total number of projected cancer cases in the world 2050.[19] Given its relatively high health and economic burden, health investment destined for addressing the cancer burden would generate economic activity within as well as beyond the Health Economy of the country. For example, targeted investments in cost-effective cancer prevention interventions would not only improve patients' well-being and help reduce the economic strain of cancer on the health system[20] but also help strengthen the Health Economy, fostering progress in R&D to advance scientific knowledge in the health and overall economy. However, low level of R&D investments for adult and childhood cancers, especially in low- and middle-income countries hinder the achievement of potential economic gains.[21,22] Addressing this R&D 'investment gap' through increased funding presents an opportunity to generate substantial economic benefits in Commonwealth countries.

Earlier studies have quantified the benefits of investing in health sector to address cancer through the first two mechanisms: (i) reducing cost of healthcare in health systems[7,9–11] and (ii) generating health and economic benefit through human capital productivity.[23,24] However, there have been no studies to quantify the benefits of investing in health sector, cancer prevention and care through the third mechanism, namely the macroeconomic benefit of this investment in the Health Economy as well as in other sectors of the broader economy.

Panel 1: Contribution of investment in the industrial health economy to the broader economy.

Consider India, where the pharmaceutical market constitutes about 1.3% of the GVA, functioning as a major global supplier of generics and producing over 60% of the world's vaccinations. India has strategically positioned itself as a global manufacturing hub, ensuring the stability and affordability of pharmaceutical supplies for middle- and low-income countries. The remarkable success of the Indian pharmaceutical sector is partly attributed to government investments and incentives, resulting in job creation and economic gains.

Similarly, following India's example,[15] the Malaysian government[16] has prioritized the development of a national generic market with a high share of production for export, and the aim of becoming a regional leader in the pharmaceutical industry.

Recognizing the interconnected nature of the economy, increased government investments in the health sector not only improve public well-being but also make significant contributions to overall economic growth. This strategic allocation of funds into a pivotal sector, intricately linked to other segments of the economy, yields economic gains.[17,18]

In this paper we provide an analysis to estimate effects, in 2022 in four purposively selected Commonwealth countries as illustrative examples: India and Nigeria, lower-middle-income countries,[25] with and without well-established biopharma and health technology sectors producing mainly generics, Malaysia, an upper-middle-income country with a nascent but growing biopharma and health technology sector, and the United Kingdom (UK), a high-income country, with a strong biopharma and health technology sector.

We express the impact of investment in the Health Economy in terms of contribution to Gross Value Added (GVA) to the economy and in terms of jobs creation. GVA is a principle of economic accounting to monetize the additional value that is created by the production of goods and services, i.e., defined as turnover less input costs. In that sense it counts only the incremental value of an industry.

Drawing on a conservative 'static estimation approach' whose bases are on the Health Economy Reporting (Panel 2), we also provide country-specific indicative assessments of the return on investment in cancer prevention.

Methods

Our analysis comprises three consecutive steps. First, we position and assess the Health Economy as a cross-industry sector. The Health Economy comprises a range of production companies, services, manufacturers, and suppliers.[28] To define this cross-industry sector, we draw on a validated approach from earlier research in which all goods and services that contribute to health in a broader sense are considered.[28,29] These relevant goods and services are identified based on statistical Classification of Products by Activity (CPA) (see Appendix A2.1. for details). The CPA is the classification at the level of the European Union to categorize goods and services. The goods and services are then clustered in three subsectors: Healthcare, Industrial Health Economy, and Services and Support (see Fig. 1) which consolidate to the extended ecosystem of the Health Economy. In a subsequent step we utilize multi-region input-output (IO) data of the World Input-Output Database[30] and the Eora Global Supply Chain Database[31,32] to quantify the magnitude of the subsectors in terms of GVA and employment. GVA can be specified in absolute terms and as a proportion of Gross Domestic Product (GDP) and employment in absolute terms and as a proportion of domestic employment. This provides us the direct contribution of the Health Economy to the country's overall economy.

Second, each of the three subsectors of the Health Economy is interlinked to other economic sectors, as the production of health goods and services is subjected to the provision of intermediate inputs. This implies that beyond the direct contribution there are spillover effects through activity in adjacent sectors. The assessment of these effects is framed and proven by the application of IO modelling.[33–35] We calculate the country-specific Leontief inverse of the IO matrix,[36] which describes how one unit of output in one sector increases intermediate output in all other sectors. Introducing sector quotas, which describe the GVA and employment per

Panel 2: Health economy reporting.

Since 2010, WifOR Institute and its collaborators have developed a systematic process for analyzing the role of both direct Health Economy effects and adjacent effects in generating economic growth.[26,27] This endeavour has led to the development of Health Economy Reporting (HER), a tool designed to evaluate the size and significance of the Health Economy in terms of employment and GVA. HER systematically assesses the contributions and added values of entities across the 'value chain of health,' elucidating interactions among stakeholders in fields such as R&D, Biotech, MedTech, Pharmaceutical Production, Retail Pharmacies, Hospitals, and Care Services. The HER initiative originated through collaboration between WifOR and the German Federal Ministry of Economic Affairs in 2017.[26,27] Numerous applications based on the HER methodology have been published, including its support for the G20 Presidency of Italy, where the methods were discussed with the G20 and the B20 Health Task Force.[12]

unit of output in every sector, allows us to estimate the value creation and employment contribution in the adjacent sectors (see Appendix A.2.3. for details).

In the third step, we consider that the first two mechanisms lead to provision of wages and thus stimulate consumption demand for goods and services in the domestic economy. We capture these induced consumption effects consistently by adding household consumption to the Leontief inverse[36] (see Appendix A.2.4. for details).

With the proposed framework, we provide structured metrics to assess the relationship between effects within and beyond the Health Economy. The multipliers illustrate how one dollar invested in health might generate output in terms of monetary contribution to GVA in the overall economy via the value chains and due to induced consumption. Additionally, the multipliers quantify how every employee in the Health Economy supports further employees in the overall domestic economy.

Furthermore, we present a modelled assessment of the economic contributions resulting from investments in preventive measures for cancer. Our methodology assumes that the derived multipliers for the entire Health Economy in each of the considered countries remain constant over time and across different investments and therewith can be applied to assess the impact of an investment in cancer prevention. Given the absence of concrete data on investment in cancer prevention by country in general, we apply a representative amount of investment. We utilize information on country-specific average yearly investment in routine Human Papilloma Virus (HPV) vaccination which is a proven measure to reduce cervical cancer morbidity and mortality[37] (see Appendix Table A6 for details). To estimate the direct effects of in the Health Economy, the effects in adjacent sectors and induced income effects due to the investment, we apply the derived multipliers to the total amount of investment.

To test the robustness of our empirical figures, we analyze the sensitivity of the respective multipliers. As our multipliers are derived from the Leontief inverse matrix, we cannot perform inference statistics directly. Instead, we rely on the estimated variation from Stehrer et al. (2024), who compare Leontief multipliers to estimated parameters (see Appendix A.2.5. for details and Appendix Tables A4 and A5 for the results of the sensitivity analyses).[38]

Role of the funding source

None. Self-funded study by Harvard University and Wifor Institute, with no external funding.

Results

The IO metrics enable comparison of national Health Economies in terms of GVA and employment. We express the relation between the direct contribution of the Health Economy and effects in adjacent sectors and induced income effects via multipliers. The total results describing the overall contribution of the Health Economy are provided separately for the domestic Health Economy itself (direct contribution), for effects along the value chain of health to adjacent sectors, and for induced income effects as consumption is stimulated from economic activity (Table 1).

For the UK, the multiplier for adjacent sectors is 0.58 and can be interpreted as one US$ of GVA in the Health Economy being associated with US$ 0.58 in adjacent sectors. The induced income multiplier is slightly higher at US$ 0.73 of GVA, reflecting the GVA generated through consumption that is associated with every US$ of GVA in the Health Economy. In 2022, rounding to the nearest billion, the GVA generated by the Health Economy in the UK amounted to about US$ 295 billion (8.9% of GDP). Additionally, along the value chain of the Health Economy, around US$ 171 billion of GVA (5.2% of GDP) were generated in adjacent sectors. These two effects generated income that induced consumption, triggering another US$ 217 billion of GVA (6.6% of GDP) (Table 1).

In terms of employment, the Health Economy in the UK provided jobs for 4.4 million employees (13.8% of domestic employment). There were an additional 1.9 million jobs created in adjacent sectors. A further 1.9 million jobs were generated as a result of induced income effects (Table 1).

For India, GVA multipliers are 0.52 for effects in adjacent sectors and 0.38 for induced income effects, smaller than those for the UK, but employment multipliers for India are larger (0.57 vs. 0.62) than for the UK (Table 1).

Rounding to the nearest billion, the Health Economy in India generated US$ 192 billion of GVA in 2022. Around US$ 100 billion were generated in addition due to value chain effects in adjacent sectors (2.7% of GDP), and a further US$ 73 billion due to induced income effects (2.0% of GDP). Around 22 million people were employed in the Health Economy, leading to a further 13 million jobs in adjacent sectors and an additional 14 million jobs due to induced income effects (Table 1).

Malaysia's Health Economy share in GDP resembled that of India, but was smaller than the UK's both in absolute and relative terms. Employment in Malaysia's Health Economy was between the levels observed in the UK and India. The Malaysian Health Economy contributed US$ 27 billion to the GVA (5.4% of GDP) (Table 1), with an additional US$ 11 billion contribution from adjacent sectors (2.3% of GDP) and a further US$ 49 billion due to induced income effects (2.1% of GDP). The sector provided 659,000 jobs (6.5% of total employment), creating an additional 181,000 jobs along the value chain in adjacent sectors (1.8% of employment) and a further 198,000 jobs (1.9% of employment) due to induced income effects (Table 1).

GVA contribution

Country	Type of effect	GVA multipliers[a]	Values in millions of US dollars	Share of GDP (%)
UK	Inside the HE		295,248	8.9
	Adjacent Sectors	0.58	171,115	5.2
	Induced Income	0.73	217,070	6.6
India	Inside the HE		192,447	5.2
	Adjacent Sectors	0.52	99,629	2.7
	Induced Income	0.38	73,197	2.0
Malaysia	Inside the HE		27,065	5.4
	Adjacent Sectors	0.42	11,401	2.3
	Induced Income	0.39	48,946	2.1
Nigeria	Inside the HE		37,543	5.8
	Adjacent Sectors	0.12	4618	0.7
	Induced Income	0.08	3104	0.5

Labor force contribution

Country	Type of effect	Employment multipliers[b]	Thousand employees	Share of domestic employment (%)
UK	Inside the HE		4434	13.8
	Adjacent Sectors	0.42	1885	5.9
	Induced Income	0.42	1878	5.9
India	Inside the HE		22,462	3.6
	Adjacent Sectors	0.57	12,729	2.1
	Induced Income	0.62	13,915	2.3
Malaysia	Inside the HE		659	6.5
	Adjacent Sectors	0.30	181	1.8
	Induced Income	0.57	198	1.9
Nigeria	Inside the HE		2829	4.9
	Adjacent Sectors	0.14	382	0.1
	Induced Income	0.11	300	0.1

Productivity	USD/employee
UK	66,578
India	8568
Malaysia	41,070
Nigeria	13,630

HE = Health Economy, GDP = Gross Domestic Product, GVA = Gross Value Added. [a]GVA related multipliers illustrate how one dollar invested in health might generates XX cents of GVA in the overall economy via the value chains (effects in adjacent sectors) and due to induced consumption. [b]Employment related multipliers reflect that every employee in the Health Economy supports YY further employees in the overall domestic economy. Source: WifOR Elaboration.

Table 1: **GVA and Employment Creation via Health Economy Investments, results for 2022.**

At around US$ 38 billion, Nigeria's Health Economy, though relatively smaller than India, Malaysia, and the UK in absolute terms, ranked second among the four countries in terms of the economy, constituting 5.8% of Nigerian GDP, with a further US$ 5 billion (0.7% of GDP) generated in adjacent sectors, and an additional US$ 3 billion (0.5% of GDP) in induced income. The multiplier effects of the Health Economy are the lowest among the four countries analyzed, however, standing at 0.12 in adjacent sectors and 0.08 in induced income as a percentage of the GDP. The Health Economy provided 2.8 million jobs in Nigeria, accounting for 4.9% total employed labor-force, with a further 380,000 jobs created in adjacent sectors (0.1% of total employment) and a further 300,000 due to induced income (0.1% of total employment). Concerning employment, the multiplier effects of the Health Economy in Nigeria are also the smallest among the four countries analyzed, with values of 0.14 and 0.11 for adjacent sectors and induced income, respectively.

In the realm of productivity, the UK's Health Economy stands out, generating an average of US$ 66,578 of GVA per employee (Table 1). Remarkably, the UK Health Economy's productivity was 7.8 times greater than that of India, 4.9 times higher than Nigeria's, and 1.6 times more than Malaysia's (Table 1).

Overall, the Health Economy sector in the four countries analyzed represented a larger share of the GDP compared to 'pivotal economic sectors' such as Manufacturing, Finance, and Information and Communication. The country with the highest GDP per capita from the sample is the UK (Table 2). The GVA contribution of the Health Economy in the UK was 3.54 times higher than that of the Information and Communication sector, 2.66 times higher than Manufacturing, and 2.26 times higher than Finance. Even when considering only the Healthcare Economy subsector (5.96% of the GDP), it outpaces the other three economic sectors by 1.51 to 2.36 times. Similarly, the number of jobs created in the UK Health Economy was between 3.12 and 1.63 times higher than those created in the Information and Communication, Manufacturing, and Finance sectors (Table 2). However, the relevance of the Health Economy compared to other pivotal economic sectors remains country-specific. In contrast to the case of the UK, the Health economy's contribution to GDP was smaller than the contribution of the manufacturing industry but significantly higher than the Information and Communication sector in all other considered Commonwealth countries. In India and Malaysia, the Health Economy GDP was also higher as the one of the Finance sectors, while this was not the case for Nigeria (Table 2).

Using the multipliers presented in Table 1 and information on health spending in cancer prevention, we provide a first approximation of the spillover effects from the Health Economy to the overall economy (effects in adjacent sectors and induced income effects). Total spending for healthcare goods and services was 11.4% of GDP in 2022[39]; comparing this figure to the Health Economy output of GVA amounting to 8.9% of GDP, indicates the close relationship between investment and return. We applied this ratio of around 80% (i.e., 8.9% divided by 11.4%) between investment and return for the countries under consideration to evaluate the potential economic return of investing in HPV vaccination.

We assumed a health investment into HPV vaccination for each of the four countries separately based on public vaccination programs (Table 3 and Appendix

Table A6), ranging between US$ 16 million in Malaysia and US$ 756 million in India. Our results show that for the UK, invested US$ 134 million translated into direct effects inside the Health Economy of US$ 107 million of GVA or 0.003% of GDP. Building on the multipliers, an additional US$ 62 million GVA would be achieved in adjacent sectors and US$ 78 million GVA in the overall economy by induced income effects. Overall, the economic footprint of the cancer investment is around US$ 240 million GVA, amounting to 0.007% of GDP. The HPV vaccination investment of US$ 756 million in India translates into economic gains of 0.030% of GDP, while in Malaysia only US$ 23 million GVA or 0.005% of GDP arise in return to the investment of US$ 16 million. Nigeria lies in between with a GVA share of 0.014% of GDP as total return.

Examining the impact of investment in HPV vaccination in the UK (Table 3), our method, based on a country-specific ratio of employees per US$ 1 million GVA from Table 2, reveals that HPV vaccination investments in the UK influence the employment landscape. It generated 2000 jobs within the Health Economy, and some additional jobs in adjacent sectors and due to induced income effects. The cumulative effect constitutes a robust economic footprint, contributing 0.007% to total domestic employment. Employment effects of HPV vaccination in Malaysia and Nigeria have a similar magnitude of 0.006% and 0.012% of total employment, respectively. For India, the employment effects are more considerable with a total employment push of 0.024%.

The results of the deterministic sensitivity analysis indicate that the main drivers of the multipliers are robust within a certain range (see Appendix A.3. for details). As an example, for the adjacent sectors, we obtained a multiplier of 0.58, resulting in a GVA effect of 5.2% of GDP. Statistical uncertainty leads to a range of GVA effects between 3.0% and 7.4% of GDP as derived from 95% confidence bands. Regarding induced income effects, the GVA effect yields a share of 6.6% of GDP, which has a range from 4.1% to 9.0%. Based on the findings from Stehrer et al. (2024), uncertainty of employment multipliers is lower, so these figures are generally less sensitive to the statistical database.

Country	Economic Sector	GVA contribution		Labor force contribution	
		Values in millions of US dollars	Share of GDP (%)	Thousand employees	Share of domestic employment (%)
UK[a]	**Health Economy**	**295,248**	**8.9**	**4434**	**13.8**
	Industrial Health Economy	48,864	1.5	290	0.9
	Healthcare Economy	196,746	6.0	3560	11.1
	Health Services and Support	49,538	1.5	584	1.8
	Manufacturing	111,010	3.4	2722	8.7
	Finance	130,483	4.0	1422	4.1
	ICT	83,400	2.5	1514	4.7
India[b]	**Health Economy**	192,447	5.2	22,462	3.6
	Industrial Health Economy	51,482	1.4	9272	1.5
	Healthcare Economy	60,089	1.6	6012	1.0
	Health Services and Support	80,876	2.2	7176	1.2
	Manufacturing	440,058	14.3	10,799	2.4
	Finance[c]	149,527	4.9	2175	0.6
	ICT[d]	155,639	5.1	1854	0.5
Malaysia[b]	**Health Economy**	27,064	5.3	659	6.5
	Industrial Health Economy	10,334	2.0	177	1.7
	Healthcare Economy & Health Services and Support	16,730	3.3	481	4.7
	Manufacturing	95,069	18.6	2591	16.8
	Finance	23,059	4.5	397	1.5
	ICT	24,890	4.9	236	2.6
Nigeria[b]	**Health Economy**	37,543	5.8	2829	4.9
	Industrial Health Economy	12,368	1.9	674	1.2
	Healthcare Economy & Health Services and Support	25,175	3.9	2155	3.7
	Manufacturing	64,246	13.8	10,322	14.1
	Finance	48,622	10.4	367	0.4
	ICT	15,402	3.3	320	0.5

HE = Health Economy, GDP = Gross Domestic Product, GVA = Gross Value Added, ICT = Information and Communication Technology. [a]UK data other sectors extracted from UK Office for National Statistics. [b]India, Malaysia and Nigeria data other sectors extracted from Worldbank (GVA) and Ilostat (employment) data base. [c]2021 value. [d]2020 value. Source: WifOR Elaboration. All values reported in 2022 US$. Due to data limitation we combine Healthcare Economy and Healthcare Service and Support for Malaysia and Nigeria. Health Economy data for UK extracted from WIOD data base, for Malaysia and Nigeria extracted from EORA data base.

Table 2: **Relative importance of the Health Economy vs. other economic sectors.**

Discussion

The framework used in this study is a first approach to translate health expenditures into a macroeconomic setting drawing on GVA contribution and employment as pivotal drivers of economic growth. Using IO modelling allows us to measure effects in adjacent sectors and to consider effects along the entire value chain of health. The unique feature of our analytical approach is to place the Health Economy (including the three sub-sectors: Healthcare Economy, Industrial Health Economy and Service and Support) as a virtual satellite account within the scheme of statistical authorities and the national accounting system. This enables a comparison of the Health Economy's role and economic impact against other sectors and policy decision areas such as education.

The assessment of four Commonwealth countries reveals that the Health Economy contributes substantially to economic growth and generates employment. These contributions extend beyond the health sector itself, reaching adjacent sectors along the health value chain and inducing effects throughout the economy. Notably, in our analysis, the UK's well-developed Health Economy stood out, constituting 8.9% of the GDP in 2022, while in India, Malaysia, and Nigeria, it accounted for 5.2%, 5.4% and 5.8%, respectively. The contribution

Investment Million US$ (Share of GDP in%)	UK	India	Malaysia	Nigeria
	134 (0.004)	756 (0.020)	16 (0.003)	100 (0.015)
GVA contribution	**Million US$–2022 Prices (Share of GDP in %)**			
Effect inside the HE	107 (0.003)	605 (0.016)	13 (0.003)	80 (0.012)
Effect adjacent sectors	62 (0.002)	314 (0.008)	5 (0.001)	10 (0.001)
Effect induced income	78 (0.002)	230 (0.006)	5 (0.001)	6 (0.001)
Labor force contribution	**Thousand employees (Share of domestic employment in %)**			
Effect inside the HE	2 (0.003)	71 (0.011)	0 (0.003)	6 (0.010)
Effect adjacent sectors	0 (0.002)	40 (0.006)	0 (0.001)	0 (0.001)
Effect induced income	0 (0.002)	44 (0.007)	0 (0.002)	0 (0.001)

HE = Health Economy, GDP = Gross Domestic Product, GVA = Gross Value Added, HPV = Human Papilloma Virus. Price index[40] and exchange rate[41] from the Office of National Statistics in England, January 2014 and January 2022. Source: WifOR Elaboration. Multipliers are implemented as reported in Table 1. Utilized total amount of investment in HPV vaccination as reported in Appendix Table A6.

Table 3: **Simulated effects of investment in cancer prevention through HPV vaccination on the Health Economy in England, in adjacent sectors and via induced income, simulation results for 2022 based on CCGs investment in 2013/14.**

of the Health Economy to employment varied widely, ranging from 3.6% in India to 13.8% in the UK.

Additionally, productivity in the Healthy Economy defines how investments in this sector influence the country's growth. Productivity in the Health Economy was US$ 66,578 in the UK, which was remarkably higher than the productivity in the other three countries (between US$ 8568 in India and US$ 41,070 in Malaysia).

To capture the value of health as an economic investment, IO multipliers are key. The concept connects GVA and employment created in the Health Economy with the additional value created in the adjacent sectors and induced income in the domestic economy. The results suggest that when health investment in the UK increases GVA in the Health Economy by US$ 1, this creates additional GVA in the overall economy of US$ 1.31, and each newly created job in the Health Economy safeguards 0.84 jobs in the overall economy. However, these multipliers also vary between nations: in India, the total GVA multiplier was 0.90, and the employment multiplier was 1.19; while in Malaysia the GVA multiplier was 0.81, and the employment multiplier was 0.87. The values observed in Nigeria, the least well-developed Health Economy, were lower: 0.2 for the GVA multiplier and 0.25 for the employment multiplier.

Although there are previous studies applying IO analysis to the Health Economy subsectors[42] as, for instance, healthcare services, none of them used this concept to the whole Health Economy as a satellite account. Therefore, results are hard to compare against earlier studies. For instance, Socci et al.[43] focused narrowly on healthcare services and identified them as pivotal in shaping the economic output of the United States. They explored strategies for achieving positive direct and indirect economic impacts through health spending. Their findings underscore the significance of ambulatory healthcare services and the hospitals and nursing/residential care facilities as key drivers of production across the broader economy. Kim et al. assessed the Korean ubiquitous healthcare industry, gauging its production, added value, and employment effects.[44] A one-unit increase in ubiquitous healthcare service output led to a 1.7461 unit rise in total production, with notable impacts in the chemical, electric and electronic device, and real estate and business services sectors. The total employment effect was calculated at 0.2229. Kim et al.'s GVA and employment multipliers are lower than our estimates, which could be explained by the ubiquitous healthcare service industry having fewer links to the overall economy than when considering the total of the Health Economy.[44]

Pereira et al., while not employing IO analysis, offer a different perspective of the healthcare sector.[14] Their approach defines health care investments as those including expenditures on health facilities on both new and used buildings, on equipment, and on means of transportation. They used a vector autoregressive model to estimate the elasticities and marginal products of investing in alternative sectors in Portugal. Their results suggested that every US$ 1 million invested in health care increased GDP by US$ 20.45 million and created 188 new permanent jobs.[14]

We evaluate the impact of Health Economy investments relying on national accountability data. Few studies have utilized national accountability data to assess even a subset of the Health Economy. For instance, Bekő et al.[44] utilized national accounts data to compute output, income, employment, value-added, and import multipliers for Slovenia's healthcare sector.[45] Their analysis, spanning 49 sectors and indicates that each new employee in healthcare generates an additional 0.7 job positions, and a one-unit income increase in the healthcare sector leads to a more than proportional rise in the overall economy's income. Notably, the healthcare sector displays one of the highest income multipliers among the 49 sectors in Slovenia, which is consistent with our comparison

between the Health Economy and the Manufacturing, Finance and Information and Communication sectors. For the case of Japan, Yamada and Imanaka examined the economic impact of all medical institutions using the IO analysis to assess the economic impact and multipliers.[46] In contrast to our work and the work from Bekő et al.,[44] Yamada and Imanaka[46] employed data from both national accounts (National Medical Care Expenditure 2005, Ministry of Health, Labour and Welfare) and profit and loss statements from Medical Economics Surveys to assess medical care expenditure or revenue. Their findings indicate a 2.78-fold return on medical care expenditure (combining multipliers for effects in adjacent sectors and induced consumption), surpassing the returns suggested by our analysis.

Assessing the whole Health Economy's size and impact across countries reveals varying GDP contributions and return on investment. To the best of our knowledge, there are no previous publications estimating direct and indirect effects of investing in the Health Economy or in healthcare sector for any of the Commonwealth countries. However, there is evidence from extant research focusing on fiscal impact multipliers (i.e., the effect of a US$1 change in spending or a US$1 change in tax revenue on the level of GDP). These publications suggest positive fiscal multipliers from governmental investment (including government consumption which considers investments in the healthcare sector) on the overall economy (e.g., [47–54]). Understanding the significance of the Health Economy is crucial for Commonwealth countries, given the vast economic heterogeneity, for instance, per-capita GDP ranging from $PPP 1169 in Malawi to $PPP 87,855 in Singapore,[55] and healthcare expenditures as a percentage of the GDP from 12.9% in Canada and 11.98% in the UK to 2.5% in Papua New Guinea and 2.4% in Brunei Darussalam.[56] Comprehension of the Health Economy investments' effects can catalyze improvements in the economic and health conditions of the least affluent nations while addressing health and economic inequalities between the countries in the group. For instance, to optimize health investments' multiplier effects, recognizing their importance and interconnectedness with the broader economy is paramount. Stakeholders at national and international levels can strategically enhance these links and invest in interventions with the highest potential for economic growth and well-being. Moreover, in the collaborative efforts of Commonwealth countries, our evaluation could guide resource allocation for improved outcomes in trade, education, healthcare, and cultural exchange.

Cancer is the top or second major cause of disease burden in the Commonwealth countries, and in most countries of the world. Investments in cancer would generate substantial health benefits by reducing morbidity and mortality and economic benefits through improved health of human capital as shown in earlier studies and Lancet Oncology Commissions.[57,58] However, health systems investments in cancer are far below in amount to what they should be relative to the health and economic burden cancer poses for countries. This is especially acute for low-income and middle-income countries.[59,60] As a result, there are major missed opportunities in alleviating the adverse health consequences of cancer and realizing economic benefits that can help stimulate economic growth and development.

We applied the IO-model of the Health Economy and as a first approximation used the derived multipliers for evaluating investment in HPV vaccination. Our results illuminate how potential investment in cancer care and cancer prevention might alleviate the pressure on the economy and underscore the benefits of strategic investments in addressing and preventing cancer, not only in terms of public health but also as a significant contributor to employment growth across various sectors. Moreover, investment in cancer prevention meets the urgent need to limit future burdens and thus to decrease direct and indirect costs of increasing cancer incidences.

Despite demographic variations, all Commonwealth countries are experiencing increasing longevity of their populations, leading to an increase in the number of new cancer cases and a higher demand for treatments.[55] For example, between 2008 and 2018, there was a 35% rise in cancer cases, with forecasts indicating a 39% increase in deaths between 2018 and 2030 (with the highest growth predicted for Brunei 67.1%, Kenya 62.7%, and Singapore 62.5%).[61] Investment in cancer treatments and implementing national prevention programs are imperative to ensure effective management of the epidemiological transition leading to increased number of cancer cases. For a given health budget, understanding the potential economic benefits from these investments could inform prioritization decisions, ensuring economic benefits, which could help expand fiscal space available for additional health investments to address the cancer burden and facilitate healthcare access for cancer patients.

A few limitations of our study should be noted. First, the modelling is restricted by the degree of data availability and granularity. For instance, additional data besides multi-region IO tables are needed to specify the level of detail of the Health Economy and its three subsectors. Especially for smaller nations, sectoral GVA development might not be available. Statistical offices typically collect such data for National Accounting. A potential solution is collaborating with a national statistical authority to set up an actual satellite account of the Health Economy with detailed subsector specifications.

Second, our methodology is grounded in a static framework. However, in the real-world context, the transformation of capital injection into the Health Economy requires time to manifest macroeconomic

effects. The effects of health investment when time-trend dynamics are incorporated are considered in the full version and application of our framework.[62] By integrating both macro- and micro-economic perspectives, this full version of the framework provides a more holistic assessment of the influence of health investment on economic growth, including considerations for human capital effects. Following the proposed approach of the full framework would require the implementation of a Structural Vector-Autoregressive model to identify the impulse-response function of the health investment. The approach builds on long time series data on health expenditures and the health economy. However, for the present use case, consistent long-term time series data of the considered countries is limited. Therefore, we opted for a static approach, as the utilization of the time dynamic estimation would not be feasible without compromising the validity of the results.

Third, assumptions are crucial in the assessment of how investments contribute to value in the Health Economy. For instance, a reliable proxy for the direct impact of health investments is the relatively stable ratio of health expenditures to Health Economy GVA over time in a specific nation. In this study, we considered the ratio only for one year. The time dynamics of the ratio are contemplated in the full version of our framework.[62]

Fourth, applying the concept of the IO multipliers to evaluate effects to the rest of the economy assumes that variation in the Health Economy's production directly influences production of intermediate goods and services as well as income in the overall economy.[63,64] Previous findings support this idea of potential forward and backward linkage of the health sectors to the overall economy.[43–45,65] However, this concept has not yet been applied when the Health Economy, including each of the subsectors, is accounted as a satellite sector in national accounts.

Even though our approach has some limitations, our methodology provides robust metrics to assess the size and the role of the Health Economy and indicates how health investments translate into economic benefits. For testing the robustness of the involved multipliers, we apply externally estimated confidence intervals to show the likely range of the parameters. The methodological foundation is built on valid data from official statistics and is settled within the national accounting system. Since its initiation,[26,27] the evaluation of the Health Economy as a satellite sector was implemented in various use cases and the ongoing discussion with policy decision makers prompted improvements in the methodology.

The present framework outlines intricate mechanisms on how the Health Economy is linked to economic outcomes (GVA contribution and employment). Our findings aim to inform policy decision making on economic planning and resource allocation across competing sectors based on a better understanding of the size and the role of the national Health Economy.[12,66–69] This is important, as financial outlays for the health sector are currently considered a 'cost', an 'expenditure', or an 'economic burden' rather than an 'investment' that yields substantial health, economic and societal benefits. Our findings underscore the contributions of health investment to the Health Economy and to the broader economy, and so, emphasize an understanding of health investments not as a driver of cost for countries but as a motor of economic growth and well-being of societies.

Contributors

RA conceived the study with co-authors. JLF, K H-V MM, and MS led the data collection in analysis with input from RA and DO. MS led the drafting of the manuscript with JLF, HH-V, and MM, with input from RA and D. MS and JLF accessed and verified the data. All authors contributed to the final manuscript and approved it.

Data sharing statement

(i) World Input-Output Database is available from: https://www.rug.nl/ggdc/valuechain/wiod/ and (ii) Eora MRIO. The Eora Global Supply Chain Database is Available from: https://worldmrio.com/.

Declaration of interests

DO, JLF, KHV, MS and MM declare no conflict of interest. RA: None related to the study. RA has research grants unrelated to the study and subject funded by Novo Nordisk, Novartis Foundation, Merck and Co, Virchow Foundation and the Bill and Melinda Gates Foundation.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.eclinm.2025.103180.

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