Gross fixed capital formation in the Brazilian health sector: methodology and results for 2010–2019[1]

Tassia Gazé Holguin, Thiago Miguez, Lia Hasenclever and Fabio Freitas

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Abstract

Health satellite accounts provide information to elucidate the interaction between the health sector and the rest of the economy. However, in Brazil these accounts have gaps, such as a lack of data on gross fixed capital formation. The aim of this article is to present a methodology to measure gross fixed capital formation in the health sector in 2010–2019 and to analyse the data thus obtained. The results show that gross fixed capital formation in the health sector is biased towards machinery and equipment rather than construction. The share of private investment increased throughout the period whereas public investment declined.

Keywords

Capital, capital formation, health, health services, national accounts, measurement, statistical methodology, public sector, private sector, health policy, Brazil

JEL classification

C81, E22, I15

Authors

Tassia Gazé Holguin is a Geographic Information and Statistics Technologist at the Brazilian Institute of Geography and Statistics (IBGE) (Brazil). Email: tassia.holguin@ibge.gov.br.

Thiago Miguez is a Research Associate at the Institute of Economics, Federal University of Rio de Janeiro, Brazil. Email: thiago.miguez@ppge.ie.ufrj.br.

Lia Hasenclever is Coordinator at the Graduate Department of Regional Planning and City Management at Candido Mendes University (Brazil). Email: lia.hasenclever@ucam-campos.br.

Fabio Freitas is an Associate Professor at the Institute of Economics, Federal University of Rio de Janeiro, Brazil. Email: fabio@ie.ufrj.br.

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I. Introduction

The ageing of Brazil's population has progressively increased the demand for health-care goods and services and accentuated the need to improve public policy planning. As a result, the health sector is gaining momentum increasingly as a major economic activity, and it now accounts for a significant share of job creation and income generation in Brazil (IBGE, 2019).

Population aging has its own epidemiological, economic and technological characteristics. In epidemiological terms, the demand for health care often occurs in atypical circumstances, such as illnesses and accidents (Barr, 1998). At the same time, the pressure on demand can intensify in times of economic crisis, since falling incomes and rising unemployment may increase the demand for health services from the public network (Vieira, 2016).

The publication *Conta Satélite de Saúde,* which has been produced by the Brazilian Institute of Geography and Statistics (IBGE) since 2009, provides macroeconomic data that elucidates the interaction between the health sector and the rest of the economy. It includes information on the generation, distribution and use of income in the country, and also on the consumption of health-care goods and services by the government and households (IBGE, 2019). Nonetheless, it has several gaps. For example, it does not contain information on gross fixed capital formation (GFCF) in the health sector, which ultimately hinders analysis on this subject in Brazil.

The investment process is an important indicator for monitoring the trend of an economy or sector. It should be noted that investment has a dual nature: it is one of the components of aggregate demand with the greatest multiplier effect, and it also influences the rate of technological change. The purchase of capital goods affects the production chain by increasing the demand for labour and inputs. Subsequently, the deployment of the corresponding fixed assets expands the supply capacity of the economy, with the result that such investment ultimately affects both the cycle and the trend of both the health sector and the economy as a whole. Moreover, innovations in the production process are partly incorporated as new fixed capital assets, so that the increase in investment also influences the pace of technological change and the advance of productivity (Miguez, 2016).

In health systems, investment in fixed assets has a positive impact on the sector's infrastructure, by contributing to its sustainability and equity. Moreover, as investment is also channelled into technological development and activities of research, development and innovation, its effects also improve diagnoses, treatments and health care in general (Teja and others, 2020).

Thus, in view of the importance of the investment process for the health sector and the economy as a whole, and given the gap that exists in this data category in the current satellite account for health, this article aims to present a methodology for measuring GFCF in the health sector, both public and private, and to analyse the robustness of the data obtained for 2010–2019. The methodology consists of mapping and analysing databases from IBGE, the Foreign Trade Secretariat (SECEX) of the Ministry of Economy, and the Public Health Budget Information System (SIOPS). This methodology can be adapted and used in other countries since it draws on databases that are usually published by national statistical bodies or compiled by international agencies. These include databases on industrial production, civil construction, foreign trade and public health expenditure.

With this objective, the article is divided into four sections in addition to this Introduction. Section II focuses on the *Conta Satélite de Saúde* publication, on the main data it contains and on its importance for the planning and execution of public policies. Section III describes the methodology proposed for estimating GFCF data in the health sector. It also explains the databases used and their manipulation, and how investments were disaggregated between the public and private system. Section IV reports and analyses the results of the data obtained; and, lastly, section V sets forth conclusions.

II. The health sector satellite account

Several countries have adopted the methodologies of international organizations to generate data on their health sector. Currently, the two main methodologies are: (i) the System of Health Accounts (SHA), developed by the Organisation for Economic Co-operation and Development (OECD) and (ii) Health Satellite Accounts (HSA), based on the manual of the System of National Accounts (SNA).[2] Brazil uses the latter to develop its satellite account for the health sector.

This topic has become increasingly important since it was recognized that continuously producing economic data on the health sector provides managers and decision-makers with a more accurate analytical overview of health systems. The potential for allocating resources more efficiently improves the planning, monitoring and evaluation of public policies, and provides extra inputs for these purposes. The use of international methodologies to produce health accounts —even if additional agreements are needed to produce more harmonious statistics— facilitates comparison between countries and enables greater standardization when measuring health data (Nakhimovsky and others, 2014).

In addition, by preparing macroeconomic aggregates, measuring the health system as an economic activity enables a better understanding of its role as a job creator and income generator, and reveals the impact it can have on a country's development. According to Vieira and Piola (2016), the objective of the health satellite account is to provide information to support public policies and decision-making in programmes and projects related to the health sector; and they link it to the growth and development of the economy as a whole. It is a macroeconomic analysis that makes it possible to understand the interaction between the health sector and the rest of the national economy.

While countries such as France, Germany, the Kingdom of the Netherlands and the United States started to publish health sector data in the 1950s and 1960s, health expenditure in Brazil was estimated from lines of research (Holguin, 2021). In the 1980s, the Institute of Applied Economic Research (IPEA) used social expenditures consolidated at the federal level, while also estimating private expenditures from the Household Budget Survey. The Brazilian Institute of Geography and Statistics did not start its statistical series on health data until 2008, with the publication *Economia da saúde: uma perspectiva macroeconômica 2000–2005* (IBGE, 2008), which provides data on the health-sector share in the aggregate value of the economy. This study could not yet be considered a satellite account for the health sector, because it did not include data on the production of system-wide health services, such as hospitals linked to the ministries of defence and education. Nonetheless, the study was a milestone, as it included the first collection of data on the country's health economy.

The first health satellite account, as such, was published the following year and covered 2005–2007 (IBGE, 2009). Since then, six editions of the health satellite account have been published, encompassing the period from 2005 to 2019.[3] Brazilian health data adhere to the international standard provided by the *System of National Accounts 2008* (European Commission and others, 2016), which implies that they are linked to the IBGE's system of national accounts and replicate its structure, concepts and methodological framework.[4]

Accordingly, like the system of national accounts (SNA), HSA consists of supply and use tables and summary tables.[5] The supply tables describe the production process carried out in the local units of the producer firms or families, plus imports. The use tables, by contrast, report the types of demand

[2] The SNA manual is the same as that used by most countries to produce their official economic statistics, such as GDP.

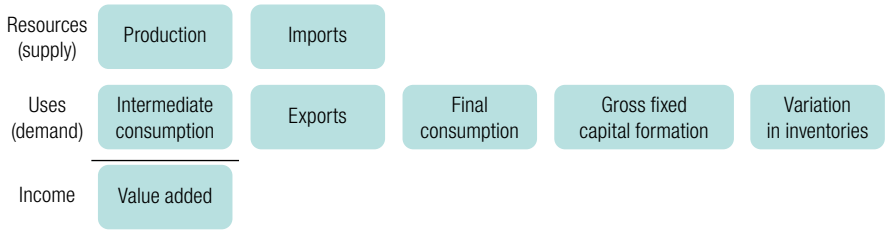
[3] However, as discussed below, the series is not fully comparable through time.

[4] The term "satellite account" derives precisely from this link, as if health data were "orbiting"; that is, as if they were linked to data from the system of national accounts.

[5] The Integrated Economic Accounts (IEA) were also published until the 2007–2009 edition.

for products and services: intermediate consumption, final consumption, exports or GFCF. Thus, the supply and use tables make it possible to analyse economic activities in terms of the production, expenditure and income generated (see diagram 1).

Diagram 1
Structure of supply and use tables



Source: Prepared by the authors.

The relationship between the health satellite account and the system of national accounts underwent a methodological change, when Reference series 2000 (SNA Ref. 2000) on which the system of national accounts covering 2000–2009 was based, was replaced by Reference series 2010 (SNA Ref. 2010), which covers the period from 2010 onwards. This framework change entails a revision of the classifications of products and economic activities, as well as the updating of some concepts in accordance with the most recent version of the *2008 System of National Accounts*. The major impact of this change for the health satellite account was the interruption of the historical data series, since the 2005–2009 data are not comparable with the data series that started in 2010.

In the case of SNA, a retropolation version was launched with more aggregated supply and use tables for 2000–2009. Thus, despite not having the same number of products and activities, the concepts are aligned, so it is possible to use the data to analyse the period starting in 2000 and the data after 2010. However, the health satellite account was not updated to the same extent: only the final consumption data in the health sector were made compatible. Unfortunately, the supply and use tables were not updated, so the 2005–2009 series remains methodologically outdated and is not compatible with the series that started in 2010.

From a methodological point of view, the current status of the health satellite account is aligned with the 2008 System of National Accounts (2008 SNA). It defines total health expenditure as the sum of two components: (i) the consumption of health goods and services in a country; and (ii) the GFCF in the facilities of health service providers. According to the 2008 SNA definition, the consumption of health goods and services corresponds to personal health care services, medical products provided to patients in outpatient facilities, total personal health expenditures, preventive measures, public health services and health insurance expenditures. Gross fixed capital formation, meanwhile, corresponds mainly to the purchase of machinery and equipment, along with civil construction. An important detail is that Brazil's health satellite account includes expenditures on heath care provided in university and military hospitals, while in SNA these are included as part of the education and public administration sectors, respectively.

Lastly, despite constant progress, Brazil's health satellite account still has a number of major shortcomings. The first is that it does not provide enough information to analyse health financing flows, which makes it difficult to compare Brazil's public spending on health with that of OECD countries. This is partly because, unlike the other countries, the Brazilian case has a complex financing system in which public and private financing and co-payment regimes coexist (Luiza and others, 2018).[6]

[6] The Brazilian health system is segmented into three subsystems: (i) the Unified Health System (SUS), which is universal and free at the point of use; (ii) the Supplementary Health System (SSS), which comprises health insurance; and (iii) the Direct Disbursement System (SDD), in which private health goods and services are purchased directly by families.

A second major shortcoming, which is the focus of this article, is the gap in information that exists in health investment expenditure in Brazil. This point became clear in the field research conducted by Holguin (2021) with health economics specialists: interviewees were unanimous in their opinion that data on GFCF in the health satellite account needed improvement, especially in terms of the separation between public and private investment. Thus, with the aim of improving the availability of statistical data and helping to gain a better understanding of the dynamics of this activity in the country, this article proposes a methodology for estimating health sector GFCF. The data will be disaggregated by type of asset acquired, namely machinery and equipment or construction, and by sector —public or private.

III. Methodology for estimating GFCF in the health sector

1. Gross fixed capital formation: conceptualization and existing data

In the national accounts, investment is defined by the concept of GFCF. According to IBGE (2016), GFCF records the expansion of an economy's productive capacity through expenditure on new fixed assets —that is, goods that are used continuously in a productive process for more than one year. Thus, the European Commission and others (2016) and IBGE (2016) note that GFCF is composed of: (i) machinery and equipment; (ii) civil construction; (iii) intangible assets; and (iv) other assets. Furthermore, machinery and equipment is usually subdivided into two categories: machinery and equipment not intended for transportation; and machinery and equipment intended for transportation.[7] Gross fixed capital formation therefore does not include financial assets or the transfer of used assets.

In the SNA Ref. 2010 series, GFCF data are compiled and disseminated through supply and use tables and integrated economic accounts. The supply and use tables provide data on the supply side, in other words how much of each product went to GFCF.[8] By contrast, the integrated economic accounts provide data on the demand side, but only on total expenditure on GFCF by institutional sectors[9] (there is no information on the acquisition profile by type of product).

Even in the specific case of the health satellite account, the information is still scarce, due in part to the methodological link with SNA Ref. 2010. The supply and use tables of the health satellite account show only the value of the product "Apparatus and instruments for medical and dental use" as destined for GFCF. However, the manufacture of electromedical, electrotherapeutic devices and radiation equipment, produced by firms included in the code of the National Classification of Economic Activities (CNAE 2660),[10] is not included, which results in the share of the Health Industrial Economic Complex (CEIS) in GFCF being underestimated. Following the example of SNA, the health satellite account also lacks data on the demand side —that is, on the purchase of civil construction by the health sector— and on GFCF separated between public and private health care. For this reason, the current IBGE data, both in SNA and in HSA, do not provide sufficiently satisfactory GFCF data on the demand side to perform sectoral studies and plan public policies in the health sector.

[7] For further details on what each category includes, see European Commission and others (2016), IBGE (2016) and Miguez and Freitas (2021).

[8] In the resource and use tables, this information does not distinguish between domestically produced and imported supply. This segregation is only performed in the years in which the input-output matrices are published.

[9] Institutional sectors are divided into five categories: non-financial corporations, financial corporations, government, households, and non-profit institutions serving households (Classification of the purpose of non-profit institutions serving households (COPNI)). For further information on their role in the national accounts and the characteristics of each category, see IBGE (2016).

[10] This class includes firms that manufacture radiation apparatus and tubes, electrodental apparatus, electrodiagnostic apparatus, X-ray apparatus, magnetic resonance apparatus, and other items.

To fill this gap, the work of Miguez and Freitas (2021) provides estimations of GFCF broken down by economic activity, and by type and origin of product. However, despite having data on GFCF in the health sector, these display a few shortcomings. The first is that the data on public health are not separated because the authors estimate the GFCF of the entire public sector in aggregate, without a breakdown by activity (education, health and public administration). Another shortcoming is that the data on the private health sector, which is referred to as "*saúde mercantil*" (market-oriented health care) do not contain estimates of demand for civil construction, but only for machinery and equipment. Accordingly, these data also have shortcomings for working with the health sector.

Given these limitations and the importance of having data on GFCF in the health sector, this study proposes a methodology for obtaining the necessary data series. The following section presents the databases used.

2. Databases used

As noted in IBGE (2016), information on GFCF comes from different sources, depending also on whether it is used for supply-side or demand-side estimations. In general, to estimate GFCF data, IBGE uses its full range of structural surveys, such as the annual industrial survey (PIA), the annual construction industry survey (PAIC), the annual services survey (PAS) and the annual trade survey (PAC). Additional information is sought from other agencies, such as SECEX, the central bank and the Brazilian Revenue Service (Receita Federal).

In this study the authors decided to use only public data sources for the estimations, to enable other researchers to apply the methodology more easily. The databases used gather information both on the supply side —as in the case of PIA-Product and PAIC— and on the demand side —such as the Public Health Budget Information System (SIOPS) and the "Siga Brasil" information system.

The PIA-Product survey, published annually by IBGE, contains detailed information on the country's industrial production. It lists the quantities and values produced and sold of more than 3,000 products from the Prodlist (list of industrial products) classification. This level of detail makes it possible to identify the machinery and equipment used in the provision of health services. The same is true for foreign trade data obtained from SECEX, which publishes monthly export and import data according to the MERCOSUR Common Nomenclature (NCM), containing more than 10,000 products, which also allows for the separation of health machinery and equipment.[11] As foreign trade data are available in United States dollars, they were converted to Brazilian reais using the average monthly exchange rate between the two currencies. Lastly, although the Prodlist and NCM classifications are not fully compatible, it was possible to finesse the data to obtain annual series of production, imports and exports of health machinery and equipment.

The PAIC survey is also published annually and reports information on firms and products related to civil construction. However, it is relatively less detailed than PIA-Product, especially as regards the aims of this study. The information is divided into three categories of the National Classification of Economic Activities (CNAE): (i) 41 – Construction of buildings; (ii) 42 – Infrastructure works; and (iii) 43 – Specialized construction services. Information on hospitals constructed in a given period, for example, is included in section 41.2 – Construction of buildings, with the Prodlist product code 4120.2030 – Non-residential buildings not previously specified (hospitals, schools, hotels, garages, stadiums, etc.). Thus, it is impossible to directly disaggregate amounts relating to the construction of hospitals, laboratories and clinics, or to separate them into the public and private domains. These data have to be inferred using other variables, as explained below.

[11] The list of machines and equipment is too long to be included in this article, but can be requested from the authors or consulted in Holguin (2021).

Data from SIOPS and Siga Brasil were used to obtain an estimation of public health expenditure. The Ministry of Health SIOPS system provides information on public health spending and financing in Brazil and is one of the data sources used in SNA (public health activity). This system aims to monitor compliance with the constitutional provision that establishes a minimum allocation of resources to public health projects and services. It records health investment expenditures divided by administrative spheres, that is Union, States and municipalities. The data used refer to the two latter spheres and to the categories considered as part of GFCF: "Works and facilities" and "Equipment and permanent material". One limitation of the SIOPS data is that the data is reported by the accountant responsible for the State or municipality in question and, although the SIOPS team reviews the data sent by the managers, it is not always consistent.

The data on federal expenditures were extracted from Siga Brasil, which is a data repository containing information from the Integrated Financial Administration System of the Federal Government (SIAFI), the Integrated Planning and Budget System (SIOP), the Information System of State Enterprises (SIEST) and the Management System of Agreements and Transfer Contracts (SICONV) of the Federal Government. Following the example of SIOPS, it is also possible to separate GFCF products into "Works and installations" and "Equipment and permanent material".

In the private sector, information on the demand side is scarce, but some options were analysed, especially the databases derived from the Statement of Economic and Tax Information of Legal Entities (DIPJ) made available by the Ministry of Finance.

The objective was to study the structure of the information available on income tax, in particular the balance sheets consolidated by CNAE, and to propose an algorithm to obtain data on private investment in health. However, these data are only available up to 2013, after which DIJP was replaced by Fiscal Accounting, which has not yet published the consolidated balance sheet data. In addition, in the case of the health sector, many philanthropic hospitals are included in the classification of non-tax paying and exempt firms, which were not required to declare this information until 2016. Lastly, information was also sought in the annual services survey (EAS), but it was noted that this survey does not include companies included in CNAE 86 (human health-care activities), so it could not be used for this study.

3. Estimation methodology

The first step in the methodology consisted of obtaining a series on GFCF in the health sector, regardless of whether the demand came from the public or the private sphere. Next, information was sought on the demand side and, as noted in the previous section, it turned out that there was insufficient information for the private sector. Therefore, after obtaining an estimate for the public sector, the private sector estimate was determined by the difference between the total and the public sector estimate.

(a) Total GFCF in health care

Detailed supply-side databases, namely PIA-Product, SECEX foreign trade data and PAIC, were used to estimate health-sector GFCF data. Data were then estimated for two groups of assets: machinery and equipment, using data from PIA-Product and SECEX, and civil construction, using data from PAIC.

The machinery and equipment share was calculated using the concept of apparent consumption, which serves as an indirect indicator of the national absorption of a given product. The apparent consumption of a good was calculated as the value of its domestic production, minus the value of exports plus the value of imports. The rationale for this approach is that the value of domestic production minus exports represents the domestic demand for domestically produced goods; while imports represent the demand for goods produced in other countries.

Estimations of the demand for machinery and equipment in the health sector were based on the products identified as capital goods most likely to be destined (almost) exclusively for the sector. In the case of PIA-Product, these products are some of those listed in the Prodlist codes beginning with CNAE 2660 – Manufacture of electromedical, electrotherapeutic and irradiation equipment, and CNAE 3250 – Manufacture of instruments and materials for medical, dental and optical uses.

The same rationale was applied to the SECEX export and import data; in other words, the MERCOSUR common nomenclature codes containing products classified as capital goods for the health sector were selected. Data in dollars were converted to Brazilian reais, using the monthly average exchange rate calculated from the rates published by the Central Bank.

The classification and organization of these data enabled the authors to obtain annual series of production, exports and imports of machinery and equipment for the health sector. Thus, apparent consumption was used to estimate the portion of total health sector GFCF that corresponded to machinery and equipment. The results are shown in table 1.

Table 1
Gross fixed capital formation in health-care machinery and equipment, 2010–2019
(Millions of Brazilian reais, current prices)

Year	Domestic production	Exports	Imports	Gross fixed capital formation in health machinery and equipment
2010	1 821.3	211.0	2 283.1	3 893.4
2011	1 904.6	226.1	2 212.5	3 891.1
2012	2 187.6	237.6	2 701.4	4 651.4
2013	2 362.0	255.2	3 351.5	5 458.4
2014	3 039.9	261.9	3 559.4	6 337.4
2015	2 670.9	357.1	4 264.7	6 578.5
2016	2 791.6	325.1	3 606.7	6 073.2
2017	2 746.9	357.4	3 593.7	5 983.2
2018	3 408.5	395.6	5 067.4	8 080.4
2019	3 578.1	468.6	5 250.3	8 359.9

Source: Prepared by the authors on the basis of Brazilian Institute of Statistics and Geography (IBGE) and the Foreign Trade Secretariat (SECEX).

In addition to machinery and equipment for use in the health sector, a portion of the supply of general-purpose capital goods —such as computers, motor vehicles (especially ambulances), furniture, and other machinery and equipment— is also part of GFCF in the health sector. However, since the demand for these products is secondary, and the data classifications used do not allow for a more detailed separation focused on health, it was decided not to apportion these products.[12]

The second part of the estimation relates to construction. For this, PAIC survey data by construction product were used, which are only available on the IBGE Automatic Retrieval System (SIDRA) portal. As in the case of PIA-Product, the PAIC data by product is classified according to Prodlist.

The product that responds best to the need to measure health-sector GFCF, related to the construction and building of hospitals, is Prodlist code "4120.2030 – Non-residential buildings not previously specified (hospitals, schools, hotels, garages, stadiums, etc.)". As the name suggests, however, this is a product that encompasses several types of building, not just hospitals. It was therefore decided to

[12] Miguez and Freitas (2021) do include these products in their estimations, since they estimate the demand for GFCF of all products for all SNA activities. However, the classification used in the authors' data and the failure to segregate between public and private health, as noted above, make it impossible to use these data in the present study.

pro-rate the value of this code based on the production value of the SNA activities that might require the types of construction included in Prodlist. Some potentially small or sporadic construction types were not included because the production value could affect the pro-rating disproportionately. Table 2 shows the correspondences between the products included in Prodlist 4120.2030 and the SNA economic activities.

Table 2
Types of construction included in Prodlist 4120.2030 and economic activities that may require them

Types of construction included in PAIC Prodlist 4120.2030 product	Activities that may require them (SNA 68)
Service stations	4680 – Wholesale and retail trade, except of motor vehicles
Gatehouse	8000 – Surveillance, security and investigation activities
Arts and culture (cinemas, theaters, clubs, circuses, theaters, amusement parks, buildings for cultural or recreational purposes)	9080 – Artistic, creative and entertainment activities
Garage (garage building and underground garage)	5280 – Warehousing, transportation support activities and courier services
Stadiums (sports stadiums, sports halls, indoor courts, gymnasiums)	9080 – Artistic, creative and entertainment activities
Forts and fortresses	8400 – Public administration, defence and social security
Churches (churches, temples, cathedrals, synagogues, mosques and other types of buildings for religious purposes)	7880 – Other administrative activities and complementary services
Prisons (jails, prisons, police stations, battalions, forts and fortresses)	8400 – Public administration, defence and social security
Incineration plants	3680 – Water, sewerage and waste management
Restaurants (restaurants, bars, snack bars, cafeterias and bakeries, canteens, refectories and other establishments that serve food)	5600 – Food services
Stables and other buildings for agricultural and livestock use	0192 – Animal husbandry, including support for animal husbandry
Health (clinics, health centres and hospitals, doctors' consulting rooms and medical offices)	8691 – Public health and 8692 – Private health
Education (schools, faculties, universities, colleges, crèches and other buildings used for educational purposes)	8591 – Public and private education 8592 – Private education

Source: Prepared by the authors.
Note: Only the activities of the construction types in the shaded rows have been taken into account.

In short, to obtain the estimation for construction in the health sector, the first step was to deduct from SIDRA the values of construction works and services relating to Prodlist 4120.2030. Next, these values were distributed according to the weighting of the production value obtained with the activities selected in table 2. In other words, the total value of construction works and services was multiplied by the share of health services in the total production value of these activities. The result is shown in table 3, which reports the estimated value of construction expenditures in the health sector.

Table 3
Gross fixed capital formation in health construction, 2010–2019
(Millions of Brazilian reais, current prices)

Year	Public health care *(Percentage of total production value)*	Private health care *(Percentage of total production value)*	PAIC Prodlist 4120.2030	Public health care	Private health care	Total GFCF in health sector construction
2010	13	14	7 364.5	963.4	1 066.5	2 029.9
2011	13	14	7 307.7	917.6	1 002.1	1 919.6
2012	12	14	10 770.0	1 302.8	1 542.2	2 845.1
2013	12	14	10 152.0	1 260.2	1 451.8	2 712.0
2014	12	15	10 304.2	1 283.1	1 552.9	2 836.0
2015	13	16	7 260.8	911.4	1 132.8	2 044.2
2016	12	16	6 440.2	800.9	1 031.5	1 832.4
2017	12	16	6 394.0	762.5	1 045.5	1 808.0
2018	12	17	6 269.1	728.0	1 087.6	1 815.6
2019	12	17	5 745.5	663.4	990.6	1 654.1

Source: Prepared by the authors.

Lastly, to obtain the estimation of total investment by the health sector, the estimates for GFCF in machinery and equipment (table 1) are added to GFCF related to construction (table 3). The result is shown in table 4.

Table 4
Total GFCF in the health sector, 2010–2019
(Millions of Brazilian reais, current prices)

Year	Gross fixed capital formation in machinery and equipment	Gross fixed capital formation in construction	Total gross fixed capital formation in the health sector
2010	3 893.4	2 029.9	5 923.34
2011	3 891.1	1 919.6	5 810.70
2012	4 651.4	2 845.1	7 496.44
2013	5 458.4	2 712.0	8 170.45
2014	6 337.4	2 836.0	9 173.42
2015	6 578.5	2 044.2	8 622.68
2016	6 073.2	1 832.4	7 905.58
2017	5 983.2	1 808.0	7 791.23
2018	8 080.4	1 815.6	9 895.96
2019	8 359.9	1 654.1	10 013.91

Source: Prepared by the authors.

(b) Gross fixed capital formation in the public and private health sector

In the previous section, estimations of GFCF in the health sector were presented without distinguishing between the public and private sectors. In this section, a methodology is presented for estimating the investments made by the public health sector. Unfortunately, as noted in section III.2, there is a major lack of data on private sector demand. Thus, since there is one estimate for total health and another for the public domain, it was decided to obtain the GFCF of the private sector by calculating the difference between the two.

Federal expenditures were extracted from Siga Brasil, and State and municipal expenditures come from SIOPS. To explain how to extract these data, it is important to understand the accounting procedures of the National Treasury Secretariat (STN), the classification of budgetary expenditures, the phases of expenditure and the concept of expenditure from the public administration standpoint. It should also be noted that health expenditure by the federal government is defined as any health-related expenditure that is incurred by any public administration body, not only by the Ministry of Health but also by university and military hospitals, for example.[13]

In terms of the phases of expenditure, Act No. 4.320/1964 states that from the public administration standpoint, every expenditure consists of three stages: commitment, settlement and payment. Commitment entails reserving the funds needed to purchase the good or contract the service in question. In other words, it is a guarantee by the manager to the creditor that the public administration has the budgetary resources needed to pay the future obligations arising from the acquisition of the good or service. Settlement is the acknowledgment that the good was delivered or the service was rendered, and payment is the realization of the payment to the creditor (payment order).

Another important point is that committed budget expenditures that have not been paid as of December 31, the fiscal year-end date, are classified as “payables”, which in turn can be divided into “processed payables” and “unprocessed payables”. The former refer to settled goods or services that

[13] Vieira and Piola (2016) discuss the various definitions of health expenditure, including that used in international manuals for the production of health accounts.

have not yet been paid; in other words, the good or service was delivered but payment has not yet been made. "Unprocessed payables" are committed expenses that have not yet been settled or paid. Thus, committed expenses that become "unprocessed payables" may or may not actually materialize. For this reason, measuring investment in terms of the commitment phase leads to an overestimation of the amounts in question.

From an economic point of view, investment should be measured on the basis of the settled expenditures of the fiscal year, including expenditures relating to previous years even if they refer to previous years' budgets (Gobetti, 2006, p. 22). International health accounts manuals also suggest that expenditures should be measured from the settlement phase. According to the 2008 SNA manual, "The general principle for the time of recording of acquisitions less disposals of fixed assets is when the ownership of the fixed assets is transferred to the institutional unit that intends to use them in production. Except in two special cases, this time is not generally the same as the time at which the fixed assets are produced. Nor is it necessarily the time at which they are put to use in the production of other goods or services" (European Commission and others, 2016; 10.53, p. 201). Therefore, the best expenditure phase in which to measure GFCF in public health is that of settled expenditure.

Thus, considering these conceptual aspects and the shortcomings of the databases, the best way to calculate public sector investment in health is through the settled expenditure of the States and municipalities and of the Union (Vieira and Piola, 2016). The latter can also include the values of "Unprocessed remainders payable" (*restos por pagar no procesados* – RPNP) that have been paid. Thus, the formula used to calculate GFCF in public health was as follows:

$$GFCF\ Public\ health = (\text{Settled expenditures} + \text{RPNP}_{paid})_{Union} + \text{Settled expenditures}_{States} + \text{Settled expenditures}_{Municipalities} \quad (1)$$

In terms of expenditure modalities, only direct investments were considered, as was also adopted by SNA.[14] Lastly, the items considered were only those allocated as investment within the capital expenditure category, and more specifically the categories medical, dental, laboratory and hospital apparatus, equipment, utensils and other equipment and permanent material; that is items that are equivalent to the machinery and equipment portion.

During the critical analysis of the SIOPS data, it was found that many municipalities do not correctly complete the data on equipment specific to the health sector and on equipment for general use. Some municipalities underestimate the data in category 4.4.90.52.08.00 – Medical, dental, laboratory and hospital apparatus, equipment, utensils. Others responded in error in subcategory 4.4.90.52.99.00 – Other permanent equipment and supplies. This inconsistency was also detected in certain States (in this case, data from the States' transparency portals were checked). For this reason, the items in category 4.4.90.52.00.00 – Permanent equipment and supplies were prorated to correctly estimate the value of category 4.4.90.52.00.08 – Medical, dental, laboratory and hospital apparatus, equipment and utensils. To perform the prorating, States and municipalities of significant size that had completed the data in full were selected. The prorating was calculated by dividing the total of category 4.4.90.52.08.00 by category 4.4.90.52.00.00.

Initially, the aim was to use data from Siga Brasil and SIOPS to estimate construction, but it was impossible to separate the value of construction in Prodlist 4120.2030 between the public and private sectors. This made it difficult to check the consistency of the preliminary estimate for construction in

[14] The other possible modality is transfers. However, a transfer implies direct investment by third parties, so using the direct investment modality exclusively avoids double counting (Santos and others, 2014).

the public and private sectors. Thus, as seen in section III.3.a, it was decided to use the production value of activities 8691 Public Health and 8692 Private Health contained in SNA to disaggregate the total value of the construction portion of health sector GFCF the calculated with the PAIC data.

Once the share relating to public health demand was calculated, the private health share was estimated by the difference between the total and the public health estimate. The result is shown in table 5.

Table 5
Gross fixed capital formation in health by type of public and private investment, 2010–2019
(Millions of Brazilian reais, current prices)

Year	Public health			Private health			Total health		
	Machinery and equipment	Construction	Total	Machinery and equipment	Construction	Total	Machinery and equipment	Construction	Total
2010	1 541.5	963.4	2 504.9	2 351.9	1 066.5	3 418.5	3 893.4	2 029.9	5 923.3
2011	1 171.7	917.6	2 089.3	2 719.4	1 002.1	3 721.4	3 891.1	1 919.6	5 810.7
2012	1 169.1	1 302.8	2 472.0	3 482.3	1 542.2	5 024.5	4 651.4	2 845.1	7 496.4
2013	1 331.6	1 260.2	2 591.8	4 126.8	1 451.8	5 578.6	5 458.4	2 712.0	8 170.4
2014	1 247.0	1 283.1	2 530.1	5 090.4	1 552.9	6 643.3	6 337.4	2 836.0	9 173.4
2015	1 000.0	911.4	1 911.4	5 578.5	1 132.8	6 711.3	6 578.5	2 044.2	8 622.7
2016	1 135.4	800.9	1 936.3	4 937.8	1 031.5	5 969.3	6 073.2	1 832.4	7 905.6
2017	948.2	762.5	1 710.7	5 035.0	1 045.5	6 080.5	5 983.2	1 808.0	7 791.2
2018	1 792.6	728.0	2 520.6	6 287.8	1 087.6	7 375.4	8 080.4	1 815.6	9 896.0
2019	1 499.2	663.4	2 162.6	6 860.6	990.6	7 851.3	8 359.9	1 654.1	10 013.9

Source: Prepared by the authors.

IV. Gross fixed capital formation in the health sector in 2010–2019

The recent COVID-19 pandemic and the resulting disruption of global supply chains revealed the strategic nature of the production of health-related goods and services. As noted above, investment in fixed assets has a positive impact on health sector infrastructure, contributing to the sustainability of the system and equity of care. In terms of technological development, the sector is intensive in both incremental and radical research, development and innovation investments;[15] and the purchase of new machinery and equipment, which incorporate many of these technological advances, has positive effects on the evolution of treatments and health care generally (Teja and others, 2020). Moreover, the improvement of primary care is closely related to the incorporation of new equipment and technologies that have optimized population monitoring and diagnoses.

The estimation of health-sector GFCF presented in this article makes it possible to analyse the trajectory of investments in the health sector relative to the Brazilian economy at large. This, in turn, enables a more complete analysis of the dynamics of the sector and provides information that is relevant for decision making when formulating public policies. In fact, the separation of investments by type —machinery and equipment, and construction— and by domains —public and private— is an important element for public health decision-making. Figure 1 displays analytical summaries of these data.

[15] Pullen and others (2009) discuss some of the concepts related to types of innovation.

Figure 1
Distribution of GFCF by type of investment and by public and private sector, 2010–2019
(Percentage of total)

Source: Prepared by the authors.

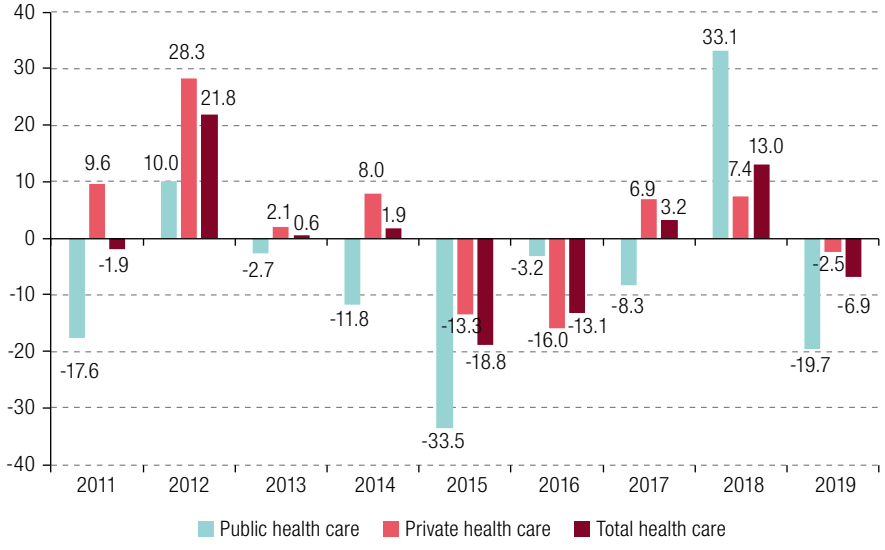
Table 5 and figure 1 highlight two key features. The first is that, in both the public and private sectors, investments in the machinery and equipment category accounting for between 60% and 80% of the total amount invested, and are always greater than investments in construction. One of the reasons for this is the speed of the technological updating cycle of health equipment, which outpaces advances in information and communication technologies and materials. Thus, even well-established health-care facilities are constantly faced with the need to acquire new equipment to replace old processes. In addition, industry pressure is seen in the eagerness to incorporate new medical technologies (Andreazzi and Affonso, 2016).

The second striking feature is the share of investment in both domains. The share of private investments is not only greater throughout the period, but the share of public investment declines progressively: it decreases from 42.3% in 2010 to just 21.6% in 2019, the lowest value in the series.

The slight uptick in the values and share of public investment in 2018 reflects the effect of the Ministry of Health Ordinance No. 3,992/2017. This was approved with the aim of giving greater autonomy to health sector managers, under which the rules on the financing and transfer of federal resources to health initiatives and services of the Unified Health System (SUS) were modified. Under the previous Ordinance No. 204/2007, resources were transferred to six funding blocks; but after the change, financial resources were henceforth allocated to just two blocks: financing and investment. Thus, while the municipal manager previously received the resources in different accounts, after the change all resources earmarked for investment went to a single account (CNM, 2018).

The data on health sector GFCF are obtained from sources that report amounts only in current prices. In order to correctly identify the dynamics of investment growth, they need to be converted to constant prices, to thus discount the effects of price variation. Owing to the diversity of data sources, it was decided to calculate deflators from the work of Passoni (2019) which, by calculating annual input-output matrices at constant prices, also made it possible to calculate deflators by product and by components of final supply and demand. The following data deflators from Passoni (2019) were used: (i) for GFCF in construction, the product 41801 – Buildings, from the vector of domestic GFCF; and (ii) for GFCF in machinery and equipment, the product 26004 – Measuring, testing and control, optical and electromedical equipment, from the vectors of domestic GFCF, imported GFCF and exports. Figure 2 presents the results of the growth rates of total GFCF in the health sector and in the public and private domains.

Figure 2
Change in real terms in health GFCF, 2011–2019
(Percentages)



Source: Prepared by the authors.

As shown in figure 2, while in 2011 total health investment declined by 1.9%, the following three years saw growth, albeit significant only in 2012. In 2015 and 2016, health sector GFCF declined once more, dragged down first by public investment, but then with a greater influence of private investment. In 2017, private health investment staged a recovery. Public investment only recovered in 2018, largely as a result of the aforementioned changes in the financing blocks, which in accounting terms made more resources available specifically for investment. However, in 2019, on the eve of the COVID-19 pandemic, investment again retreated across the board. This context is likely to have an

impact on the 2020 data, as the pandemic is very likely to have boosted investment in the sector. Considering the entire period covered, the average growth rate of total GFCF in health was minus 0.7% per year: the private sector grew by 2.6% per year on average while the public sector shrank by 7.6%.

The trajectory of public health investment in Brazil depends, partly, on the allocation of funding for the Unified Public Health System. The story of how these resources are allocated and the poor results obtained in the period analysed in this article dates back to before 2010. Health services are financed from the income of the Social Security Budget.[16] By law, 30% of the budget, excluding unemployment benefits, was supposed to be allocated to the health sector until the budget guidelines law was passed (Vieira, 2016). As this never actually happened, Constitutional Amendment 29 (EC 29) was created to define rules for the use of resources at the federal, State and municipal levels. The Union had to invest a minimum amount in 2000, which could not be less than that committed in 1999, adjusted upwards by 5%. Until 2004, the value committed in the previous year would be corrected according to nominal GDP growth. States and municipalities were required to allocate 12% and 15% of tax revenues and constitutional transfers, respectively, to public health initiatives and services. In 2015, EC 86 changed the method used to calculate minimum expenditure on public health initiatives and services by the Union by linking the minimum allocation to a percentage of net current revenues (Vieira and Benevides, 2016).

In 2016, health-care funding suffered another setback with the passage of EC 95 (known as the expenditure cap) which effectively froze government spending for 20 years. Primary expenditure (federal spending minus interest expense) was capped at a ceiling defined as the amount spent in the previous year adjusted for cumulative inflation (based on the National Broad Consumer Price Index (IPCA)). That is, this ceiling means that public spending will no longer track population and income growth (Vieira and Benevides, 2016).

The decrease in public expenditure leads to a fall in economic growth, a reduction in public revenue collection and, consequently, more expenditure cuts; in other words, it entails a vicious circle (Rossi, Dweck and Arantes, 2018). In a context of fiscal austerity, declining public health funding and economic crisis, health investment expenditure will also likely be affected while the ceiling is in place. This will further undermine the supply of health goods and services for the Brazilian population, while also causing a negative impact on development and on innovation and technology policies in the health sector.

Although articles on health investment in Brazil are few, authors such as Orair and Siqueira (2018) analyse the trajectory of public investment in the country in recent decades. They conclude that budgetary constraints on public investment intensified after 2011 (p. 956), even though public spending expanded in that period. The authors emphasize that the relationship between public investment and business cycles is less deterministic than some economists suggest; and that, in this period, the fiscal regime and changes in the orientation of economic policy influenced the course of public investment. In other words, the rate of growth of the economy is not the only determinant of the level of public investment, but the fiscal regimes and economic policies adopted by the government also play a role. Since investment expenditures are not mandatory, greater fluctuation is to be expected in these categories, unlike spending on wages, for example.

Public investment in Brazil grew between 2006 and 2010 but, from 2011 onwards, the data estimated here show that investments, including in the health sector, flatlined despite an increase in social spending. In this period, the fiscal space available for public investments shrank (Orair and Siqueira, 2018, p. 961).

[16] Resources obtained from the budgets of the Union, the States, the federal district and the municipalities, as well as from social contributions. In principle, these resources are distributed among social security, social assistance and the health sector (Piola and others, 2012).

Thus, the results presented in figure 2 seem to corroborate the hypothesis that, in a context of fiscal constraint, public investment tends to retreat sharply, even in essential areas such as health. This is because discretionary spending —in this case, investment— is the first to be cut despite rules to guarantee a minimum allocation of resources.

This context of limited investment in the health sector is of major concern considering the economic crisis and the increase in unemployment in recent years. The number of families covered by private health insurance can be expected to decrease,[17] and the demand for SUS services is likely to increase. This ultimately generates pressure to increase investment in supply capacity, either by hiring labour or by purchasing equipment. In short, the current public health financing policy seems to be moving in the opposite direction to the needs of the population.

In 2020, the onset of the COVID-19 pandemic made the weaknesses of the health sector in Brazil even more evident, not only in terms of the pharmaceutical sector and reliance on imported active pharmaceutical ingredients (APIs) (Hasenclever and others, 2020), but also in terms of the need to invest in the sector's infrastructure.

The methodology proposed in this article to measure health investments, therefore, is just another tool to draw attention to the actual needs of the health sector. It is important to continue analysing health investment expenditures in the coming years, given the possible effects of EC 95, 2016 and the COVID-19 pandemic itself.

V. Conclusion

The health satellite account provides health managers with a macroeconomic view of the sector, in addition to serving as a source of data for the formulation of public policies. Nonetheless, it suffers from a few gaps, such as the absence of information on GFCF in the health sector. The only GFCF data included in the health satellite account is the contribution made by the sectors linked to the health industrial complex from the supply side. Accordingly, the aim of this article is to present a proposal to estimate health sector GFCF from the demand side. This proposal can be adapted and replicated by other countries, since it uses databases of industrial production, civil construction, foreign trade and public expenditure on health.

The data sources used in the proposed methodology were PIA-Product, PAIC and SNA —official IBGE surveys— to estimate initially the total GFCF of the sector, as a first version of the data, divided into the categories of machinery and equipment and construction. In a second stage, data from Siga Brasil and SIOPS were used to estimate the demand for GFCF in health by the public sector. Unfortunately, the data sources used to make the private sector estimate were insufficient, so it was decided to calculate this as the difference between the total and the public sector estimations.

While filling some gaps, this approach also has its shortcomings. First, it was decided not to estimate the demand for general-purpose capital goods (which arises not only from the health sector but also from several other sectors), such as automobiles (where ambulances are included), computers and furniture. In addition, having to calculate the GFCF of the private health sector exclusively by elimination imposed a constraint on the estimations, since there is no parameter for comparing dynamics and adjusting the methodology.

[17] Although it is an expense that can be considered relatively income-inelastic, a combination of high unemployment and the rising cost of health insurance can leave families with insufficient income to purchase it.

The data showed that the sector's GFCF is more intensive in machinery and equipment than in construction, in both the public and the private domains. This can be considered a "technical" characteristic of the sector, owing to the constant need to update equipment technology. It was also noted that public investments have been declining consistently in recent years. However, it is important to note that SUS health services are partly supplied by the private network through agreements or contracts (Santos, Santos and Borges, 2013). Thus, although total investment spending is less in the public sector, the services of the Unified Public Health System are produced partly in the private network through the outsourcing of beds and examinations. Nonetheless, public investments in health are expected to decrease further with the implementation of EC 95 (expenditure ceiling), a worrisome situation resulting from the duration and prolonged consequences of the COVID-19 pandemic.

Lastly, despite recent progress in health statistics and the methodology proposed here, it would be important for IBGE to take steps to publish data on GFCF on the demand side. Also, the current data on the supply side suffer from a limitation: they do not take into account highly complex equipment such as tomographs, ultrasound scanners and X-ray equipment, which are part of CNAE 2660 and are assigned in SNA under product 26004 – Optical and electromedical measuring, testing and control equipment. The official data thus end up underestimating the CEIS contribution to the total GFCF of the Brazilian economy. Since this is a set of products with a significant weight in health sector investment, it should be disaggregated in a future change in the SNA base.

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