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Heterogeneity in The drivers of health expenditures financed by health insurance in a fragmented health system: The case of Switzerland

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ABSTRACT

Switzerland is the world's second largest spender on health care, both per capita and as a share of the Gross Domestic Product (GDP). The Swiss health care system is a federation of 26 cantonal systems with highly fragmented provision and financing of care, leading to important geographical disparities in expenditures. We propose a simple conceptual framework to guide the decomposition of health care expenditures into five core components (i.e. demography, propensity to use health services, substitution between domains of care, quantity of services delivered, and unit price of these services), with the objective of better understanding the drivers of geographic variation. We illustrate this framework using aggregated insurance data from 85 % of the 2006 insured population and measure cross-cantonal variation disaggregated into these five components. Results obtained indicated a West-East gradient of controllable costs after adjusting for demography and propensity to use health services. Moreover, we found specific explanations for cost overruns: visits to physicians in private practice in some cantons, and, e.g., outpatient hospital care or variations in drug related expenses in others. This shows that the simple proposed approach provides interesting insights into the drivers of cost differences between regions, specifically in terms of substitution among health services, quantity of delivered services, and their prices.

1. Introduction

In Switzerland, health care expenditures per capita and as a share of GDP is among the highest in developed countries [1]. Despite the recognition of the quality of care provided in Switzerland, evidence suggests that several countries achieve similar outcomes at a lower cost [2]. The aim of this paper is to propose an innovative analysis method for cost containment, taking advantage of regional disparities of health care costs.

In the last decades, many econometric studies have analyzed the drivers of health expenditures using either cross sectional regression (first-generation studies) or panel data regression (second-generation studies) methods [3]. Those studies focused on the impact of several covariates on health expenditures (e.g. GDP, age, gender, doctors' density, in-patient share of costs, urbanization, territorial decentralization). However, results obtained by these different studies were quite heterogeneous and some methodological issues can be pointed out. [4]. First, the small sample sizes used in these studies (26 cantons in Swiss comparisons; less than 100 countries in international comparisons) limited the identification of the model when too many explanatory variables were introduced. Second, regression methods that were used are often plagued by endogeneity (i.e. correlation between one or more explanatory variables and the error term) and/or stationarity (i.e. non-independence of observations over time) issues. Finally, all these studies analyzed health care expenditures globally, whereas some authors argued that the effect of institutional factors on quantities and prices should be analyzed separately [3].

Such decomposition of total health care expenditures into meaningful components brings valuable insights that one could miss otherwise (i.e. analyzing the overall amount might hide large differences in some components). For instance, Schleiniger [5] decomposed total health care expenditures in Switzerland into price and quantity and found that increases were predominantly quantity-driven. Another interesting attempt to break down costs has shown the benefit of stratifying according to health care utilization, in addition to quantities and prices [6].

In this paper, we build up on these studies by proposing a third-generation analysis model, which decomposes total health costs into five intrinsic components: the demographic structure of the

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population, its propensity to use health care services, the volume and price of services, as well as the type of services/domains of care (e.g. outpatient vs. inpatient care). The demographic component corresponds to an adjustment for an exogenous factor, difficult to modify. The propensity to use health services might be amenable by medium-term policies, while the three others (volume, price, substitution among domains of care) could be addressed in a shorter time lapse. Notice that this decomposition could then be completed by cross-sectional or panel regression methods to analyze the effect of a limited number of extrinsic environmental variables (urban-rural, socio-economic status, etc.) on the different components listed above.

We apply this decomposition model on Swiss health insurance data to illustrate the value of this approach for inter-cantonal cost comparisons. The Swiss context is interesting because it is a federal state, giving its cantons a great autonomy to manage their health system. Health insurance is mandatory since 1996 and several private nonprofit insurers are authorized to fix their premiums at the cantonal level [7]. Nevertheless, the Federal authority controls that these premiums reflect insurers' costs [8]. Subsidies to persons with low income to pay their insurance premium vary strongly among cantons [9]. Moreover, if the physicians' density in certain specialties is too high, cantons are allowed to limit the number of physicians reimbursed through the compulsory scheme of health insurance [10].

The main decisions regarding the organization of health care – and in particular, the planning and provision of inpatient care – depends on 26 cantons and semi-cantons (the confederation's contribution is only 20 % of the public health care budget). Most tariff structures are standardized across the country (SwissDRGs, TarMed, drugs' prices) but unit prices may differ significantly from one canton to the other.

Our study aims to show how our proposed costs' decomposition model apply with a small number of regions (26 Swiss cantons), in the context of a complex and fragmented structure of the health system. It might also motivate to collect representative data allowing to update the results in Switzerland and to generalize the approach for international comparisons of health costs.

2. Materials and methods

2.1. Setting

The setting include all compulsory health insurance reimbursements made by health insurers under the Swiss health insurance law (LAMal) in 2006, which represented 35 % of the total health care expenditures in the country. The remaining 65 % was mainly financed out-of-pocket (32 %), by State (federal, cantonal and communal levels, 17 %) and private insurers (9 %) [11]. These other parts were excluded because data were either partially (only inpatients for cantonal part) or totally (out-of-pocket, private insurers) missing. Although we did not work with total health care expenditures, we assumed the insurers' share to be constant across each domains of care (and, thus, representative of the total health care expenses), except for inpatient, where they represented about 45 % of total costs. Nevertheless, since the analysis was stratified for in- and outpatients, this should not alter the validity of the comparisons.

We use a rich dataset collected for risk adjustment purposes by the Swiss health insurers association (santesuisse, "Daten pool") that covers 97.8 % of the insured population. A large subset of this data was complemented by more detailed information ("Tariff pool") provided by insurers on a voluntary basis about type of provider (medical specialty, somatic or psychiatric hospital, laboratories, etc.), nature of the services (visits, drugs, material, etc.), quantities (number of hospital days, number of visits, number of nursing home days, etc.), and reimbursements (Swiss francs). Ultimately, our dataset represents expenditures for 85 % of the 2006 Swiss population, a significantly higher proportion than available data during the following years (about 60 %, including recent years). Other sources of data, especially hospital and nursing home statistics were used to cross-validate the propensity rates to use those services by age and gender.

2.2. Decomposition framework

The method we developed in this paper was inspired by the flexible budgeting method – sometimes also called "variance analysis" –, which has been proved for long to be an adequate tool for analyzing complex health care production processes [12–14]. This approach uses reference values (budget or standards) to analyze cost differences, for instance using observed and reference quantities (q_1 and q_0 respectively) and observed and reference prices (p_1 and p_0 respectively). The difference in costs = $q_1\ p_1 - q_0\ p_0$ is equal to $q_1\ p_1 - q_1\ p_0 + q_1\ p_0 - q_0\ p_0$, which is equivalent to $q_1\ (p_1 - p_0) + p_0\ (q_1 - q_0)$. The first term expresses the impact of price differences and the second term reflects the impact of quantity differences. Initially, this method was developed for cost accounting in an industrial context, but nothing prohibits extending its use for the comparison of public services or regions. Reference values often results from a budgeting process, but might also correspond to historic values, average values, norms, expected values from prediction models, or from a benchmark for instance. Here, we propose to consider the average Swiss values as the reference points to compare observed cantonal costs and generalize the method to a two dimensional framework (i.e. with the number of patients on the X-axis and per patient' costs on the Y-axis).

The starting point of our framework is to multiply per patient expenditures in various domains of care (i.e. outpatient, inpatient, etc.) by the number of patients in each domain of care. The domains of care include a range of service types (i.e. type of specialist visit). First, we define expenditures per patient (exp_k) in the domain of care k as the quantity of service type used multiplied by the cost of each unit of service (e.g. visit, days, etc.), summed over all service types:

$$exp_k = \Sigma_j q_{jk*} c_{jk},$$

where q_{jk} is the quantity of service type *j*, in domain k, used per patient, and c_{jk} is the unit price of service type *j*, in domain k. We then define the number of patients in care domain k as the propensity to use services of domain k, which varies at the demographic-group level, multiplied by the size of the corresponding demographic group i:

$$n_k = \Sigma_i d_{i*} p_{ik},$$

where d_i is the number of individuals in the demographic group i and p_{ik} the proportion of individuals of demographic group i with at least one service type used in the domain of care k. Finally, per patient expenditures are multiplied by the number of patients in the corresponding groups, and summed over all domains of care to obtain total health expenditures:

$$tot\_exp = \Sigma_k exp_k n_k = \Sigma_k t_k \Sigma_i \Sigma j \Sigma_k d_{i*} p_{ik*} q_{jk*} c_{jk}$$

We add the term $\Sigma_k t_k$, where t_k is the proportion of total costs attributable to the domain of care k, to capture the relative importance of each domain of care k in our decomposition.

As our objective is to assess geographical variation in health expenditures, we need to define a reference region from which all differences are calculated. By construction, each component is independent from each other, therefore allowing us to produce a simple graphical representation of the decomposition. Fig. 1 illus-

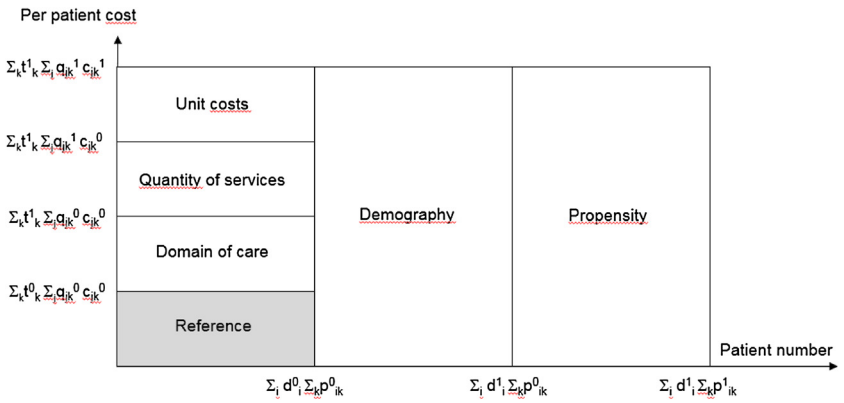

Fig. 1. Cost variance analysis.

trates the analysis for a region ("region 1″) in which all components of health care expenditures are larger than in the reference region ("region 0″) (i.e. higher price, higher quantity, more expensive type of service used, and an unfavorable demographic structure composed of people having a higher propensity to ask for health care services and containing a higher proportion of old people). The largest area corresponds to total health care expenditures for region 1 and the small one (grey colored) to expenditures in the reference region 0. The difference between these two areas is the sum of five components:

- Domain of care: $\Delta R_k = \Sigma_i \Sigma_j \Sigma_k\, d^0{}_i\, p^0{}_{ik}\, (t^1{}_k - t^0{}_k)\, q^0{}_{jk}\, c^0{}_{jk}$
- Quantity of services: $\Delta R_q = \Sigma_i \Sigma_j \Sigma_k\, d^0{}_i\, p^0{}_{ik}\, t^1{}_k\, (q^1{}_{jk} - q^0{}_{jk})\, c^0{}_{jk}$
- Unit costs: $\Sigma_i \Sigma_j \Sigma_k\, d^0{}_i\, p^0{}_{ik}\, t^1{}_k\, q^1{}_{jk}\, (c^1{}_{jk} - c^0{}_{jk})$
- Demography: $\Delta R_d = \Sigma_i \Sigma_j \Sigma_k\, (d^1{}_i - d^0{}_i)\, p^0{}_{ik}\, t^1{}_k\, q^1{}_{jk}\, c^1{}_{jk}$
- Propensity: $\Delta R_p = \Sigma_i \Sigma_j \Sigma_k\, d^1{}_i\, (p^1{}_{ik} - p^0{}_{ik})\, t^1{}_k\, q^1{}_{jk}\, c^1{}_{jk}$

The area for domain of care represents additional costs induced by a higher proportion of more expensive care domains used on the Y-axis, multiplied by the number of patients in that care domain ($\Sigma_i \Sigma_k\, d^0{}_i\, p^0{}_{ik}$) on the X-axis. The same logic applies to quantity of services and unit costs areas. The demographic area reflects additional expenses attributable to a higher proportion of patients belonging to the costly age and gender categories. Finally, the propensity area represents additional costs explained by more patients with a high propensity of using care in specific domains. For instance, if a region has more residents living in nursing homes, the financial impact of the propensity component would correspond to the number of supplementary nursing homes residents multiplied by the mean cost of each resident observed in this region. One can simply demonstrate that the sum of the five areas is equal to the difference in expenditures between the two regions:

$$\Delta R = \Sigma_i \Sigma_j \Sigma_k d^1{}_i p^1{}_{ik} t^1{}_k q^1{}_j c^1{}_j - \Sigma_i \Sigma_j \Sigma_k d^0{}_i p^0{}_{ik} t^0{}_k q^0{}_j c^0{}_j$$
$$= \Delta R_d + \Delta R_p + \Delta R_t + \Delta R_q + \Delta R_c.$$

This algebraic equality is more meaningful than the graphical representation as regions often have positive and negative differences in the various components, which are difficult to represent graphically.

2.3. Data

As we were not allowed to analyze patient-level data, the Swiss Health Observatory processed the data and aggregated the information at the canton level on reimbursement prices and quantities in each domain of care and service types listed in Appendix A. We measured the quantities of visits to physicians in private practice and ambulatory hospital care, packages for medications and invoices for other ambulatory services; length of stay were used to quantify inpatient care (long term or acute care).

We then implemented the framework using this data as well as demographic information at the canton level. Specifically, in each canton (see list in Appendix B) we calculated the weight of each domain of care k as a proportion of total expenditures. For each service *j*, we then calculated the quantity of service per insured, as well as the reimbursement prices (reimbursement divided by the quantity of service). The propensity of using care in the six domains of care was defined as the proportion of individuals from demographic class i (gender-age, with five years intervals) with at least one service used in domain of care k. Finally, we stratified our dataset by canton, age, and gender, according to data published by the Swiss Federal Statistical Office and calculated the number of individuals in each demographic class i (five years intervals and gender). In our applied example below, the reference region is built using the mean value of each component.

2.4. Policy

This framework aims at facilitating screening of health policies that could be implemented to reduce variation in health care expenditures in a structured and systematic way. In particular, it can highlight the mechanisms generating high costs as well as the relative impact of each cost driver in the various regions. If the main cost driver in a canton is, e.g., unit costs, then the policy focus should be on tariff negotiations, such as outpatient or hospital fees, drug prices, or nursing home per day prices. If the volume of services is identified as of primary importance, policies aiming at limiting inappropriate interventions could then be favored by setting up global budgets [15], strengthening gatekeeping, or by limiting reimbursement of specific services. If the gap is primarily due to the type of services used, appropriate financial incentives might be set to promote the most efficient care setting (e.g. outpatient vs. inpatient, home-based vs. institutionalized care). While these first three components are clearly amenable to short- and medium-term policy changes, the demographic component is not. Nevertheless, it is central to adjust for age structure to compare different regions or cantons. As for the propensity to use health services, it is also somewhat contextual, as it may reflect cultural behavior, but it might also be influenced by health policies, for instance by using financial (e.g. co-payments), and non-financial (e.g. information, opening hours) instruments.

Moreover, the decomposition of cost differences might constitute a basis to build a cost-containment strategy. This latter can either take the form of concerted global (i.e. federal) policies to tackle issues shared by several cantons, or of local (i.e. cantonal) policies to tackle canton-specific issues.

Table 1
Health insurance cost variance analysis (Swiss francs per insured, 2006).

Canton	Observed costs	Swiss average	Diffe-rence	Demo-graphy	Propensity	Domain of care	Quantity of services	Unit costs
AG	2'490	2'757	−267	−87	−34	−78	−48	−21
AI	1'821	2'757	−936	−55	−498	−20	144	−507
AR	2'120	2'757	−636	51	−267	29	17	−466
BE	2'972	2'757	215	97	48	5	−151	215
BL	2'835	2'757	78	32	18	17	265	−254
BS	3'616	2'757	860	216	189	71	856	−472
FR	2'598	2'757	−159	−139	72	−39	−258	205
GE	3'650	2'757	893	−37	−41	159	293	518
GL	2'330	2'757	−427	46	−257	158	−113	−261
GR	2'344	2'757	−413	12	19	−41	−13	−390
JU	2'752	2'757	−5	37	−162	−24	310	−166
LU	2'277	2'757	−480	−52	−95	−36	−184	−113
NE	2'973	2'757	217	83	72	7	−132	186
NW	2'037	2'757	−720	−65	−177	−162	−129	−188
OW	2'129	2'757	−627	−59	−33	−141	−205	−190
SG	2'299	2'757	−458	−36	49	−67	83	−487
SH	2'605	2'757	−152	101	−169	−23	324	−384
SO	2'661	2'757	−96	6	−83	5	75	−97
SZ	2'311	2'757	−446	−101	39	−54	−255	−74
TG	2'327	2'757	−430	−49	−248	128	−186	−76
TI	3'283	2'757	526	143	153	17	283	−71
UR	2'203	2'757	−554	15	−174	−153	180	−422
VD	3'169	2'757	412	−27	−137	34	111	431
VS	2'483	2'757	−274	−41	−130	−91	25	−37
ZG	2'239	2'757	−518	−126	−80	−112	−219	18
ZH	2'690	2'757	−66	−12	−37	14	−66	35
Average of absolute values			418	66	126	65	189	242

3. Results

Health care expenditures covered by compulsory health insurance varied considerably between Swiss cantons in 2006. The mean cost per insured reached 2757 Swiss francs, with a standard deviation of 459 Swiss francs (Table 1).

Differences in total expenditures per insured with the reference region (mean), ranged from CHF -936 in Appenzell Innerrhoden to CHF + 893 in Geneva. The impact of demography ranged from CHF -139 in the canton with the lowest proportion of elderly residents (ZG) to CHF + 216 in the canton with the highest share of elderly (BS). For many cantons, the demographic component was relatively small (<CHF 100). The propensity to use health care was relatively low in small central cantons (AI, AR, NW, UR) and particularly high in two cantons (BS, TI) and its impact ranged from CHF -498 to CHF + 189. Some cantons tended to favor expensive types of services (e.g. specialist outpatient care in GE, psychiatrists in BS, acute care in TG), while those in central Switzerland (NW, OW, UR) used cheaper services. The quantity of services used per insured clearly drove expenditures up in several cantons (BL, BS, GE, TI, JU, SH) and was often the largest component in absolute terms. Finally, reimbursement prices explained a significant part of cantonal differences, with higher values in several French-speaking cantons (GE, VD, FR, NE) and only one mainly German-speaking (BE). The lowest prices were observed predominantly in rural German-speaking cantons (AI, AR, GL, GR, NW, OW, SG, SH, UR). For both AI and GE, this component accounted for around half of their health care expenditures differences.

As the price, quantity and type of services components are most amenable to policy changes in the short term, we focus on the sum of these three components disaggregated at the domain of care level (Table 2).

The main drivers behind positive differences amenable to short-term policies greater than CHF 100 per insured and per year (i.e. in cantons GE, BS, JU, VD, TI) can be easily identified. For GE, physicians in private practice accounted for more than half of these additional expenditures, while 15 % were attributable to nursing homes. Physicians in private practice and drug consumption were the main drivers of extra health care expenditures in BS. In JU and VD, the positive difference was mostly driven by hospital outpatient costs. In JU, this domain of care was higher than the net difference but was partially compensated by lower use of physician care. Finally, the three main determinants of the observed differences in TI were hospitalizations, drugs and other outpatient services. Fig. 2 displays geographical variation in the sum of these three components. The figure suggests a clear West-East gradient in health expenditures per insured, that may also reflect an urban-rural gradient.

4. Discussion

We proposed a simple nonparametric approach to break down health expenditures into five components: unit cost of services, service utilization at both the extensive (i.e. propensity) and intensive (i.e. quantity) margins, a component reflecting the domain of care, and a demographic component.

In our application to health expenditures covered by mandatory health insurance in Switzerland, we showed that the propensity to use care component explained a non-negligible portion of variation in health expenditures between cantons, which might in part reflects cultural differences [3,16].

While the domain of care component only played a second role in almost every canton, both quantity and unit costs explained a substantial portion of the variance potentially amenable to policies, in line with previous findings (see, e.g. [5,6,17]). The average quantity and unit cost components (in absolute values) reached respectively 189 and 242 Swiss francs per year, much higher than any other components (Table 1). Cantons with the highest (i.e. Baselstadt, Genève, Ticino, Jura, Schaffhausen) and lowest (i.e. Fribourg, Luzern, Obwald, Schwytz, Thurgau, Zoug) values of the quantity component are heterogeneous in terms of language, religion, income, or their urban/rural dimension, which might indicate that quantity of services has more to do with medical practice and supply-side characteristics. On the contrary, the unit cost component seems to be correlated with the main population characteristics of the cantons (i.e. German-speaking rural areas tend to have lower unit costs of services). These contrasts between quan-

Table 2
Differences amenable to short-term policies - per domain of care.

		Outpatients				Inpatients	
Canton	Difference*	Physicians	Hospital	Drugs	Other**	Nursing home	Hospital
AG	−147	−31	−37	−41	−48	−25	34
AI	−383	5	−69	−160	−41	−63	−54
AR	−420	44	−55	−118	−54	−64	−174
BE	70	−88	−15	3	8	5	156
BL	28	93	−39	15	12	−63	10
BS	455	157	52	157	59	−36	66
FR	−92	−114	14	−41	−8	81	−24
GE	971	456	63	167	75	142	68
GL	−216	−156	78	−27	3	54	−167
GR	−444	−146	22	−45	−8	−75	−192
JU	120	−124	194	27	−9	27	4
LU	−333	−124	−7	−61	−32	−49	−58
NE	61	1	6	100	22	47	−116
NW	−479	−169	−26	−104	−24	−56	−99
OW	−536	−206	−44	−91	−34	−67	−94
SG	−471	−86	−102	−51	−39	−46	−147
SH	−83	105	−72	3	−33	−73	−13
SO	−18	67	−52	18	44	−44	−51
SZ	−384	−104	−71	−67	−15	1	−128
TG	−133	−50	0	−106	−16	−48	88
TI	230	−5	−9	99	48	−2	99
UR	−395	−212	25	−84	−66	−92	34
VD	576	96	235	67	86	63	29
VS	−103	−130	109	−34	−21	45	−73
ZG	−313	−45	−82	−114	−42	21	−50
ZH	−17	102	−33	−28	−9	19	−69

* Difference = Domain of care + Quantity of services + Unit costs of Table I.
** Other = laboratory, home care, other services, ambulance and other transportations, material.

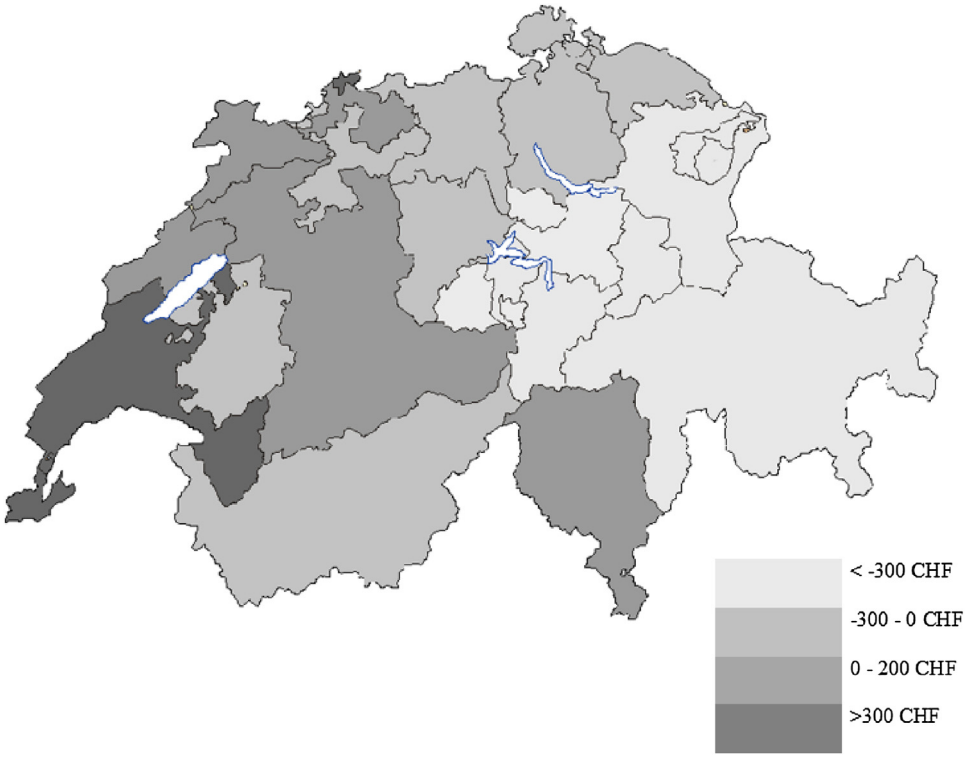

Fig. 2. Manageable cost differences in the 26 Swiss cantons (2006).

tity and unit costs might explain why some studies that considered health care costs globally did not detect significant effect for some covariates (e.g. urbanization; [18]).

Finally, as shown in previous studies [19,20,9,21]), the demography component explained important differences between cantons, justifying the need to adjust for age and gender distribution of the population, even if regional comparisons are made within the same country.

The geographic analysis of manageable differences by canton suggests a West-East gradient in the control of health care expenditures (Fig. 2). Other studies already showed that culture had a strong influence on the propensity to use home care structures

[22] and the type of care chosen for end-of-life (home, nursing home, hospital; [23]). Our results demonstrate that cultural aspects might also have an impact on amenable health care costs. This geographic gradient might suggest the adoption of stronger measures to contain costs in Western Switzerland. However, such aggregate analysis may hide important information and the analysis of the variation amenable to short/medium-term policies broken down by domain of care revealed interesting cantonal specificities. Notably, the main drivers of amenable differences were physician in private practice visits for Geneva and Basel Stadt, outpatient hospital care in Vaud and Jura, while in Ticino this part of the variation was mainly explained by drugs and other ambulatory services use, and inpatient hospitalizations. These results showed a great diversity of issues among cantons, suggesting that canton-specific policy should be implemented.

Overall, our study shows how variance analysis can be applied to health care expenditure analysis and illustrates that various causes should be addressed to control costs, each canton having its own main issues. The proposed approach provides precise results without resorting to estimates, which is a great advantage when one has to work with small sample sizes (e.g. number of countries or subnational entities such as cantons or regions). Moreover, unlike regression methods, it is not prone to the common issues of endogeneity and stationarity. Therefore, it might also be useful in an international context, to compare health care costs across countries. For OECD's countries for instance, most required data would be available to obtain global costs per type of services (hospitals, nursing homes, ambulatory visits, etc.) and corresponding quantities, allowing the computation of unit costs. Regarding demographic data, this would also be readily available. Some additional information would be necessary to measure the propensity to use different types of services per age and gender, for instance. Such data are usually available in national hospital and nursing home statistics. As for ambulatory care, estimates could be obtained from insurance data.

Limitations of this study include the focus on health care costs rather than on the outcomes. Higher costs might be associated with better health improvement or responsiveness for instance. Moreover, we did not introduce morbidity in the comparisons, although some epidemiologic factors might influence the quantities of services [24]. Finally, the dataset used to illustrate our method is more than 10 years old, which might question the relevance of our finding for Switzerland's current situation. Interestingly, despite several institutional changes since 2006, between-canton differences in expenditure patterns have remained remarkably stable over the past decade [25]. This suggests that there is a huge inertia in the evolution of health care costs. Nevertheless, it would be wise to confirm our results with updated data. Further research would also be necessary to investigate the effect – or absence of effect – of institutional changes on the different components of care (quantities, unit costs, substitution, propensity to use health services). One way to proceed would be to include these institutional changes as control variables [26].

5. Conclusion

We proposed an innovative approach to disentangle health care costs and analyze their variance explained by several components. Some cantonal discrepancies were explained by contextual variables (i.e., demography, propensity to seek health care services), others were explained by manageable variables (i.e., type of domain of care, quantity and unit costs of service). Our model allowed the identification of the main cost drivers in the cantons where health care expenditures amenable to policies were the highest, i.e. physician in private practice visits in Geneva and Basel Stadt, hospital outpatient care in Vaud and Jura, and a set of factors in Ticino. The heterogeneity observed in this federalist system would not have been highlighted, had only overall costs been considered. Variance analysis – by decomposing costs into different components – allows taking more accurate management decision to control costs. Since most data are available in most developed countries, the proposed approach might also be used at an international level.

Ethics

The setting of this study did not involve any personal information and were only based on aggregated data.

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Declaration of Competing Interest

The authors certify that they have no conflict of interest.

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Appendix A. Domains of care and service types

Domain of care	Service type	Unit
Outpatient care		
Physicians in private practice	Internal medicine and general practitioners, surgeons, gynaecologists, paediatricians, psychiatrists, other specialties	Visits
Ambulatory hospital care	Somatic, psychiatric	Visits
Medications	44 therapeutic groups: anti-anemia, anti-asthmatic, anti-coagulation, antidepressant, anti-diabetic, anti-hypertensive, anti-osteoporosis, anti-psychotic, chemotherapy, and treatment treatments for: digestive function, digestive infection, epilepsy, eye infection, skin inflammation, skin infection, pain, thyroid function, etc.	Packages
Other ambulatory services	Laboratory, home care, other services, ambulance and other transportations, material	Invoices
Inpatient care		
Long-term and chronic care	Nursing home, chronic hospital care	LOS (days)
Acute care	Somatic and psychiatric stays	LOS (days)

Appendix B. List of Swiss cantons

AG Aargau
AI Appenzell Innerrhoden
AR Appenzell Ausserrhoden
BE Bern
BL Basel-Landschaft
BS Basel-Stadt
FR Fribourg

GE Geneva
GL Glarus
GR Graubünden
JU Jura
LU Luzern
NE Neuchâtel
NW Nidwalden
OW Obwalden
SG St. Gallen
SH Schaffhausen
SO Solothurn
SZ Schwyz
TG Thurgau
TI Ticino
UR Uri
VD Vaud
VS Valais
ZG Zug
ZH Zürich

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