Federal Finance Administration Working Paper No. 27

June 2025

Determinants of Healthcare Expenditure: Evidence from Switzerland between 1960–2022

Benjamin Lerch
Carsten Colombier
Thomas Brändle

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Department of Finance FDF
Federal Finance Administration FFA
Economic and Monetary Policy EMP

The working papers of the Economic and Monetary Policy Division do not necessarily reflect the official positions of the Federal Finance Administration, the Federal Department of Finance or the Federal Council. The authors assume full responsibility for the theses defended in this work and for any errors it may contain.

Publishing information

Text	Federal Finance Administration, Economic and Monetary Policy Division EMP Benjamin Lerch, Carsten Colombier and Thomas Brändle Bundesgasse 3 CH-3003 Berne Switzerland
E-Mail	benjamin.lerch@efv.admin.ch, carsten.colombier@efv.admin.ch, thomas.braendle@efv.admin.ch
Internet	www.efv.admin.ch FFA Baseline work on economic policy

Layout	Webteam FFA, SPK
ISSN	1660-8240
Languages	English, German

Abstract

Healthcare expenditure growth is a key economic policy issue threatening the sustainability of public finances in advanced economies. This paper examines the determinants of healthcare expenditure in Switzerland using a time-series analysis for the period 1960-2022. Applying a dynamic OLS and an outlier-robust modified generalized maximum likelihood (MM) estimation approach, we find that income growth, population ageing, and Baumol's cost disease have all contributed to increasing total and public healthcare expenditure. The analysis suggests an income elasticity between 0.9 and 1.3, accounting for roughly half of the secular increase in healthcare expenditure. Our estimations also suggest a decrease in income elasticity over time. We find that population ageing has contributed by around 15% to the growth in healthcare expenditure. Income growth, demographic shifts, medical progress, slow productivity growth and labor shortages in healthcare are poised to intensify spending pressures in the years ahead, with implications both for total and public healthcare expenditure. Our results substantiate the policy debate on the determinants of healthcare expenditure, provide a tailored evidence basis for the healthcare expenditure projection framework for Switzerland and underscore the need for comprehensive reforms in the health sector to contain expenditure growth.

JEL codes: H51, I18, J11, C22

Keywords: Health expenditure, public finances, income elasticity, population ageing, Baumol's cost disease

Kurzfassung

Die Gesundheitsausgaben sind in den letzten Jahrzehnten stark gestiegen. Dies stellt eine zentrale wirtschaftspolitische Herausforderung dar und setzt die öffentlichen Finanzen Finanzen in fortgeschrittenen Volkswirtschaften zunehmend unter Druck. Was treibt das Wachstum der Gesundheitsausgaben an? In diesem Papier werden die Bestimmungsgründe der Gesundheitsausgaben in der Schweiz für den Zeitraum von 1960 bis 2022 mit Hilfe einer Zeitreihenanalyse untersucht. Mit verschiedenen ökonometrischen Ansätzen wird gezeigt, dass das Einkommenswachstum, die Alterung sowie die Baumolsche Kostenkrankheit massgeblich zum Wachstum der Gesundheitsausgaben beigetragen haben. Die Analyse legt eine Einkommenselastizität zwischen 0,9 und 1,3 nahe, womit diese etwa die Hälfte des langfristigen Ausgabenwachstums im Gesundheitswesen erklärt. In den letzten Jahrzehnten hat sie jedoch abgenommen. Die Alterung ist für etwa 15 % des Anstiegs der Gesundheitsausgaben verantwortlich. Für die kommenden Jahre ist zu erwarten, dass der medizinisch-technische Fortschritt, der demografische Wandel, das geringe Produktivitätswachstum und der zunehmende Fachkräftemangel im Gesundheitswesen den Ausgabendruck für Prämienzahlende und öffentliche Haushalte weiter erhöhen. Die vorliegenden Ergebnisse leisten einen Beitrag zum besseren Verständnis der Determinanten des Ausgabenwachstums. Sie ermöglichen zudem ein auf die Schweiz zugeschnittene evidenzbasierte Fundierung der Ausgabenprojektionen für das Gesundheitswesen der Eidgenössischen Finanzverwaltung. Die Analyse unterstreicht ausserdem die Dringlichkeit umfassender Reformen im Gesundheitswesen, um das Ausgabenwachstum langfristig zu dämpfen.

Résumé

La forte augmentation des dépenses de santé au cours des dernières décennies représente un défi économique majeur et exerce une pression croissante sur les finances publiques. Quels sont les facteurs qui déterminent la croissance des dépenses de santé ? La présente analyse examine les déterminants des dépenses de santé en Suisse pour la période 1960-2022 à l'aide d'une analyse de séries temporelles. Diverses approches économétriques montrent que la croissance des revenus, le vieillissement de la population et l'effet Baumol ont contribué de manière significative à l'augmentation des dépenses de santé. Nos estimations suggèrent une élasticité des revenus entre 0,9 et 1,3, expliquant environ la moitié de l'augmentation à long terme des dépenses. Nous constatons également une diminution de cette élasticité au cours des dernières décennies. Le vieillissement de la population contribue à hauteur d'environ 15 % à l'augmentation des dépenses de santé. À l'avenir, les progrès médico-techniques, l'évolution démographique, la faible croissance de la productivité et la pénurie croissante de personnel qualifié dans le secteur de la santé devraient continuer d'accroître la pression sur les dépenses, tant globales que publiques. Nos résultats apportent des éléments concrets au débat politique sur les déterminants des dépenses de santé et fournissent une base empirique pour le cadre de projection des dépenses de santé en Suisse de l'Administration fédérale des finances. Ils soulignent également l'urgence de réformes globales dans le secteur de la santé afin de contenir durablement l'augmentation des dépenses.

Contents

1. Introduction

The secular growth of healthcare expenditure (HCE) is a critical economic policy challenge that poses significant risks to the sustainability of public finances in advanced economies. As HCE continues to rise, understanding the driving forces is essential to inform policymakers and develop strategies to ensure fiscal sustainability and maintain equitable access to healthcare.

This paper explores the determinants of HCE in Switzerland using a time-series analysis over the period 1960–2022. We examine the role of income growth, alongside key factors such as population ageing and Baumol's cost disease, in driving the secular increase in HCE. We evaluate the relative contributions of these determinants to both total and public HCE.[1]

Switzerland provides an intriguing case to study due to its unique healthcare system. It is characterized by a highly decentralized federal structure, private non-profit insurance companies offering mandatory health insurance and significant public sector involvement, including regulation and subsidies. Moreover, with health spending accounting for about 11.5% of GDP in 2023 (CHF 94 billion), Switzerland is one of the OECD countries with the highest HCE in terms of GDP (OECD, 2025; FSO, 2025a). The country's high-income level, ageing population, and decentralized healthcare governance offer an interesting context for understanding the interplay between economic, demographic, and policy factors shaping HCE trends. Moreover, the rapid and sustained rise in HCE exacerbates concerns regarding universal access to healthcare services and the fiscal sustainability of the healthcare sector.

In response, policymakers have recently approved reforms in the Swiss healthcare system. These reforms include the introduction of monistic financing, cost targets for mandatory health insurance, and new minimum cantonal contribution provisions to strengthen the financing of the individual premium subsidy scheme.[2] However, further reforms are necessary. Addressing these challenges requires a thorough understanding of the drivers of rising HCE.

Our analysis provides updated estimates of the determinants of healthcare spending. It also provides a tailored evidence base on key assumptions on structural cost drivers for Switzerland's HCE projection framework, informing decision-makers about future spending trends (Brändle and Colombier, 2017; 2022; FDF, 2024). Finally, it contributes to the broader discourse on long-term sustainable healthcare financing and fiscal sustainability analysis in advanced economies (European Commission, 2024; Lorenzoni et al., 2024).

Figure 1 shows the secular increase in GDP and HCE per capita in Switzerland. While GDP has roughly doubled since 1960, HCE has more than quintupled, from less than CHF 2,000 per capita in 1960 to more than CHF 10,000 in 2022. The impact of income on HCE is a central topic in health economics, especially in developed countries where healthcare systems are well-established, but disparities in access and utilization persist.

1 We are grateful to Martin Baur, as well as Boriana Goranova, Philipp Mohl, Santiago Alvaro Calvo Ramos and Adam Levai from the EU Commission's DG ECFIN, and to the participants of the 2024 European Health Economics Association Conference, PET 2024 International Conference on Public Economic Theory, 23rd Annual International Conference on Health Economics, Management & Policy, Deutsche Gesellschaft für Gesundheitsökonomie (dggö) 2025 Annual Conference and the Swiss Network on Public Economics for feedback and useful comments.

2 The EFAS introduces a monistic financing system for all services covered by mandatory health insurance in Switzerland, regardless of whether they are provided on an outpatient basis, in hospitals or in nursing homes. The reform aims to improve financial incentives between outpatient and inpatient care by ensuring a common cost-sharing between health insurers and cantons.

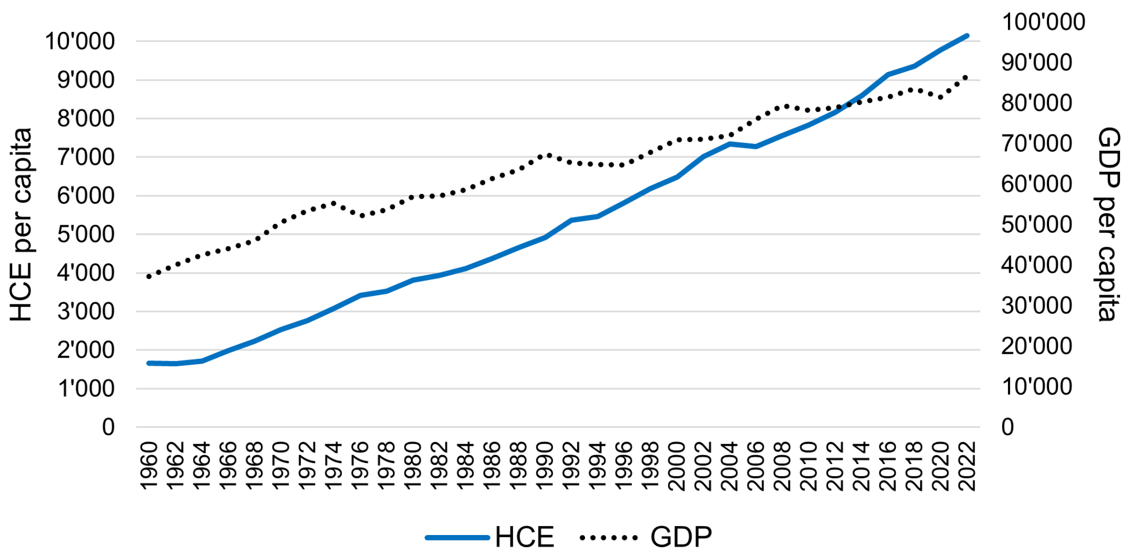
Numerous empirical studies have demonstrated that income is a key determinant of HCE, influencing total spending as well as the allocation of resources (Nghiem and Connelly, 2017). As individuals experience higher income, their healthcare spending generally increases, often due to improved access to healthcare services, better insurance coverage, and greater demand for quality care. Moreover, rising income is argued to be related to technological progress in the health sector (Smith et al., 2009), raising HCE (Marino and Lorenzoni, 2019). In this context, the income elasticity of HCE has been of primary interest. Some studies suggest that healthcare is a luxury good, i.e. the income elasticity is above 1 (Newhouse, 1977; Gerdtham et al., 1992; Clemente et al., 2004; Colombier, 2018), while others argue that it is more of a normal good, i.e. the income elasticity is below 1 (Giannoni and Hitiris, 2002; Di Matteo, 2005; Costa-Font et al., 2011; Casas et al., 2021; Lorenzoni et al., 2024). Further cross-country literature on the income elasticity of HCE indicates mixed evidence, with estimates varying significantly depending on country-specific factors, time periods analyzed and the underlying empirical approach (Baltagi and Moscone, 2010; Martín et al., 2011; Baltagi et al., 2017). What makes the estimation of the income elasticity challenging is the difficulty to discern between demand and supply-side effects (Smith et al., 2009). In other words, the estimates of income elasticity may be influenced by factors that are highly correlated with GDP such as medical progress, healthcare prices or insurance coverage.

For Swiss cantons and covering the period from 1970 to 2012, Brändle and Colombier (2016) estimate an income elasticity for public HCE of 0.8. Earlier analyses at the Swiss cantonal level include Crivelli et al. (2006) and Reich et al. (2012). More closely related to this study, Colombier (2018) conducts a time-series analysis of the determinants of total HCE in Switzerland from 1960 to 2012, finding an income elasticity ranging from 0.9 to 1.1.

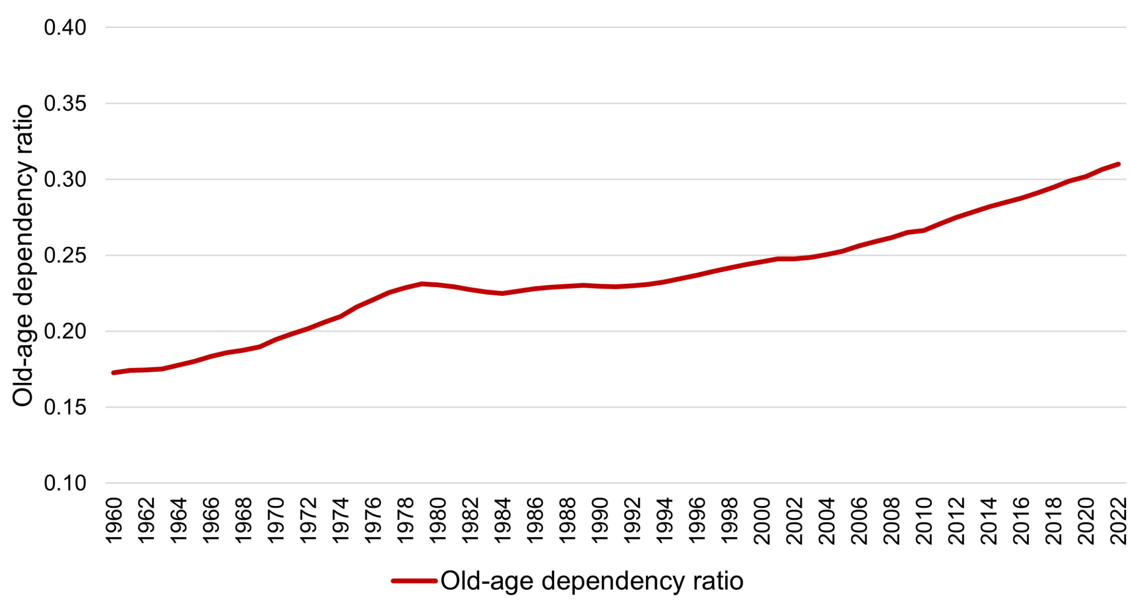
Figure 1 (Panel B) also shows that Switzerland has experienced significant population ageing: the old-age dependency ratio has risen from around 20% in 1960 to almost 33% in 2022. In other words, the ratio of people in their working age to those aged 65 years and above has fallen from five to about three, and it is expected to fall further to about two by 2060 (FSO, 2025b). Empirical studies have highlighted the role of demographic changes in explaining increases in HCE (Smith et al., 2009; Gregersen, 2014; Breyer et al., 2015; Colombier, 2018). Some studies argue that rising healthcare costs are less attributable to ageing itself and more to the proximity to death, a concept known as the "red-herring hypothesis" (Zweifel et al., 1999; Seshamani and Gray, 2004; Werblow et al., 2007; Costa-Font and Vilaplana-Prieto, 2020). However, this hypothesis remains contentious, with a growing body of evidence challenging its validity (Colombier and Weber, 2011; Panczak et al., 2017; Breyer and Lorenz, 2021; Milkovska et al., 2024).

Figure 1: Healthcare expenditure (HCE) and GDP per capita (CHF, real at 2015 prices) and old-age dependency ratio

Panel A: HCE and GDP



Panel B: Old-age dependency ratio



Source: Author's computation using data from the Federal Statistical Office (FSO).
Notes: The old-age dependency ratio accounts for the share of individuals aged 65 or older of the working-age population, defined as those aged between 20 to 64 years old.

The literature also identified Baumol's cost disease as an important supply-side factor in explaining rising HCE (Baumol, 1967; Bates and Santerre, 2013; Hartwig, 2008; Hartwig and Sturm, 2014; Colombier, 2017). Baumol's cost disease emerges from the fact that cost pressures in labor-intensive sectors, such as the healthcare sector, increase more than in other industries. These sectors experience lower benefits from labor-related technological progress. Therefore, productivity growth is slower than in the overall economy. Given the relatively high price inelasticity of demand for health services, health workers' wages need to increase in line with wages in the rest of the economy to maintain the attractiveness of the health sector. This can lead to cost pressures, affecting overall HCE. Factors that could exacerbate this trend include labor shortages and inefficient tariffs for medical services.

This paper contributes to the literature by extending the analysis of Colombier (2018) by a decade, examining the determinants of both total and public health expenditure, and looking more closely at the relationship between income and health expenditure in Switzerland. Our time-series analysis uses both a dynamic OLS and an outlier-robust modified generalized maximum likelihood (MM) estimator to account for various identification issues that might bias our estimates.

The results highlight the combined impact of income growth, population ageing, and Baumol's cost disease on both total and public HCE. We estimate the income elasticity of healthcare spending to lie between 0.9 and 1.3, with slightly lower elasticities for public HCE. Income growth accounts for roughly half of the long-term increase in HCE. However, the relationship between income and healthcare spending appears to have weakened in more recent decades. In our time-series macroeconomic approach, we cannot disentangle whether this effect is driven by supply (e.g. medical progress) or demand factors (e.g. higher demands for health services from the population).

Population ageing has contributed about 15% to HCE growth, but we expect its impact to increase in the future, as the "Baby-Boom"-Generation ages. Our findings also suggest the influence of Baumol's cost disease since the mid-1970s, and in particular for public HCE. This trend is likely driven by the higher importance of long-term care in public HCE, given that it is more labor-intensive than other types of healthcare services, such as outpatient or inpatient hospital treatments. Cantons and municipalities are particularly affected by this dynamic as they are responsible for a share of long-term care costs. By contrast, the federal government is primarily affected by total HCE growth, which translates into higher payments for individual premium reductions. These payments also place additional fiscal pressure on the cantons.

Our empirical analysis also controls for a wide range of additional factors, including mortality rates, physician density, the share of foreigners, income inequality, educational attainment, and institutional characteristics (De la Maisonneuve et al., 2017). The latter include key policy reforms such as the introduction of mandatory health insurance in 1996, the implementation of a standardized tariff structure for outpatient services (TARMED) in 2004, a reform of the individual premium reduction scheme in 2008, and the 2012 hospital financing reform.

The paper is structured as follows. Section 2 briefly outlines the institutional framework of the Swiss healthcare system. Section 3 provides an overview of healthcare determinants and the underlying data. Section 4 introduces our empirical methodology. Section 5 presents the results of our time-series analysis. Section 6 concludes and discusses policy implications.

2. Institutional background

The Swiss healthcare system is highly decentralized, with responsibilities distributed across federal, cantonal, and municipal levels of government. A central feature of the Swiss system is the mandatory health insurance (MHI), introduced in 1996 with the Health Insurance Act (HIA), which requires all residents to obtain health coverage with community-rated premiums. Individuals must pay out-of-pocket for medical services until they reach their deductible, after which the health insurance begins to cover the costs. To ease the financial burden of MHI premiums for low-income households, both the federal government and cantons provide subsidies in the form of individual premium reductions (IPR).

In 2004, Switzerland introduced a nation-wide fee-for-service tariff system (TARMED) to standardize reimbursement rates for outpatient services. This system sets fixed prices for a variety of services (e.g. consultations, medical procedures, diagnostic tests, and treatments) based on a uniform set of criteria. TARMED was designed to provide greater transparency and fairness in payments, while controlling healthcare costs and improving system efficiency. After more than 20 years, TARMED will be replaced by the TARDOC tariff system, which includes individual service tariffs and flat-rate structures, set to take effect in 2026.

In 2008, a comprehensive reform of the fiscal equalization system and the division of responsibilities between the federal and the cantonal level of government was implemented. This reform affected also the IPR system. The reform fixed the federal contribution to IPR at 7.5% of the gross cost of MHI and no longer depends on the financial strength and premiums of the cantons; it is divided among the cantons based on their resident population. The cantons supplement the federal contribution with their own funds. In 2024, another reform of the IPR scheme was passed, which requires the cantons to contribute a minimum share to the financing of subsidies. This contribution varies between 3.5% and 7.5% of the gross costs of MHI.[3] In addition, the cantons will be obliged to define the maximum share of a resident's health insurance premium that may be borne in relation to his or her disposable income.

The implementation of the Swiss DRG reform in 2012 constituted a major restructuring of the hospital financing system. This reform introduced a new reimbursement scheme for hospitals based on Diagnosis Related Groups, aiming to standardize hospital payments and improve transparency and cost efficiency. Before 2012, hospital funding in Switzerland was largely based on per diem payments, which incentivized longer hospital stays and contributed to substantial variation in hospital costs between cantons and institutions.

Although most reforms aim to ensure universal access to health services while maintaining efficiency and cost containment, their ultimate impact on HCE is unclear a priori. This can also be attributed to several market failures in the healthcare sector, including asymmetric information. Asymmetric information arises, for instance, when patients have less knowledge about their health and appropriate treatments than healthcare providers, which can result in suboptimal treatment decisions. Since providers are often profit-oriented, supplier-induced demand may result in treatments that go beyond what is medically necessary. In addition, moral hazard may arise when insured individuals consume more healthcare services than necessary, as they do not bear the full financial cost.[4] These incentives can align with those driving supplier-induced demand, potentially compounding upward pressure on HCE. The impact of reforms on HCE is ultimately an empirical question.

3 The cantonal contribution is determined based on the share of income spent on MHI premiums by the lowest-income 40% of insured residents in the canton. If premiums represent less than 11% of income, the minimum contribution is 3.5% of gross MHI costs. If they account for 18.5% or more, the minimum rises to 7.5%. Between these thresholds, the contribution increases linearly.

4 However, according to behavioral economics, it should be noted that patients' decisions are not always in line with moral hazard theory. This can result in the wrong decisions being made, leading to cost-effective treatments being underused and relatively worthless medical treatments being overused ("behavioural hazard") (see Baicker et al., 2015).

3. Determinants and data

3.1 Healthcare expenditure determinants

We use publicly available macro-data from various sources, primarily from the Swiss Federal Statistical Office (FSO), on HCE and its main determinants as defined in the literature. We use aggregated data on HCE between 1960 and 2022 from the healthcare costs database of the FSO. We further use data on public HCE from the Financial Statistics of the Federal Finance Administration (FFA). We complement these data with information on population counts from the FSO and the GDP deflator from the State Secretariat of Economic Affairs (SECO) to compute real HCE per capita. As we are interested in estimating the income elasticity of HCE, we also obtained historical data on real GDP per capita from the FSO.

Notably, income elasticity accounts for a series of important drivers of HCE that cannot be disentangled in our time-series analysis. First, advances in medical technology, which are among the most important drivers of HCE (Newhouse, 1992). The isolation of the empirical impact of medical advances on HCE is inherently difficult (Chernew and Newhouse, 2011; Marino et al., 2017), with technological progress often being treated as a residual in regression analyses. However, medical advances are likely to increase with income growth (Smith et al., 2009), suggesting that the residual captures only the impact of medical advances that are independent from income. Following Lorenzoni et al. (2024), we account for technological progress that is not captured by GDP growth using a time trend. Second, our income variable is also capturing increasing demands for health services of the population. As individuals become wealthier, they have more disposable income available for their health (Smith et al., 2009).

To proxy demographic changes, in particular population ageing, we compute the old-age dependency ratio, i.e. the ratio between the population aged 65 years or above and the working-age population. We expect that a higher old-age dependency ratio increases HCE, as older workers tend to demand more health services. We further use FSO data on mortality as an inverse proxy for the health status of the population reflecting advances in medical technology. The impact of lower mortality rates on HCE is unclear a priori. On the one hand, improved treatments and preventive care could reduce costs by enhancing efficiency and reducing the need for expensive interventions. On the other hand, improved treatments may induce higher utilization of therapies. In addition, increased longevity may lead to higher healthcare spending, particularly if individuals require prolonged treatment, or long-term care in later life. In addition, the mortality rate could also be interpreted as a proxy for the red-herring hypothesis at the macro-level (van Baal and Wong, 2012; Breyer et al., 2015). These potentially underlying forces cannot be disentangled in our time-series analysis. However, while a positive relationship could provide suggestive evidence for the red-herring hypothesis, a negative relationship would rather reflect medical progress.

To further account for demographic changes, we also use the share of foreigners in Switzerland from the FSO, as immigrants may utilize health services differently than natives (Sarría-Santamera et al., 2016). The impact of this trend on HCE is also unclear a priori, as it depends on whether foreigners demand more or less health services than the native population. Their utilization pattern again depends on several factors, such as preferences, income, occupation and education.

In additional analyses, we also account for the share of the population with a tertiary education from the FSO census. Higher educational attainment is often associated with healthier lifestyles and engagement in more preventive healthcare, leading to better health and therefore lower HCE (Fletcher and Frisvold, 2009; Raghupathi and Raghupathi, 2020).[5]

An important supply-side determinant of HCE growth identified in the literature are relative price effects, including inefficiently high tariffs in the health sector, labor shortages (e.g. nurses and technicians) and Baumol's cost disease (Baumol, 1967). We use as a proxy for Baumol's cost disease the ratio of real wages and productivity from the SECO and Mergele et al. (2024). Due to the challenges related to adequate measures of productivity and prices for the healthcare sector, we proxy Baumol's cost disease by computing the ratio of hourly wages and productivity – defined as GDP per hour according to Mergele et al. (2024) – in the overall economy at 2005 prices. Assuming that wages align with productivity in sectors not affected by Baumol's cost disease, the effect should be primarily driven by labor-intensive sectors, such as the healthcare sector.

Moreover, we account for the supply of healthcare services using a measure of physician density from the Swiss Medical Association (FMH). The impact of a higher physician density on HCE might be positive or negative. It could reduce supply shortages, improving efficiency in the market and decreasing costs, as well as increasing costs due to market failures in the healthcare sector (Léonard et al., 2009; Reich et al., 2012).

We also account for the potential impact that income inequality might have on HCE, both affecting total and public HCE, since under the HIA, health insurance premiums for people with low incomes are to be reduced through federal and cantonal subsidies (IPR). We use the share of income held by the top 10% of the population as a proxy for changes in income inequality since 1960. These data are taken from the Swiss Inequality Database of the Institute for Swiss Economic Policy of the University of Lucerne.[6] An increase in inequality may lead to a greater reliance on IPR, thereby driving up public HCE. Additionally, financial constraints among low-income individuals could result in delayed medical treatment, ultimately leading to higher emergency care and overall healthcare costs.

Finally, we include the most important institutional reforms (see Section 2) using a set of dummy variables equal to 1 starting in the year in which the institutional change took effect. These reforms include the introduction of the MHI in 1996, the introduction of TARMED in 2004, the reform of the individual premium reduction scheme in 2008, and the hospital financing reform of 2012. While health sector reforms are usually not intended to increase HCE – often aiming to improve efficiency while containing spending growth –, some may have unintended cost-increasing effects. These effects can arise from other policy objectives, such as equity considerations or market failures, such as asymmetric information in the healthcare sector.

5 We linearly interpolate data on the share of tertiary educated population from the FSO decennial census between 1960 and 2010. From 2011, educational data from the Swiss Labour Force Survey are available on a yearly frequency.

6 Data on top income are available up to 2020. To avoid losing observations, we estimate the values for 2021 and 2022 using the average growth rate from the previous five years. Additionally, in the Appendix, we conduct the analysis excluding these years. An alternative proxy for income inequality is the Gini coefficient, but the data are not available over our 60-year time horizon, often starting consistently only from the late 1990s or early 2000s.

3.2 Descriptive statistics

Table 1 shows descriptive statistics for the variables over our sample period. The average HCE per capita between 1960 and 2022 has been CHF 5,370, ranging from CHF 1,646 in 1960 to CHF 10,227 in 2022. Almost one third of total HCE is covered by the public sector. This includes contributions to the cost of hospital services and long-term care services (such as home care and nursing homes), as well as funding for the IPR. The cantons play a particularly significant role in managing this expenditure. Another third of HCE is covered by mandatory health insurance and the remaining portion is primarily borne by individuals through cost sharing (e.g. co-payments and out-of-pocket payments).

As illustrated in Table 1, Switzerland's real GDP per capita more than doubled between 1960 and 2022, increasing from approximately CHF 37,000 to almost CHF 87,000 (using prices at 2015 levels). During the same period, the old-age dependency ratio rose significantly, from about 20% in 1960 to 33% in 2022. These trends are expected to have contributed to the secular growth in HCE.

The mortality rate shows the number of deaths per 1,000 inhabitants each year. This indicator fell from 10 in the 1960s to below 8 in the late 2000s and has remained constant since, with a temporary increase to 8.8 in 2020 due to the COVID-19 pandemic. The physician density increased significantly from 0.3 general physicians per 1,000 inhabitants in 1960 to more than 1 general physician in 2022. The share of foreigners in the population has also increased over the last decades, from 9% to 25%. Inequality remained stable until the 1990s but has risen moderately since then, with the top 10% of the population's income share increasing from 30% to over 33%. The share of individuals with a tertiary education has also been increasing in the last decades, from less than 5% in the 1960s to more than 40% in 2022.

Table 1: Descriptive statistics

Variable	Unit	Obs.	Mean	Std.	Min.	Max.	Expected sign
Panel A: Dependent variables							
ln HCE	ln, per capita	63	8.46	0.55	7.41	9.23	
HCE	CHF (2015), per capita	63	5,370	2,560	1,646	10,227	
ln public HCE	ln, per capita	63	7.28	0.49	6.08	7.94	
Public HCE	CHF (2015), per capita	63	1,615	655	436	2,809	
Panel B: Independent variables							
ln GDP	ln, per capita	63	11.04	0.22	10.52	11.37	+
GDP	CHF (2015), per capita	63	63,802	13,501	37,193	86,656	+
Old-age dependency ratio	>65 as % of working-age population	63	26.73	3.44	19.61	32.85	+
Baumol's cost disease	Ratio of wages and productivity	63	-0.64	0.06	-0.79	-0.51	+
Mortality rate	Deaths / 1,000 inhabitants	63	8.83	0.59	7.80	10.00	+/-
Physician density	Physician / 1,000 inhabitants	63	0.71	0.25	0.32	1.08	+/-
Foreign population	% of population	63	17.98	4.06	9.16	25.46	+/-
Top10	Top 10% population income	63	31.78	1.73	29.62	35.08	+
Tertiary education	% of population	63	17.78	10.44	3.60	41.53	-
MHI	1 if year>=1996, 0 otherwise	63	0.41	0.50	0	1	+/-
TARMED	1 if year>=2004, 0 otherwise	63	0.29	0.45	0	1	-
IPR reform	1 if year>=2008, 0 otherwise	63	0.24	0.43	0	1	+/-
Hospital reform	1 if year>=2012, 0 otherwise	63	0.16	0.37	0	1	+/-

Notes: This table presents descriptive statistics (mean, standard deviation, minimum and maximum) for all variables used in the time-series analysis. The sample covers the period from 1960 to 2022, with yearly observations. When data is unavailable, interpolated values are included.

4. Empirical approach

This section presents the empirical approach used in our time-series analysis, including estimators to address identification issues and a structural break analysis.

4.1 Estimating equation

We estimate the relationship between the potential cost determinants and HCE in Switzerland between 1960 and 2022. Our main estimating equation is as follows:

$$\ln HCE_t = \beta_0 + \beta_1 \ln GDP_t + \beta_2 Ageing_t + \beta_3 Baumol_t + \boldsymbol{X'}_t \gamma + \varepsilon_t$$

where HCE is real healthcare expenditure per capita (in CHF at 2015 prices), GDP is real GDP per capita (at 2015 prices), Ageing is the age-dependency ratio and Baumol captures the relative price effect through Baumol's cost disease. The vector **X**′ includes a set of covariates, including also a time trend and institutional reforms, and **ε** is the error term.

4.2 Cointegration and outlier-robust estimators

We use a dynamic OLS (DOLS) approach to correct for possible endogeneity bias in the explanatory variables (Saikkonen, 1991). Accordingly, we include a set of lags and leads in first differences of the continuous regressors. The number of lags and leads are identified by the Akaike information criterion (AIC).

Following the time-series literature, we use unit-root tests and find that HCE and most explanatory variables contain a stochastic trend and are difference-stationary (see Appendix, Table A1) (Dreger and Reimers, 2005; Gerdtham and Löthgren, 2000; Okunade and Murthy, 2002; Colombier, 2018). We therefore test for a cointegration relationship between HCE and the explanatory variables using the bounds-testing approach by Pesaran et al., (2001). Unlike other single-equation cointegration tests, the bounds test accommodates both stationary and difference-stationary regressors, and it allows for multiple cointegrating relationships among them. The results confirm that there is a cointegration between HCE and the explanatory variable across all tested models (see Appendix, Table A2).

Moreover, health data often deviate from a Gaussian distribution (Cantoni and Ronchetti, 2006). Therefore, our time-series data might be influenced by outliers resulting from measurement errors or events, such as an oil-price crisis, consumer-behavior changes due to tax adjustments (Franses and Haldrup, 1994) and pandemics. Least squares approaches, such as DOLS, can be sensitive to outliers – where even a single outlying observation may cause the least-squared estimator to become biased or inefficient. To address this sensitivity to outliers, we additionally use an outlier-robust modified generalized maximum likelihood estimator (MM) (Yohai et al., 1991; Temple, 2000; Zaman et al., 2001; Hartwig and Sturm, 2014; Colombier, 2018).

Due to its robustness to outliers, the MM estimator is well-suited for identifying the most consistent and reliable components of the estimated model. The MM estimator identifies outliers in most estimations and mitigates their impact through its robust weighting scheme. We apply two methods to detect outliers. First, we follow Hubert et al. (2008) in identifying outliers that are potentially harmful for the DOLS estimator. Moreover, we use the Shapiro-Wilk test on the hypothesis of Gaussian distributed data.

4.3 Structural breaks

In our time-series analysis, it is important to account for the possibility of structural breaks. Structural breaks can affect the stability of the model parameters and therefore bias the estimates. To account for this, we use the Rec-CUSUM test, the Chow breakpoint test and the OLS-MOSUM test. In accordance with Colombier (2018), the tests indicate a structural break in the HCE time series of Switzerland during the 1970s – in particular in 1971, 1975 and 1976 (see Appendix, Figure A1). These structural breaks may be attributed to the macroeconomic conditions of the 1970s, including the collapse of the Bretton Woods system and the oil crisis. These events led to an 8% contraction in Swiss real GDP between 1975 and 1976, likely imposing tighter financial constraints that curbed also HCE. A structural break in these years is also visible in Figure 1. In the empirical analysis, we implement a sample split starting in 1976 to account for these structural breaks in the data. We do not observe a structural break in our time series that coincides with healthcare reforms in Switzerland.

4.4 Time trend

Including a time trend to proxy medical progress uncorrelated with GDP growth has become standard practice in the literature (e.g. Lorenzoni et al., 2024). However, this approach provides only an imperfect measure of medical advances. Our analysis reveals that the time trend is influenced by various confounding factors and exhibits strong correlations with key HCE determinants also beyond GDP – for instance, a 91% correlation with the old-age dependency ratio and a negative 87% correlation with the mortality rate. In fact, the time trend shows the highest collinearity among all explanatory variables. These findings suggest that caution is warranted when interpreting estimates of the time trend.

5. Results

We begin by analyzing the determinants of total HCE growth and then evaluate their impact on public HCE. Additionally, we examine the influence of structural breaks in our time series and investigate changes in income elasticity over time.

5.1 Total healthcare expenditure

Table 2 summarizes our main results. The first two columns illustrate the results from the DOLS estimator. The latter two are from the MM estimator. Columns 1 and 3 show the estimates from our core specification, including only our main variables of interest – income, ageing and Baumol's cost disease –, the time-trend and a set of dummy variables (introduction of MHI and TARMED as well as the IPR and hospital financing reforms). Columns 2 and 4 show the results from a full model's specification which, additionally to the variables from Columns 1 and 3, includes further potential determinants of HCE, such as the mortality rate, physician density, the share of the foreign population and income inequality.

We find that real GDP per capita has a positive and statistically significant relationship with HCE. The income elasticity ranges between 1.2 and 1.3, depending on the model specification. These estimates suggest that, on average over our sample period, HCE increases more than proportionally with income growth. Using a simple back-of-the-envelope calculation, these estimates suggest that income growth explains about half of the growth in HCE between 1960 and 2022. Importantly, our estimates in the core model in Columns 1 and 3 are slightly larger than when controlling for the full battery of control variables. This finding stems from the fact that GDP per capita is correlated with our control variables. Our estimates might be biased upwards, as they capture also part of this explanatory variance, when we do not account for additional determinants in the empirical analysis. Two driving forces that affect HCE through income are medical technical advances and increasing demands of the population. In other words, our estimate of the income elasticity captures both supply and demand-side factors affecting health spending.

We also find that population ageing significantly contributes to rising HCE, with estimates ranging from 1.7 to 1.9. In other words, an increase in the age-dependency ratio of one percentage point is associated with an increase of HCE of 1.7% to 1.9%. Between 1960 and 2022, this translates into an increase of HCE of about 15% associated with population ageing, as the old-age dependency ratio increases from 20% to almost 33%. This result remains robust when accounting for changes in mortality rates and suggests that the growing proportion of the population aged 65 years and older has contributed to the secular increase in HCE. Without reforms, countries are likely to face growing strain on their healthcare systems as population ageing intensifies in the coming decades.

Table 2: Determinants of total healthcare expenditure

	Total healthcare expenditure			
	DOLS		MM	
	(1)	(2)	(3)	(4)
ln GDP per capita	1.296***	1.217***	1.273***	1.192***
	(0.154)	(0.129)	(0.196)	(0.120)
old-age dependency ratio	1.730***	1.822***	1.754***	1.902***
	(0.318)	(0.429)	(0.408)	(0.486)
Baumol's cost disease	-0.534	0.625	-0.572	0.270
	(0.428)	(0.443)	(0.621)	(0.360)
mortality rate		-0.033		-0.048**
		(0.020)		(0.024)
physician density		0.116		0.083
		(0.076)		(0.091)
foreign population		0.815*		0.621
		(0.482)		(0.485)
top 10%		-0.001		0.001
		(0.006)		(0.007)
time trend	0.014***	0.007**	0.015***	0.009***
	(0.003)	(0.003)	(0.004)	(0.002)
MHI	0.024	0.043*	0.021	0.028**
	(0.022)	(0.023)	(0.029)	(0.016)
TARMED	-0.066**	-0.096***	-0.073**	-0.134***
	(0.027)	(0.030)	(0.032)	(0.025)
IPR	-0.099***	-0.060**	-0.095***	-0.050**
	(0.031)	(0.026)	(0.036)	(0.023)
hospital reform	-0.001	-0.002	0.002	0.005
	(0.020)	(0.019)	(0.021)	(0.023)
Observations	61	61	61	61
Share of harmful outliers (%)	0.0	0.0	0.0	1.6
Shapiro-Wilk test	0.99	0.99	0.99	0.85***

Notes: This table presents estimates from the DOLS and MM estimators. Total healthcare expenditure and GDP per capita are expressed in natural logarithms. The regressions also include lags and leads of the first differences for all continuous independent variables. Columns 1 and 3 report estimates from the core specification, while columns 2 and 4 present results from the full specification. Minor variations in the MM estimates may arise from the estimator's sensitivity to small sample sizes. The Lumley-Heagerty (1999) standard errors are corrected for autocorrelation, heteroscedasticity and small-sample bias. Harmful outliers: vertical outliers and bad leverages; Shapiro-Wilk test for Gaussian distribution, H0: Gaussian distribution, W statistic. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

Table 2 does not provide evidence that the combination of average-economy wage growth and sluggish productivity growth has contributed to rising total HCE. This may result from the fact that our proxy is an imperfect measure of Baumol's cost disease, as it reflects wages and productivity in the overall economy rather than in the healthcare sector specifically. This could bias our estimates toward zero due to measurement error. When we include a measure of higher educational attainment in our full model specification (see Appendix, Table A3), the estimate of Baumol's cost disease becomes statistically significant, with a coefficient of approximately 0.6 using our MM-estimator. The estimate is noisier when applying the DOLS approach, but it remains of a similar order of magnitude. This discrepancy may stem from the influence of outliers, which are identified by the MM-estimator, the non-Gaussian nature of the data or structural breaks in our sample period. These findings suggest that price pressures in the labor-intensive healthcare sector may contribute to rising HCE, but that the estimates remain sensitive to model specification and the set of included covariates.

The time trend which might serve as a proxy for medical progress that is not explained by income growth is also statistically significant. Our estimate suggests that each year HCE increases, on average, by 0.7% to 1.5%, ceteris paribus. However, this estimate should be interpreted with caution, due to identification issues, as discussed above.

There is no significant relationship between mortality and HCE when using the DOLS approach, whereas the MM approach indicates a statistically significant negative relationship. Again, the different results can be due to harmful outliers. The result of the MM estimator may stem from improved access to healthcare and higher-quality medical services, including better management of chronic diseases and emergency situations. These factors reduce the probability of death while simultaneously increasing HCE. Moreover, technological progress may extend individuals' longevity, but many will require assistance and spend their final years in long-term care facilities, further increasing HCE.

Although physician density is positively correlated with healthcare spending – meaning health expenditure increases as the number of physicians rises – the estimate is not statistically significant at the 10% level. However, it becomes significant for the sub-sample period 1976-2022 (Table 4). Furthermore, we find that an increase in the share of the foreigners is associated with higher HCE, but we observe no relationship between our proxy for income inequality (the top 10% share) and healthcare spending.

Moreover, we find that reforms of the healthcare sector may have influenced HCE. According to our full model's estimates, the introduction of the MHI in 1996 is positively associated with HCE. This result may be explained by the fact that the introduction of MHI increased individuals' access to healthcare, increasing the demand for health services. However, the small size of the coefficient suggests only a minor relevance for HCE growth after 1996. On the other hand, the introduction of TARMED and the reform of the IPR are negatively associated with HCE. This may follow from the fact that these reforms enhanced price regulation and transparency, as well as efficiency within the healthcare system, helping to contain cost growth. However, it should also be considered that a major revision of public finance statistics took place in 2008, revising public HCE downwards. As this revision coincides with the IPR reform, part of the effect is likely to be due to the former.

In the Appendix, we run further robustness analyses. First, we include the share of the population with a tertiary education degree, since it may influence HCE and could potentially confound our estimates of interest. We do not include this variable in our main specification in Table 2 due to the lack of educational data for most years prior to 2010, which required linear interpolation. The results are presented in Table A3. We find that the share of the population with higher education is negatively correlated with HCE, i.e., higher educational attainment is associated with lower HCE per capita. This finding is consistent with existing literature (e.g., Raghupathi and Raghupathi, 2020). Second, our results may be influenced by the COVID-19 pandemic, which led to a significant increase in HCE in Switzerland, in particular in 2021.[7] In Table A4 of the Appendix, we exclude the pandemic years (2020, 2021, and 2022) from the sample and find that our estimates remain largely consistent with those from our main specifications.

7 HCE rose by nearly 7% in 2021. In 2022, it increased by a further 2.5%, slightly below the pre-pandemic average growth rate of 3%, but still indicating that HCE has remained on an upward trajectory.

5.2 Public healthcare expenditure

In Table 3, we analyze the impact of the cost determinants on public HCE. Public HCE account, on average, for about 30% of total HCE in Switzerland. This includes contributions to the costs of hospital services and long-term care services (such as home care and nursing homes), as well as funding for the IPR, among others. The cantons play a particularly significant role in managing this expenditure. While similar, the results between total and public HCE also reveal some noteworthy differences.

We find that income growth remains a key determinant, also for HCE covered by the public sector. The estimated income elasticity ranges from 0.9 to 1.3, which is similar – although slightly lower in the lower bound from our full model's specification – to the elasticity observed for total HCE (Table 2). The old-age dependency ratio exhibits a positive relationship with public HCE, with a slightly larger coefficient than in previous estimations in our core specification, and a similar, but noisier, estimate in our full model specifications.

Moreover, our results suggest that Baumol's cost disease has a more pronounced association with public HCE than with total HCE. This finding can likely be attributed to the higher share of the public sector's co-financing of long-term care facilities. Long-term care services are more labor-intensive than other areas of healthcare and therefore benefit less from technology-driven productivity gains. As a result, Baumol's cost disease is particularly accentuated in this sector, leading to a greater impact on public HCE. The more important role of long-term care in public HCE compared to total HCE is also reflected in the lower income elasticity observed in the full model in Table 3 relative to Table 2. This difference likely stems from the fact that the demand for long-term care is less sensitive to income than other types of medical treatment.

We find again that the time trend is positively related to public HCE. We also find a negative relationship between public HCE and the mortality rate. This result is more pronounced for public HCE than for total HCE. A plausible explanation is that as mortality rates among the elderly decline (e.g., because of improved access to healthcare and higher-quality medical services) more individuals may require long-term care. Since cantons and municipalities contribute to the financing of long-term care, this leads to an increase in public HCE.

We do not observe a statistically significant relationship between public HCE and physician density, foreign population or the introduction of the MHI in 1996 in the full specification of the DOLS regression. However, the MM estimation indicates a statistically negative relationship between the introduction of MHI and HCE.[6] The difference between the DOLS and MM approach may be due to the relatively high share of potentially harmful outliers and non-Gaussian distributed data. In our full specification, we also find that TARMED is associated with a reduction in public HCE, suggesting that the introduction of the tariff system has contributed to curbing the growth of public HCE. As in the regressions of Table 2, the proxy for income inequality is not statistically significant.

Table 3: Determinants of public healthcare expenditure

	Public healthcare expenditure			
	DOLS		MM	
	(1)	(2)	(3)	(4)
ln GDP per capita	1.263***	0.941***	1.290***	0.927***
	(0.218)	(0.215)	(0.225)	(0.177)
old-age dependency ratio	2.460***	1.673	2.500***	1.532
	(0.721)	(1.215)	(0.835)	(1.049)
Baumol's cost disease	1.196**	2.113**	1.155**	1.843***
	(0.563)	(0.784)	(0.581)	(0.686)
mortality rate		-0.138***		-0.147***
		(0.051)		(0.037)
physician density		0.060		0.251
		(0.203)		(0.212)
foreign population		0.243		-1.012
		(1.494)		(1.008)
top 10%		-0.015		-0.009
		(0.015)		(0.009)
time trend	0.012***	0.012**	0.012***	0.013***
	(0.004)	(0.005)	(0.004)	(0.004)
MHI	-0.009	-0.038	-0.016	-0.086***
	(0.041)	(0.058)	(0.048)	(0.024)
TARMED	-0.032	-0.115***	-0.035	-0.135***
	(0.025)	(0.037)	(0.027)	(0.037)
revision FS	-0.817***	-0.778***	-0.819***	-0.781***
	(0.025)	(0.035)	(0.032)	(0.031)
hospital reform	-0.035	-0.035	-0.033	0.041
	(0.029)	(0.043)	(0.032)	(0.058)
Observations	61	61	61	61
Share harmful outliers (%)	0.0	0.0	1.6	6.6
Shapiro-Wilk test	0.98	0.97	0.99	0.82***

Notes: This table presents estimates from the DOLS and MM estimators. Public healthcare expenditure and GDP per capita are expressed in natural logarithms. The regressions include a dummy variable to account for the comprehensive revision of the public financial statistics (FS) by the Federal Finance Administration in 2008, including public healthcare expenditure. This dummy coincides with the dummy for the IPR reform (set to 1 starting in 2008) from Table 2. The regressions also include lags and leads of the first differences for all continuous independent variables. Columns 1 and 3 report estimates from the core specification, while columns 2 and 4 present results from the full specification. For further information, see Table 2. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

5.3 Structural break in the mid-1970s

According to the results of the structural-break analysis described in Section 4.3, we perform a sample split and focus on the period after the identified structural breaks, i.e. from 1976 to 2022. Table 4 shows the results on total HCE. The time trend is excluded in these specifications due to its high collinearity with GDP growth and other potential determinants from the mid-1970s and the identification issues discussed in Section 4.[8]

8 Table A5 in the Appendix reproduces Table 4 including the time trend for the sample period 1976–2022. Due to the identification issues discussed previously, the estimates – including a non-significant and negative income elasticity – are rather implausible.

Table 4: Determinants of total healthcare expenditure from 1976 to 2022

	Total healthcare expenditure			
	DOLS		MM	
	(1)	(2)	(3)	(4)
ln GDP per capita	1.842***	0.929***	1.684***	0.970***
	(0.210)	(0.202)	(0.142)	(0.179)
old-age dependency ratio	0.805	0.963	0.555	1.024
	(0.595)	(0.685)	(0.514)	(0.599)
Baumol's cost disease	1.055**	1.645***	1.259***	1.555***
	(0.478)	(0.498)	(0.387)	(0.533)
mortality rate		-0.000		-0.002
		(0.017)		(0.018)
physician density		0.173**		0.163**
		(0.078)		(0.063)
foreign population		2.643***		2.599***
		(0.442)		(0.505)
top 10%		0.013		0.012
		(0.010)		(0.011)
MHI	0.101***	0.046*	0.126***	0.048**
	(0.027)	(0.026)	(0.018)	(0.022)
TARMED	-0.030	-0.041	-0.019	-0.046
	(0.023)	(0.028)	(0.020)	(0.020)
IPR	-0.054**	-0.029	-0.042**	-0.029
	(0.023)	(0.029)	(0.021)	(0.025)
hospital reform	0.021	-0.026	0.025*	-0.023
	(0.013)	(0.016)	(0.015)	(0.015)
Observations	45	45	45	45
Share of harmful outliers (%)	2.2	0.0	4.3	0.0
Shapiro-Wilk test	0.91***	0.96	0.82***	0.94**

Notes: This table presents estimates from the DOLS and MM estimators. Total healthcare expenditure and GDP per capita are expressed in natural logarithms. The regressions also include lags and leads of the first differences for all continuous independent variables. Columns 1 and 3 report estimates from the core specification, while columns 2 and 4 present results from the full specification. The dummy variables along with less degrees of freedom than in the overall sample have made the usage of an initial M-S estimator necessary in the full MM model (Column 4) (Maronna and Yohai, 2000). For further information, see Table 2. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

An important feature of the estimations in Table 4 is that the income elasticity's size is significantly higher in the core model than in the full model according to both estimators. However, the estimates of the core model are likely subject to an omitted variable bias that we address in the full model specification with the inclusion of further confounding variables. We therefore refer only to the full model's results in the following.

For the period 1976–2022, we find an income elasticity of total HCE of about 0.9 to 1.0, which is lower than the estimates of 1.2 to 1.3 from Table 2 over our full sample period (1960–2022). The higher estimates from Table 2 are therefore likely driven by the early years in our sample (1960–1975). The estimates for population ageing have declined in magnitude and become noisier, yet remain positive and around 1.0 (with significance levels approaching 10%), still providing suggestive evidence on the role of population ageing for secular HCE growth.

In Table 4, we find a positive and statistically significant association between Baumol's cost disease and HCE in our reduced sample from 1976 to 2022. This finding likely stems from the fact that the relationship between wages and productivity is relatively stable in the period 1960–1975 (in real terms). Therefore, Baumol's cost disease was not a particularly relevant element in the Swiss economy, since the manufacturing industry had been the most important sector until the early 1970s (Colombier, 2025). In later years, following the growing importance of the service sector, including personal services such as healthcare, the difference between wages and productivity has been increasing continuously. This development suggests a growing importance of Baumol's cost disease, contributing to an increase in HCE as share of GDP.

Turning also to the other covariates, the estimates of the full model suggest that an increasing physician density is associated with a significant increase in HCE from 1976. A possible explanation for this result is the existence of market failures in the healthcare sector which fuel supplier-induced demand. In contrast, we find no further evidence for the negative association between the mortality rate and HCE, suggesting that the estimates from Table 2 are mainly driven by the period 1960-1975. However, confounding effects of population ageing and technological progress could also be biasing our estimates at the macro-level, as the decreasing mortality rate might be fostering the ageing process.

Finally, we find a positive and statistically significant association between the share of foreign population and HCE in Table 4. The coefficient is substantially larger than in Table 2 – a somewhat surprising result, given that the literature highlights that immigrants tend to be healthier and younger than the native population on average (Giuntella and Mazzonna, 2015; Kennedy et al., 2015). However, several confounding factors may be at play. First, by excluding the 1960s and early 1970s, we omit a period marked by a sharp rise in immigration during a phase of economic growth.[9] Therefore, the larger magnitude of our estimates for the period 1976–2022 may result, at least in part, from reduced variation in the explanatory variable, leading to a mechanical increase in the estimated coefficient. Second, we are unable to disentangle demand-side from supply-side effects. The positive coefficient does not necessarily imply that foreigners consume more healthcare services due to different preferences or similar (demand-side); rather, it may reflect concurrent trends, such as the expansion of the healthcare sector and occupations in which foreigners are strongly represented. In fact, due to labor shortages, Switzerland has increasingly attracted foreign healthcare personnel (supply-side).[10] Determining which of these effects are at play remains an open question that warrants further investigation.

9 From the mid-1970 to the mid-1990s, the share of foreigners remained relatively stable at around 14% to 16%. Subsequently, immigration rates began to rise again – a trend that continued following the Agreement on the Free Movement of Persons between Switzerland and the EU in 2002.

10 For instance, 41.3% of physicians currently practicing in Switzerland obtained their medical degrees abroad, up from just 31% in 2014 (FMH, 2025). An increase has also been observed in the share of foreign-trained healthcare personnel beyond physicians, such as nurses and care personnel.

5.4 Decrease in income elasticity

As shown in Table 2, we estimate the income elasticity of HCE over our full sample period ranging between 1.2 and 1.3. This result is relatively high compared to recent empirical findings (Casas et al., 2021; Lorenzoni et al., 2024). However, literature reviews on the topic suggest that studies focusing on more recent periods often report lower income elasticities (Baltagi and Moscone, 2010; Martín et al., 2011). The results from Table 4, starting in 1976, confirm this trend. To investigate this tendency further for Switzerland, we estimate the income elasticity across two sub-periods: 1960-1989 and 1990-2022. Specifically, we include in our regressions a dummy variable equal to one for years from 1990 and zero otherwise – 1(1990-2022) – and interact it with our measure of real GDP per capita. Table 5 summarizes the results.

Table 5: Income elasticity before and after 1990

	Total healthcare expenditure			
	DOLS		**MM**	
	(1)	**(2)**	**(3)**	**(4)**
ln GDP per capita	1.242***	1.175***	1.230***	1.113***
	(0.108)	(0.104)	(0.140)	(0.073)
ln GDP per capita x1(1990–2022)	-0.664***	-0.462**	-0.646***	-0.303**
	(0.151)	(0.179)	(0.171)	(0.122)
1(1990-2022)	7.402***	5.144**	7.201***	3.371**
	(1.673)	(1.981)	(1.900)	(2.503)
Covariates	Core	Full	Core	Full
Observations	61	61	61	61
Share harmful outliers (%)	0.0	0.0	1.6	5.0
Shapiro-Wilk test	0.99	0.98	0.98	0.75***

Notes: This table presents estimates from the DOLS and MM approaches. Total healthcare expenditure and GDP per capita are expressed in natural logarithms. We include a dummy variable equal to 1 for sample years from 1990 onwards, and 0 for all prior years. This dummy has been interacted with the natural logarithm of GDP per capita. The interaction term reflects the income elasticity in the 1990–2022 relative to the 1960–1989 period. A negative value indicates that the income elasticity is lower after 1990 compared to the earlier period of the sample. The regressions also include lags and leads of the first differences for all continuous independent variables. Columns 1 and 3 report estimates from the core specification, while columns 2 and 4 present results from the full specification. Minor variations in the MM estimates may arise from the estimator's sensitivity to small sample sizes. For further information, see Table 2. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

Consistent with empirical evidence, the interaction term in Table 5 shows that the income elasticity of HCE is lower for the 1990–2022 period in comparison to the previous three decades (1960–1989). This result suggests that healthcare spending has become less responsive to income growth in more recent years.

The change in the relationship between income and HCE is associated with an upward level change in HCE for the period 1990–2022, as indicated by the dummy variable 1(1990–2022). This structural shift could be attributed to a range of factors, including technological advancements, policy reforms, demographic changes, and past increases in healthcare costs. Existing literature has also highlighted a non-linear relationship between HCE and GDP, suggesting that as economic development progresses, the growth rate of HCE tends to diminish (e.g. Celik et al., 2023; Ginn, 2024).

While our macro-level analysis cannot disentangle whether the structural shift is driven by supply-side or demand-side factors or a combination of them, it does reveal a relatively weaker relationship between income growth and HCE for Switzerland, at least starting from the mid-1970s. Further research is needed to explore the underlying causes of this trend.

6. Conclusions

This paper examines the determinants of HCE in Switzerland using a time-series analysis from 1960 to 2022. Our findings highlight the combined influence of income growth, population ageing, and Baumol's cost disease on HCE. We find an income elasticity of HCE in the range of 0.9 to 1.3, with slightly lower estimates for public HCE. This impact is likely to be driven by both higher demand for healthcare services from the population and an expansion in the supply of these services due to medical-technological advances. However, our results suggest a weakening of the relationship between income and HCE in more recent decades.

We find that population ageing contributes approximately 15% to HCE growth. We expect the relative importance of ageing to increase in the future, as the "Baby-Boom" generation ages. Our findings also suggest the influence of Baumol's cost disease since the mid-1970s, and in particular for public HCE. This trend is likely driven by the higher importance of long-term care for public HCE, given that it is more labor-intensive than other types of healthcare services, such as outpatient or inpatient hospital treatments. Cantons and municipalities are particularly affected by this dynamic as they are responsible for a share of long-term care costs. By contrast, the federal government is primarily affected by total HCE growth, which translates into higher payments for IPR. These payments also place additional fiscal pressure on the cantons.

The results of this time-series analysis provide a foundation for informing the policy debate on the determinants of HCE. They highlight the need for tailored measures at various levels of government to better manage HCE growth. This is particularly relevant given that HCE is expected to continue rising in the coming decades, as sustained income growth, demographic shifts, and labor shortages are poised to intensify cost pressures. These trends will have implications for both total and public healthcare spending, potentially exacerbating fiscal sustainability challenges in the health sector and public finances overall.

The findings of this analysis provide a tailored evidence base for the HCE projection framework of the Swiss Federal Finance Administration, providing guidance on key assumptions on structural cost drivers. The future outlook emphasizes the pressing need for comprehensive reforms in the healthcare sector. Key policy recommendations include promoting preventive care to enhance population health, identifying and supporting high-risk groups, creating more attractive working conditions to mitigate labor shortages in the health sector, the introduction of cost targets, and critically evaluating the adoption of medical technologies and therapies based on their cost-effectiveness.

References

Baicker, K., S. Mullainathan, and J. Schwartzstein (2015). "Behavioral hazard in health insurance." *The Quarterly Journal of Economics*, 130(4), 1623-1667.

Baltagi, B. H., R. Lagravinese, F. Moscone, and E. Tosetti (2017). "Health care expenditure and income: A global perspective." *Health Economics*, 26(7), 863–874.

Baltagi, B. H., and F. Moscone (2010). "Health care expenditure and income in the OECD reconsidered: Evidence from panel data." *Economic Modelling*, 27(4), 804–811.

Bates, L. J., and R. E. Santerre (2013). "Does the US health care sector suffer from Baumol's cost disease? Evidence from the 50 states." *Journal of Health Economics*, 32(2), 386–391.

Baumol, W. J. (1967). "Macroeconomics of unbalanced growth: the anatomy of urban crisis." *The American Economic Review*, 57(3), 415–426.

Brändle T. and C. Colombier (2016). "What drives public health care expenditure growth? Evidence from Swiss cantons, 1970–2012." *Health Policy*, 120(9), 1051–1060.

Brändle, T., and C. Colombier (2017). "Healthcare expenditure projections up to 2045." FFA Working Paper No. 21, Federal Finance Administration, Berne.

Brändle T. and C. Colombier (2022). "Healthcare expenditure projections up to 2050: Ageing and the COVID-19 crisis." Federal Finance Administration Working Paper No. 25, Berne.

Breyer, F., N. Lorenz, and T. Niebel. (2015). "Health care expenditures and longevity: Is there a Eubie Blake effect?" *The European Journal of Health Economics*, 16, 95–112.

Breyer, F., and N. Lorenz, (2021). "The "red herring" after 20 years: ageing and health care expenditures." *The European Journal of Health Economics*, 22, 661–667.

Cantoni, E., and E. Ronchetti (2006). "A robust approach for skewed and heavy-tailed outcomes in the analysis of health care expenditures." *Journal of Health Economics*, 25(2), 198–213.

Casas, I., J. Gao, B. Peng, and S. Xie (2021). "Time-varying income elasticities of healthcare expenditure for the OECD and Eurozone." *Journal of Applied Econometrics*, 36(3), 328–345.

Celik, E. U., T. Omay, and D. Tengilimoglu (2023). Convergence of economic growth and health expenditures in OECD countries: Evidence from non-linear unit root tests. *Frontiers in Public Health*, 11, 1125968.

Chernew, M. E., and J. P. Newhouse (2011). "Health care spending growth." *In Handbook of Health Economics* (Vol. 2, pp. 1–43). Elsevier.

Clemente, J., C. Marcuiello, A. Montanes, and F. Pueyo (2004). "On the international stability of health care expenditure functions: are government and private functions similar?" *Journal of Health Economics*, 23, 589–613.

Colombier, C. (2017). "Drivers of healthcare expenditure: what role does Baumol's cost disease play?" *Social Science Quarterly* 98(5), 1603–1621.

Colombier, C. (2018). "Population ageing in healthcare–a minor issue? Evidence from Switzerland." *Applied Economics*, 50(15), 1746–1760.

Colombier, C. (2023). "Reflections on the development of relative prices in the healthcare sector." FFA Note, Federal Finance Administration, Bern.

Colombier, C. (2025). "Die Entwicklung der Arbeitsproduktivität in der Schweiz: Stabilisierung seit den 1970er-Jahren." FFA Note, Federal Finance Administration, Bern.

Colombier, C., and W. Weber (2011). "Projecting health-care expenditure for Switzerland: further evidence against the 'red-herring' hypothesis." *The International Journal of Health Planning and Management*, 26(3), 246–263.

Costa-Font, J., M. Gemmill, and G. Rubert (2011). "Biases in the healthcare luxury good hypothesis? A meta-regression analysis." *Journal of the Royal Statistical Society Series A: Statistics in Society*, 174(1), 95–107.

Costa-Font, J., and C. Vilaplana-Prieto (2020). "More than one red herring'? Heterogeneous effects of ageing on health care utilisation." *Health Economics*, 29, 8–29.

Crivelli, L., M. Filippini, and I. Mosca (2006). "Federalism and regional health care expenditures: an empirical analysis for the Swiss cantons." *Health economics*, 15(5), 535–541.

De la Maisonneuve, C., R. Morino-Serra, F. Murtin, J. Oliveira Martins (2017). "The role of policy and institutions on health spending." *Health Economics*, 26(7), 834–843.

Di Matteo, L. (2005). "The macro determinants of health expenditure in the United States and Canada: assessing the impact of income, age distribution and time." *Health Policy*, 71, 23–42.

Dreger, C., and H.-E. Reimers (2005). "Health care expenditures in OECD countries: A panel unit root and cointegration analysis." *International Journal of Applied Econometrics and Quantitative Studies*, 2(2), 5–19.

Elliot, G., Rothenberg, T.J., Stock, J.H. (1996). "Efficient tests for an autoregressive unit root", *Econometrica*, 64(4), 813–836.

European Commission (2024). "2024 Ageing Report. Economic and Budgetary Projections for the EU Member States (2022-2070)." Institutional Paper 279, April 2024. Brussels.

Fletcher, J. M., and D.E. Frisvold (2009). "Higher education and health investments: Does more schooling affect preventive health care use?" *Journal of Human Capital*, 3(2), 144–176.

Franses, P. H., and N. Haldrup (1994). "The effects of additive outliers on tests for unit roots and cointegration." *Journal of Business and Economics Statistics*, 12(4), 471–478.

Federal Department of Finance, FDF (2024). "Fiscal sustainability report for Switzerland: Ageing and net zero target." Bern, 23. April 2024.

Federal Statistical Office, FSO (2025a). "Health care costs up 2.4% in 2023." Neuchâtel, April 2025.

Federal Statistical Office, FSO (2025b). "Population projections." Neuchâtel, April 2025.

Gerdtham, U. G., J. Sogaard, F. Andersson, and B. Jonsson (1992). "An econometric analysis of health care expenditure: A cross-section study of the OECD countries." *Journal of Health Economics*, 11, 63–84.

Gerdtham, U.-G., and M. Löthgren (2000). "On stationarity and cointegration of international health expenditure and GDP." *Journal of Health Economics* 19(4), 461–475.

Giannoni, M. and T. Hitiris, (2002). "The regional impact of health care expenditure: the case of Italy." *Applied Economics*, 34, 1829–36.

Ginn, W. (2024). "Healthcare expenditures and economic growth: evidence via panel local projections." *The European Journal of Health Economics*, 1–16.

Giuntella, O., and F. Mazzonna (2015). "Do immigrants improve the health of natives?" Journal of Health Economics, 43, 140–153.

Gregersen, F. A. (2014). "The impact of ageing on health care expenditures: a study of steepening." *The European Journal of Health Economics*, 15(9), 979–989.

Hartwig, J. (2008). "What drives health care expenditure? Baumol's model of unbalanced growth revisited." *Journal of Health Economics*, 27(3), 603–623.

Hartwig, J., and J.-E. Sturm (2014). "Robust determinants of health care expenditure growth." *Applied Economics*, 46(36): 4455–4474.

Hubert, M., Rousseeuw, P.J., and Van Aelst, S. (2008). "High breakdown robust multivariate methods." *Statistical Science*, 23(1), 92–119.

Kennedy, S., M. P. Kidd, J. T. McDonald, and N. Biddle (2015). "The healthy immigrant effect: patterns and evidence from four countries." *Journal of International Migration and Integration*, 16, 317–332.

Léonard, C., S. Stordeur, and D. Roberfroid (2009). "Association between physician density and health care consumption: a systematic review of the evidence." *Health Policy*, 91(2), 121–134.

Lorenzoni, L., P. de Biase and S. Dougherty (2024). "Long-term projections: Different paths to fiscal sustainability of health systems", in OECD, Fiscal Sustainability of Health Systems: How to Finance More Resilient Health Systems When Money Is Tight?, OECD Publishing, Paris, https://doi.org/10.1787/880f3195-en.

Lumley T. and P. Heagerty (1999). "Weighted Empirical Adaptive Variance Estimators for Correlated Data Regression." *Journal of the Royal Statistical Society B*, 61, 459–477.

Maronna, R. A., and V. J. Yohai. (2000). "Robust regression with both continuous and categorical predictors." *Journal of Statistical Planning and Inference* 89: 197–214.

Marino, A., and L. Lorenzoni (2019). "The impact of technological advancements on health spending: A literature review." OECD Publishing, Paris.

Marino, A., D. Morgan, L. Lorenzoni, and C. James (2017). "Future trends in health care expenditure: A modelling framework for cross-country forecasts." OECD Publishing, Paris, https://doi.org/10.1787/247995bb-en.

Martín, J. J. M., M. Puerto Lopez del Amo Gonzalez, and M. Dolores Cano Garcia (2011). "Review of the literature on the determinants of healthcare expenditure." *Applied Economics*, 43(1), 19–46.

Mergele L., B. Kaiser, D. Wehrli, T. Schönleitner, R. Föllmi und M. Siegenthaler (2024). "Die langfristige Entwicklung von Arbeit, Freizeit und Produktivität in der Schweiz". Grundlagen für die Wirtschaftspolitik Nr. 45. Staatssekretariat für Wirtschaft SECO, Bern.

Milkovska E., P. van Baal, and B. Wouterse (2024). "Slicing the red herring two ways: Changes in costs in the last years of life by disease and over time." Mimeo.

Narayan, P. K. (2005). "The saving and investment nexus for China: evidence form cointegration tests." *Applied Economics*, 37(17), 1979–1990.

Newhouse, J. P. (1977). "Medical-care expenditure: A cross-national survey." *Journal of Human Resources*, 12(1), 115–125.

Newhouse, J. P. (1992). "Medical care costs: How much welfare loss?" *Journal of Economic Perspectives*, 6(3), 3–21.

Nghiem, S. H., and L. B. Connelly (2017). "Convergence and determinants of health expenditures in OECD countries." *Health Economics Review*, 7, 1–11.

OECD (2025), OECD Data Explorer. Accessed 01.04.2025.

Okunade, A. A., and V. N. R. Murthy (2002). "Technology as a 'major driver' of health care costs: A cointegration analysis of the Newhouse conjecture." *Journal of Health Economics*, 21, 147–159.

Panczak, R., X. Luta, M. Maessen, A. E. Stuck, C. Berlin, K. Schmidlin, and K. M. Clough-Gorr (2017). Regional variation of cost of care in the last 12 months of life in Switzerland: small-area analysis using insurance claims data. *Medical Care*, 55(2), 155–163.

Pesaran, M. H., Y. Shin, and R. J. Smith (2001). "Boundstesting approaches to the analysis of level relationships." *Journal of Applied Econometrics*, 16(3), 289–326.

Raghupathi, V., and W. Raghupathi (2020). "The influence of education on health: an empirical assessment of OECD countries for the period 1995–2015." *Archives of Public Health*, 78, 1–18.

Reich, O., C. Weins, C. Schusterschitz, and M. Thöni (2012). "Exploring the disparities of regional health care expenditures in Switzerland: some empirical evidence." *The European Journal of Health Economics*, 13, 193–202.

Saikkonen, P. (1991). "Asymptotically efficient estimation of cointegration regressions." *Econometric Theory*, 7(1): 1–21.

Sarría-Santamera, A., A. I. Hijas-Gómez, R. Carmona, and L. A. Gimeno-Feliú (2016). "A systematic review of the use of health services by immigrants and native populations." *Public Health Reviews*, 37, 1–29.

Seshamani, M., and A. M. Gray (2004). "A longitudinal study of the effects of age and time to death on hospital costs." *Journal of Health Economics*, 23(2), 217–235.

Smith, S., J. P. Newhouse, and M. S. Freeland (2009). "Income, insurance, and technology: why does health spending outpace economic growth?" *Health Affairs*, 28(5), 1276–1284.

Swiss Medical Association, FMH (2025). "FMH-Ärztestatistik 2024: Engpass in der Grundversorgung akzentuiert sich." Medienmitteilung, Bern, 26. March 2025.

Temple, J. (2000). "Growth regressions and what the textbooks don't tell you." *Bulletin of Economic Research*, 52(3), 181–205.

van Baal, P. H., and A. Wong (2012). "Time to death and the forecasting of macro-level health care expenditures: some further considerations." *Journal of Health Economics*, 31(6), 876–887.

Werblow, A., S. Felder, and P. Zweifel (2007). "Population ageing and health care expenditure: a school of 'red herrings'?" *Health Economics*, 16(10), 1109–1126.

Zaman, A., P. J. Rousseeuw, and M. Orhan (2001). "Econometric applications of high-breakdown-robust regression techniques." *Economics Letters*, 71(1), 1–8.

Zweifel, P., S. Felder, and M. Meiers (1999). "Ageing of population and health care expenditure: a red herring?" *Health Economics*, 8(6), 485-496.

Appendix

Table A1: Unit-root tests

Tested variable	Levels I(0)	First-differences I(1)
ln HCE per capita	-1.075	-3.284**
ln public HCE per capita	-0.894	-4.443***
ln GDP per capita	-1.549	-4.829***
old-age dependency ratio	-2.426	-3.687***
Baumol's cost disease	-4.205***	–
mortality rate	-2.060	-5.629***
physician density	-2.125	-4.504***
foreign population	-2.518	-4.236***
top 10%	-2.571	-4.863***
tertiary education	-0.238	-7.472***

Notes: Elliott, Rothenberg and Stock (1996) is used to test the variables for a unit root; H0: unit root; DF-GLS statistic is reported. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

Table A2: Cointegration tests

Model	ln total HCE per capita	ln public HCE per capita
OLS core	7.74***	25.37***
OLS full	5.94***	14.27***
MM core	8.14***	15.23***
MM full	5.70***	6.39***

Notes: Bounds-testing procedure by Pesaran et al. (2001) using the small-sample correction by Narayan et al. (2005); H0: no cointegration, F-statistic. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

Table A3: Determinants of healthcare expenditure including educational attainment

	Total and public healthcare expenditure			
	DOLS		MM	
	Total HCE	Public HCE	Total HCE	Public HCE
	(1)	(2)	(3)	(4)
ln GDP per capita	1.041***	0.535**	0.940***	0.810***
	(0.121)	(0.233)	(0.077)	(0.209)
old-age dependency ratio	2.223***	2.554**	2.204***	3.291***
	(0.428)	(1.182)	(0.286)	(1.117)
Baumol's cost disease	0.603	2.174**	0.559**	1.838**
	(0.433)	(0.820)	(0.283)	(0.768)
mortality rate	0.011	-0.021	-0.077**	0.051
	(0.027)	(0.060)	(0.033)	(0.050)
physician density	0.107*	0.044	-0.002	0.238
	(0.054)	(0.162)	(0.050)	(0.151)
foreign population	1.808***	2.617	2.698***	3.878**
	(0.598)	(1.630)	(0.584)	(1.672)
top 10%	-0.001	-0.016	-0.007*	-0.025**
	(0.006)	(0.014)	(0.004)	(0.011)
tertiary education	-1.221***	-2.848***	-2.354***	-3.725***
	(0.389)	(0.843)	(0.465)	(0.651)
time trend	0.013***	0.027***	0.018***	0.024***
	(0.003)	(0.006)	(0.002)	(0.006)
MHI	0.042**	-0.037	0.030*	-0.026
	(0.018)	(0.041)	(0.017)	(0.035)
TARMED	-0.054*	-0.005	-0.094***	0.014
	(0.030)	(0.043)	(0.023)	(0.035)
IPR / revision FS	-0.039*	-0.724***	-0.018	-0.686***
	(0.022)	(0.048)	(0.013)	(0.045)
hospital reform	0.002	-0.031	0.017	0.017
	(0.016)	(0.048)	(0.010)	(0.005)
Observations	61	61	61	61
Share harmful outliers (%)	0.0	0.0	4.9	3.3
Shapiro-Wilk test	0.99	0.99	0.49***	0.67***

Notes: This table presents estimates from the DOLS and MM estimators. Total healthcare expenditure and public healthcare expenditure (dependent variables) and GDP per capita are expressed in natural logarithms. The regressions also include lags and leads of the first differences for all continuous independent variables. Columns 1 and 3 report estimates from the full specification on total healthcare expenditure, while columns 2 and 4 present results from the full specification on public healthcare expenditure. Minor variations in the MM estimates may arise from the estimator's sensitivity to small sample sizes. For further information, see Table 2. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

Table A4: Determinants of total healthcare expenditure excluding COVID-19 years

	Total healthcare expenditure			
	DOLS		MM	
	(1)	(2)	(3)	(4)
ln GDP per capita	1.189***	1.230***	1.278***	1.191***
	(0.115)	(0.129)	(0.190)	(0.117)
old-age dependency ratio	1.954***	2.006***	1.747***	1.931***
	(0.261)	(0.418)	(0.401)	(0.462)
Baumol's cost disease	-0.577	0.574	-0.560	0.163
	(0.466)	(0.449)	(0.621)	(0.330)
mortality rate		0.057		-0.047*
		(0.047)		(0.025)
physician density		0.133*		0.075
		(0.068)		(0.009)
foreign population		1.035**		0.534
		(0.491)		(0.451)
top 10%		0.003		0.002
		(0.006)		(0.007)
time trend	0.016***	0.008**	0.015***	0.010***
	(0.002)	(0.003)	(0.004)	(0.003)
MHI	0.007	0.042**	0.022	0.024
	(0.019)	(0.020)	(0.029)	(0.017)
TARMED	-0.075***	-0.057	-0.071*	-0.060***
	(0.025)	(0.033)	(0.039)	(0.022)
IPR	-0.097***	-0.054**	-0.097**	-0.129***
	(0.026)	(0.023)	(0.040)	(0.030)
hospital reform	-0.000	-0.011	0.001	0.006
	(0.014)	(0.018)	(0.021)	(0.013)
Observations	58	58	58	58

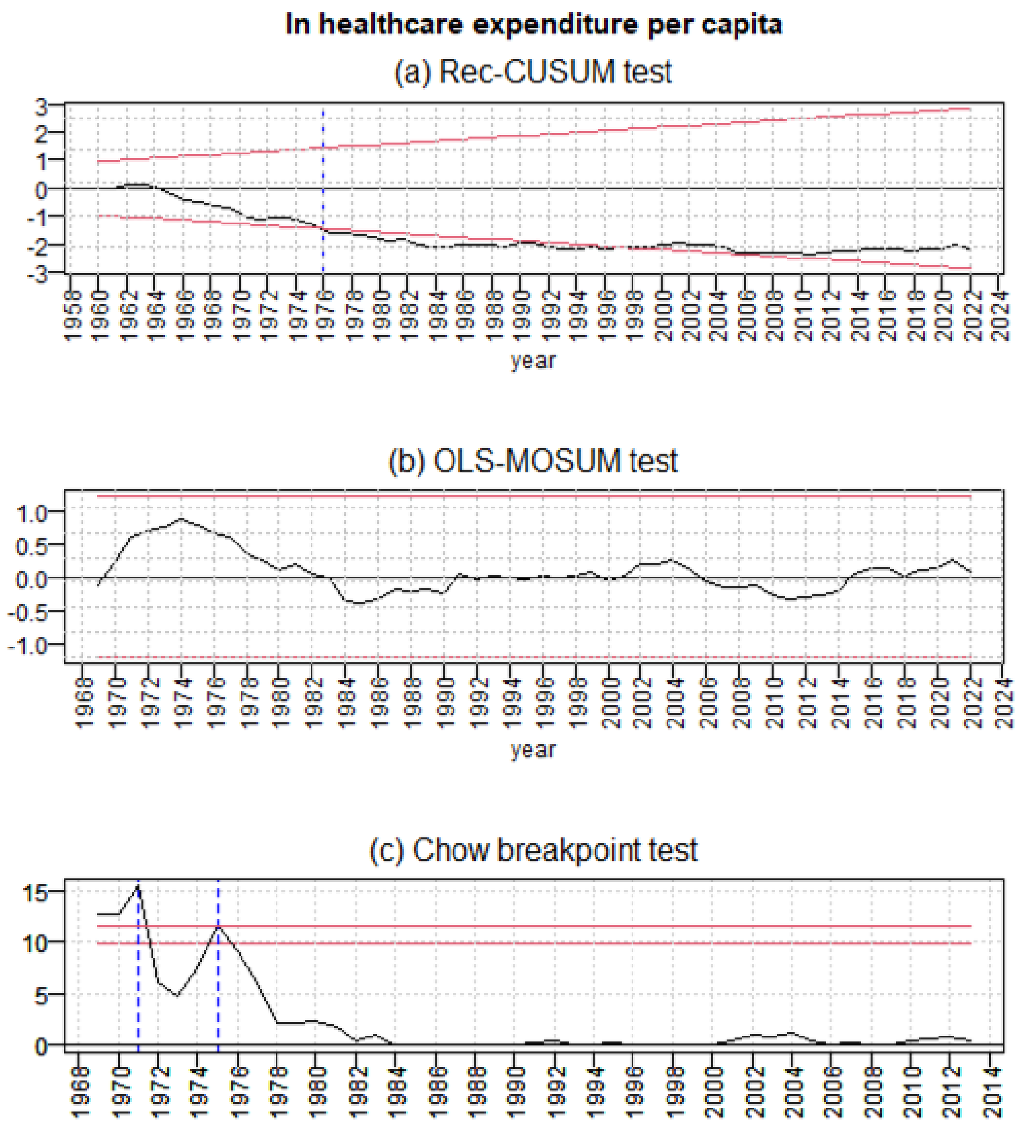
Notes: This table presents estimates from the DOLS and MM estimators. Total healthcare expenditure and GDP per capita are expressed in natural logarithms. Regressions are computed excluding the COVID-19 pandemic years (2020-2022). The regressions also include lags and leads of the first differences for all continuous independent variables. Columns 1 and 3 report estimates from the core specification, while columns 2 and 4 present results from the full specification. Minor variations in the MM estimates may arise from the estimator's sensitivity to small sample sizes. For further information, see Table 2. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

Table A5: Determinants of total healthcare expenditure from 1976 to 2022 (including time trend)

	Total healthcare expenditure			
	DOLS		MM	
	(1)	(2)	(3)	(4)
ln GDP per capita	0.111	-0.372	0.208	-0.354
	(0.270)	(0.311)	(0.223)	(0.289)
old-age dependency ratio	-0.847*	-1.551**	-0.666	-1.543**
	(0.452)	(0.613)	(0.432)	(0.633)
Baumol's cost disease	0.270	0.906***	0.515	0.903**
	(0.369)	(0.300)	(0.300)	(0.359)
mortality rate		-0.021*		-0.021*
		(0.011)		(0.011)
physician density		0.131**		0.130***
		(0.051)		(0.043)
foreign population		0.632		0.647
		(0.449)		(0.460)
top 10%		-0.006		-0.007
		(0.007)		(0.008)
Time trend	0.023***	0.025***	0.021***	0.024***
	(0.003)	(0.005)	(0.002)	(0.004)
MHI	0.053***	0.032	0.065***	0.034**
	(0.017)	(0.019)	(0.014)	(0.017)
TARMED	-0.018	-0.019	-0.015	-0.019
	(0.017)	(0.018)	(0.020)	(0.019)
IPR	-0.040**	0.001	-0.053***	0.001
	(0.019)	(0.015)	(0.015)	(0.016)
hospital reform	-0.003	-0.028***	0.004	-0.027***
	(0.010)	(0.009)	(0.008)	(0.008)
Observations	45	45	45	45
Share of harmful outliers (%)	0.0	0.0	6.5	0.0
Shapiro-Wilk test	0.96	0.97	0.88***	0.96

Notes: This table presents estimates from the DOLS and MM estimators. Total healthcare expenditure and GDP per capita are expressed in natural logarithms. The regressions also include lags and leads of the first differences for all continuous independent variables. Columns 1 and 3 report estimates from the core specification, while columns 2 and 4 present results from the full specification. The dummy variables and the smaller amount of degrees of freedom than in the overall sample have made the usage of an initial M-S estimator necessary in the full MM model (Column 4) (Maronna and Yohai, 2000). For further information, see Table 2. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

Figure A1: Structural break tests



Notes: Red lines show the 95%-confidence interval in Panels (a) and (b). The Chow breakpoint test is used as an F-test for unknown structural breaks. The critical values of the Chow-(F-)statistic at the 5%- (upper red line) and 10%-significance level (lower red line) are shown in Panel (c). As HCE follows an AR(1)-process, we test the following equation: ln(HCEt)=α+βln(HCEt-1)+et with et being the error term. Both, the Rec-CUSUM test (S-statistic: 1.171***), Panel (a), and the Chow breakpoint test (Chow supF-statistic: 15.512***), Panel (b), reject the H0 of no structural break at the 5% significance level. The Rec-CUSUM test detects a structural break in 1976 and the Chow breakpoint test in 1971 and 1975. The second breakpoint is almost rejected at the 5%-level. In contrast the OLS-MOSUM test (Panel (a)) does not reject the H0 of no structural break (MO-statistic: 0.882).