Understanding Differences in Health Care Spending: A Comparative Study of Prices and Volumes Across OECD Countries

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ABSTRACT: Variations across OECD countries in the prices of health care and hospital services can be vast. These price differences mean that comparisons of such services should be adjusted to reflect the 'real' volumes consumed. Purchasing power parities (PPPs) can be used to make such comparisons more accurately, going beyond simple GDP-based comparisons, by aggregating the prices of actual individual consumption of health items. These health and hospital PPPs demonstrate that GDP PPPs are a weak substitute, as price structures vary widely. Moreover, there is tentative evidence that higher relative prices for health care tend to bloat health expenditure and are associated with lower life expectancy.

KEYWORDS: Health care costs, health expenditures, comparative study

Introduction

Health systems face the challenge of providing high-quality care for their populations while keeping expenditures under control. Understanding what factors contribute to variability in health care expenditures across countries can help policymakers better identify opportunities to improve the efficiency of their health systems. In some countries, excess utilisation may drive up total expenditures, while in others the culprit may be comparatively higher prices. In order to disentangle the drivers of expenditures, international comparisons of health care expenditures are becoming an increasingly important tool to inform policy decisions, as they foster mutual learning.[1-3]

Comparisons of health care expenditures across countries are carried out at different levels of aggregation – including at the level of country,[4] provider,[5] episode of care[6] and technology.[7,8] Health expenditures are a function of utilisation (volumes of health care goods and services consumed) and prices. In order to produce meaningful comparisons across countries that allow us to determine what is driving total expenditure variations – that is utilisation or prices – appropriate measurement methods are required to disentangle these factors.[9] In practice, 2 main approaches are used. One approach relies on converting final expenditures valued at national price levels and expressed in national currencies using market exchange rates. The other approach uses purchasing power parities (PPPs) – measures of price level differences of the same basket of goods and services in different countries.[10-12] Conceptually, PPPs are the cross-country equivalent of consumer or producer price indexes,[13] in that they are designed to summarise price levels of countries relative to an arbitrary base country or numeraire.

In a world in which the law of one price were true, market exchange rates would be all that we would need for converting accounts in one currency into another.[10] The price of any item in one country would be the price in any other converted at the exchange rate, and the same would be true for a price index for consumption, investment and GDP. However, '*tariffs, transportation costs, non-tariff barriers, information costs and profit margins drive a wedge between prices in different countries with the size of the wedge depending on the tradability of the good*'.[14] Moreover, market exchange rates are volatile since they are determined by the supply and demand for different currencies, which are influenced by currency speculation, interest rates, government intervention, and capital flows between countries.

Consequently, relative prices for the same goods or services in different countries can vary widely, such that it is useful to compare prices directly, and to calculate spatial price indexes – that is PPPs – for GDP and its components. Given a set of prices of representative goods and services in – say – consumption, it is straightforward to use standard index number formulas (Paasche, Laspeyres or Fisher type, for example) to compute consumption price indexes for any pair of countries, and then convert those binary indexes into multilateral indexes.

In the context of calculating PPP indices, comparisons of health expenditures across countries are particularly difficult to carry out because health services are 'comparison resistant', with health care being far from a conventional market, where prices reflect the interaction of supply and demand, acting as signals for the efficient allocation of resources.[15] In practice, prices for the same items in health may differ widely across payers[16] and market areas,[17] both within and across countries.[2]

Using OECD data,[18] we were able to make international comparisons of health care prices and volumes, with a focus on hospitals. The data available also allowed us to further explore the relationship between health and hospital price levels and health spending and life expectancy. As such, we were interested in examining: (1) country variations in health and hospital prices, and how they correlate with economy-wide price levels and with household welfare, respectively; (2) the

Table 1. Number of items in the Eurostat-OECD 2020 PPPs health and hospital surveys by category.

CATEGORY	SUB-CATEGORY	NUMBER OF ITEMS	%
Pharmaceutical products	Original	83	30.7
	Generics	77	28.5
Other medical products		24	8.9
Therapeutic appliance and equipment		15	5.6
Medical services		11	4.1
Dental services		7	2.6
Paramedical services		16	5.9
Hospital services	Inpatient	32	11.8
	Day surgery	5	1.9
Total		*270*	*100*

Source: Eurostat-OECD 2020 PPPs health and hospital surveys, unpublished.

importance of using the appropriate deflators for international comparisons of health spending; and (3) whether price levels tend to correlate with health spending from public sources and life expectancy at birth.

Data and Methods

The Eurostat-OECD PPP programme was established in the early 1980s to compare on a regular and timely basis the GDPs of the member states of the European Union and the member countries of the OECD. In the context of work on PPPs, Eurostat and OECD work with national statistical offices to gather and validate price data on a regular basis

PPPs are conversion rates that show the ratio of prices for a basket of goods in one currency relative to the same goods in another. When PPPs are used to convert expenditures into a common unit, the results are valued at a uniform price level and the comparison of expenditures across countries reflect only the differences in the volume of goods and services consumed.

PPPs are calculated by first gathering price information for a representative basket of the aggregate in study.

The Eurostat-OECD classification used to compute GDP PPPs breaks down final expenditure into 7 main aggregates – individual consumption expenditure by households, by non-profit institutions serving household and by government, collective consumption expenditure by government, gross fixed capital formation, changes in inventories and acquisitions less disposals of valuables, and balance of exports and imports – which are subsequently broken down in expenditure categories, groups and classes, and finally into 206 basic headings.[11] It is at the basic heading level that products are selected, prices collected and validated, and PPPs first calculated and averaged. PPPs are available at an economy-wide level (GDP), industry level (eg, health and education), and for selected spending aggregates (eg, actual individual consumption and government consumption).[18]

GDP PPPs can be very useful to compare the size of economies.[12] Actual Individual Consumption (AIC) PPPs can be useful to compare household income across countries, as they comprise the goods and services that households actually consume to satisfy their individual needs, irrespective of whether they are purchased by households themselves, by government and non-profit institutions serving households. AIC PPPs are designed to capture prices of a basket of goods and services that households actually consume, including for example – in addition to health care – food and beverages, transport and culture.

In order to generate *Health* PPPs, 'Actual Individual Consumption of Health' PPPs are computed based on a representative consumption basket of 270 items, of which 199 are goods and 71 are services (Table 1). For example, the price of a 15 to 20 minutes visit to a general practitioner and the price of an intramuscular injection of influenza vaccine by a nurse are gathered and compared across countries, as specific items on the health price survey. Expenditures on the same item headings are also collected in domestic currency units, which are used in the PPP aggregation process, in order to arrive at representative health price indexes.

For the largest category of health care consumption – hospital services – *Hospital* PPPs are computed based on a representative and internationally comparable basket of 37 items (case types), such as a normal delivery, a hip replacement and an open prostatectomy.[19] Those services represent – on average across OECD countries – 18.2% of total hospital discharges and 18.5% of total hospital spending.[20] Due to difficulties in estimating mean representative hospital prices, for Korea, New Zealand, Turkey and the United States, hospital PPPs are estimated predominantly by using salaries of

medical and non-medical staff (input-based method). This approach assumes that hospital productivity is uniform across countries, implying that countries are equal in their ability to convert inputs into outputs.

Different methods can be used to compute multilateral PPPs. The choice of method is based on 2 basic properties: transitivity and base country invariance. PPPs are transitive when the PPP between any 2 countries is the same whether it is computed directly or indirectly through a third country. PPPs are base country invariant if the PPP between any 2 countries is the same regardless of the choice of base country. To derive multilateral treatment episode PPPs that satisfy the property of invariance and transitivity, a set of binary price indexes or parities between each pair of countries – the partner country and the numeraire or base country – was computed. Item-level price ratios between each pair of countries were first weighted using the base country's weights (Laspeyres-type index):

$$L_{j/h} = \sum_{i=1}^{k} \frac{P_{i/j}}{P_{i/h}} * w_{ih}$$

and then weighted again using the partner country's weights (Paasche-type index):

$$PA_{j/h} = \frac{1}{\sum_{i=1}^{k} \frac{P_{i/h}}{P_{i/j}} * w_{ij}}$$

In both equations, h is the base country and j the partner country, $P_{i/j}$ and $P_{i/h}$ are the unit prices i in countries j and h, w_{ih} is the share of expenditure devoted to the care component i in the base country h, w_{ij} is the share of expenditure devoted to the component i in partner country j, and k is the number of components making up the aggregate in study (eg, health).

To maintain symmetry, the geometric mean of the 2 indices was computed for every pair of countries in the comparison (Fisher-type index):

$$F_{j/h} = \sqrt{L_{j/h}} * PA_{j/h}$$

The Fisher-type indexes between each pair of countries were then converted into transitive, invariant multilateral indexes using the Elteko-Koves-Szulc (EKS) method[21,22]:

$$EKS_{j/h} = \left(\prod_{l=1}^{c} F_{l/j} / F_{l/h} \right)^{1/c}$$

where $EKS_{j/h}$ is the EKS PPP between countries h and j; $F_{l/j}$ and $F_{l/h}$ are Fisher PPPs between countries l and j and l and h respectively; c the number of countries involved. Those indexes are the PPPs.

Two sets of indices are derived using PPP data for the health, hospital and AIC aggregates[18]: (a) price level indices,

the ratio of PPPs to exchange rates; and (b) indices of real expenditures per capita (or standardised measures of volumes), computed by dividing the expenditure aggregate under study by PPPs by population.

In our study, health and hospital expenditure data are based on the System of Health accounts data collection framework.[23] This framework offers guidelines for reporting internationally comparable measures of health expenditure by financing source, provider and type of service.

To explore the impact of using different PPPs indices for international comparisons of health spending, we generate Kernel density estimates of volumes of health spending per capita estimated using GDP, AIC and health PPPs. The Kernel density estimation is a non-parametric way to estimate the probability density of a random variable (in our case, per capita health spending), and can illustrate the effect of the PPPs on the shape of the OECD-wide health spending distribution.

Finally, we also examine whether the health and hospital price levels are correlated with higher or lower health expenditure from public sources and better or worse outcomes. To explore the relationship between price levels and public spending on health care and life expectancy at birth, a system of simultaneous non-linear equations is used – see Lorenzoni et al[24] and Dougherty et al[25] for a description of the model and its use in previous work. A micro-founded model of utility maximisation by a social planner subject to a budget constraint and a health production function underlie the empirical work. This model suggests that public spending on health care per capita depends on income, health systems characteristics and on the share of the elderly (age of 65 + years) in the population. Likewise, life expectancy depends on total health care spending, GDP per capita (net of total health care spending), health systems characteristics, the stock of people with upper secondary and higher education, the prevalence of daily smoking and alcohol consumption in litres per capita.

Results

Descriptive analysis

Figure 1 shows the variation in price levels for health goods and services for each OECD country in relation to the average price level for health observed across OECD. Iceland and Switzerland have the highest health prices in the OECD – on average the same basket of goods and services would cost 72% and 67% more than the OECD average, respectively. Health care prices also tend to be relatively high in Norway, Sweden, Israel, Ireland and the United States. In contrast, the price for the same mix of health care goods and services in Chile and Greece is around two-thirds of the OECD average. The lowest health care prices in the OECD are in Turkey, at only around 20% of the OECD average.

Health care goods and services prices tend to be correlated with overall economy prices, but for several countries, the divergence is marked (Figure 2).
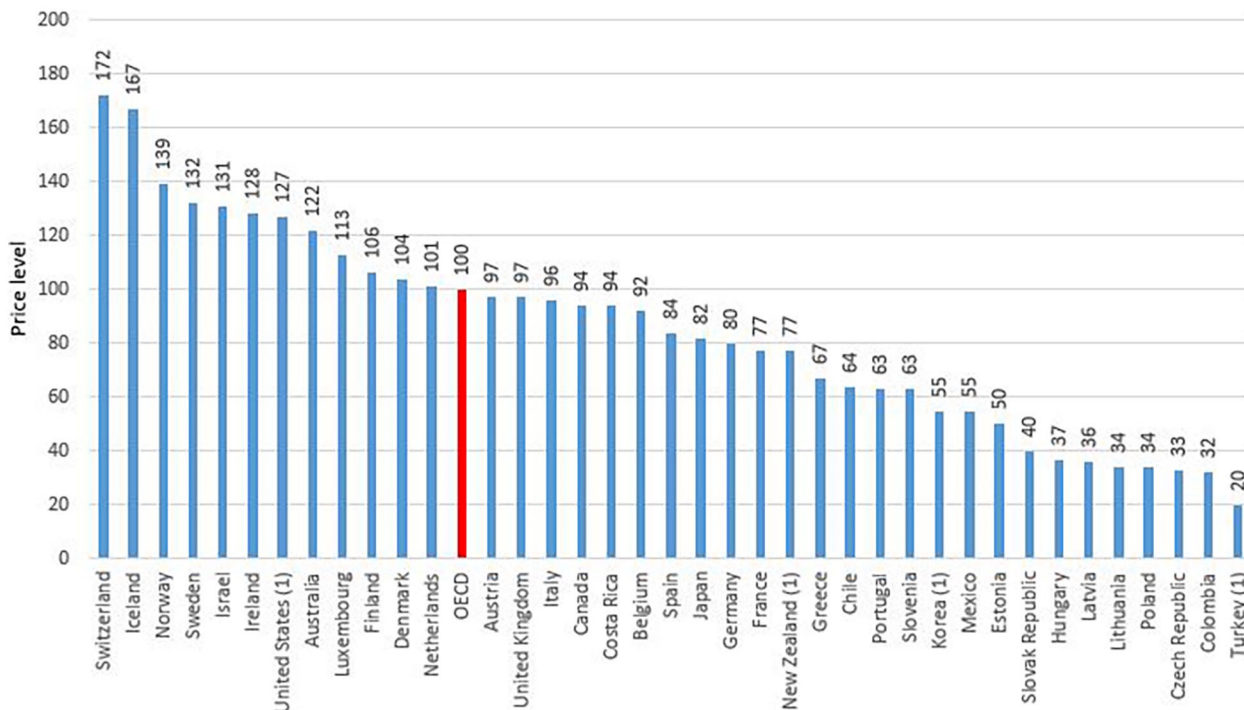
Figure 1. Price levels for health goods and service, 2017, OECD = 100.
Source: OECD Health Statistics.[18]
(1) For hospitals, PPPs are estimated predominantly by using salaries of medical and non-medical staff (input method).
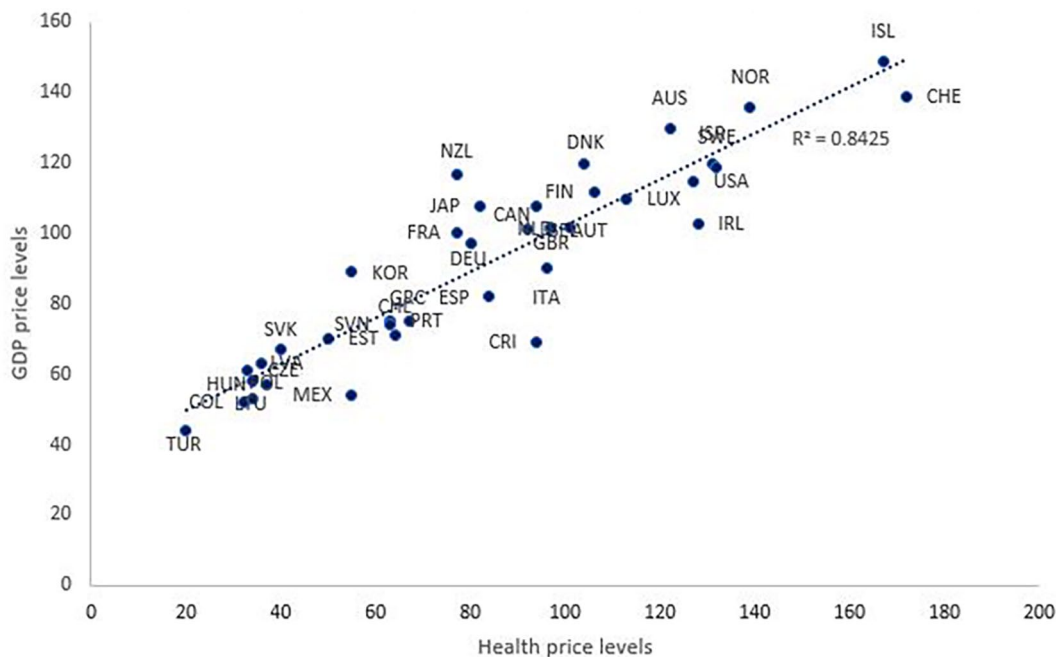

Figure 2. Comparison of price levels for GDP and health, 2017, OECD = 100.
Source: OECD Health Statistics.[18]

Hospital expenditure typically accounts for around one-third of overall health spending in OECD countries and therefore weighs heavily in the overall health price level calculations. However, the variation in prices of hospital services is even greater across OECD countries than in the health sector as a whole. As with health prices, hospital prices tend to be higher in higher-income economies. Estimates of hospital services prices for 2017 suggest that in Switzerland they are more than double the average level calculated across OECD countries, whereas prices in Turkey are only around one-eighth of the
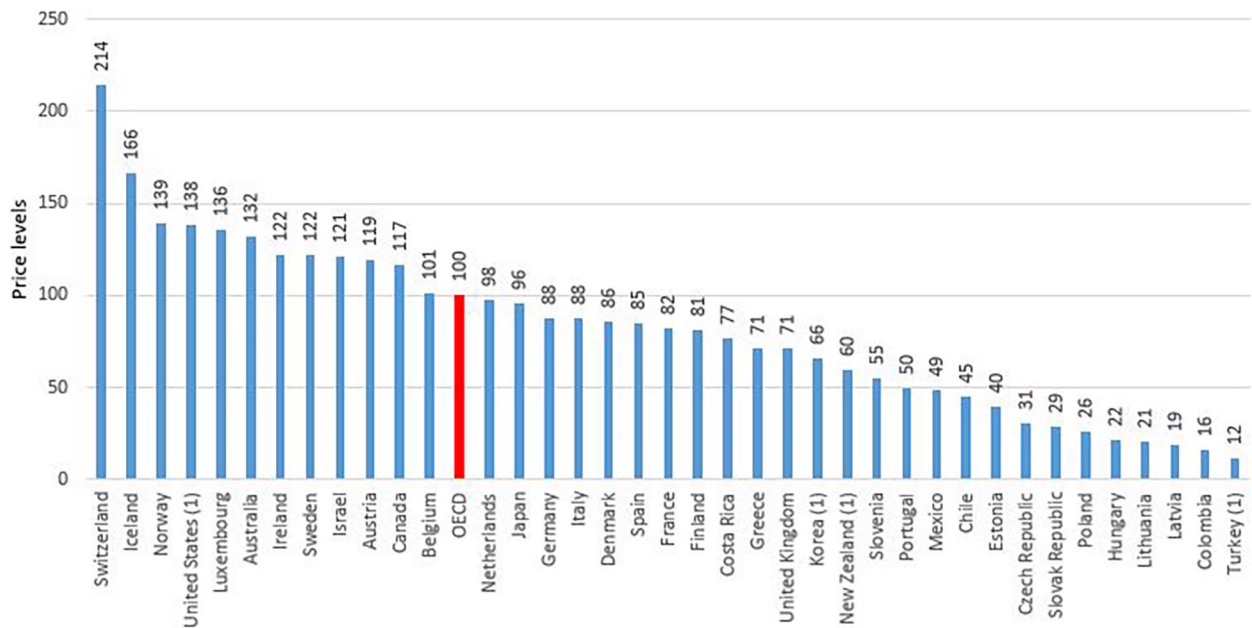
Figure 3. Price levels for hospital services, 2017, OECD = 100.
Source: OECD Health Statistics.[18]
(1) PPPs are estimated predominantly by using salaries of medical and non-medical staff (input method).
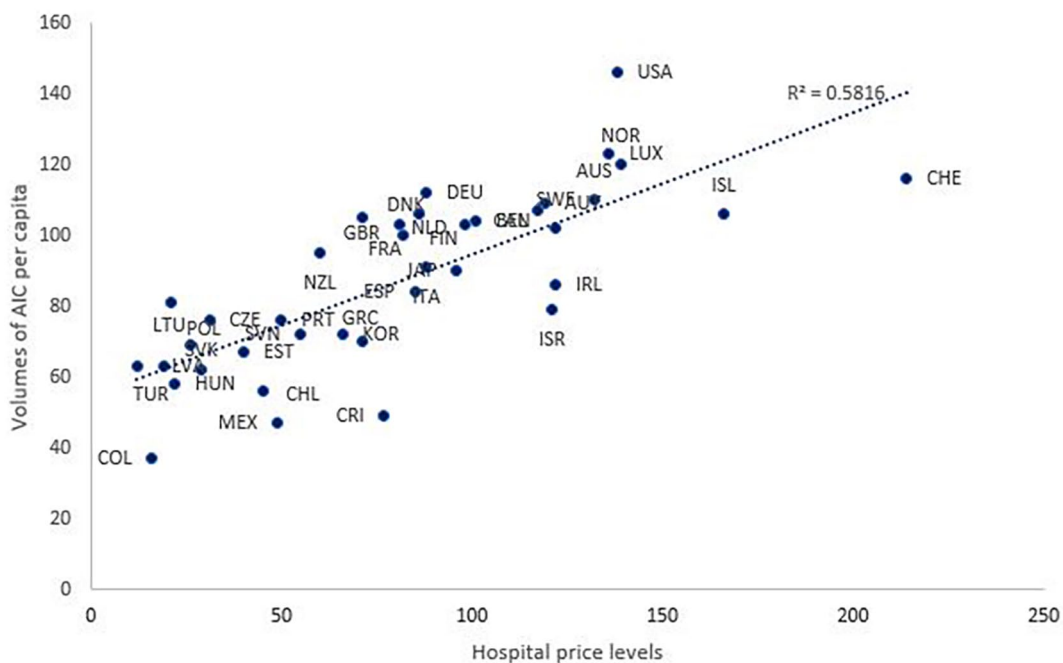

Figure 4. Comparison of price levels for hospital services and overall per capita actual individual consumption, 2017, OECD = 100.
Source: OECD Health Statistics.[18]

OECD average (Figure 3). More labour intensive than the health sector as a whole (typically 60%-70% of hospital spending is staff costs), service prices in hospitals are heavily determined by local (national) wage levels, but may also be influenced by hospital financing mechanisms and funding arrangements, the structure of service provision, as well as the market structure and competition among payers and among providers, and the way prices are set.[26]

Figure 4 shows the price levels for hospitals plotted against the index of real per capita actual individual consumption (AIC), which constitutes a measure of average household material welfare. In line with expectations, there is a significant correlation: higher levels of AIC correspond to higher price levels for hospitals.

Adjusting for the differences in health goods and services prices across countries can give a measure of the amount of
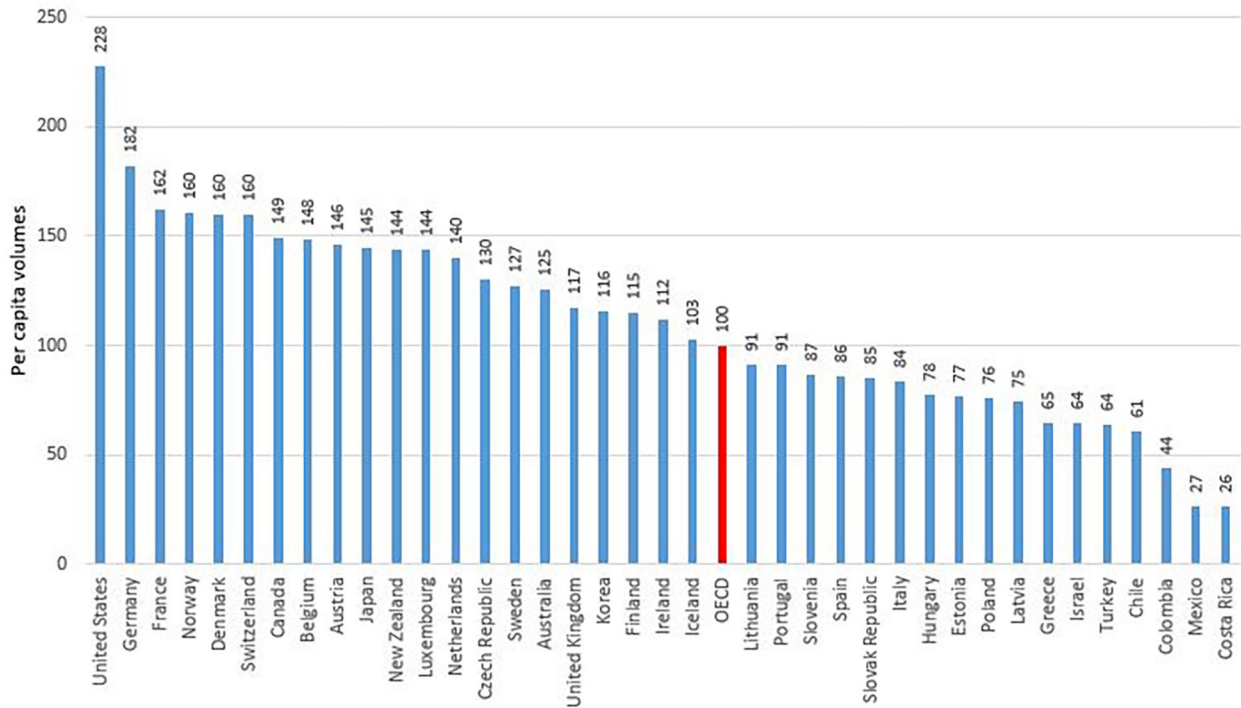
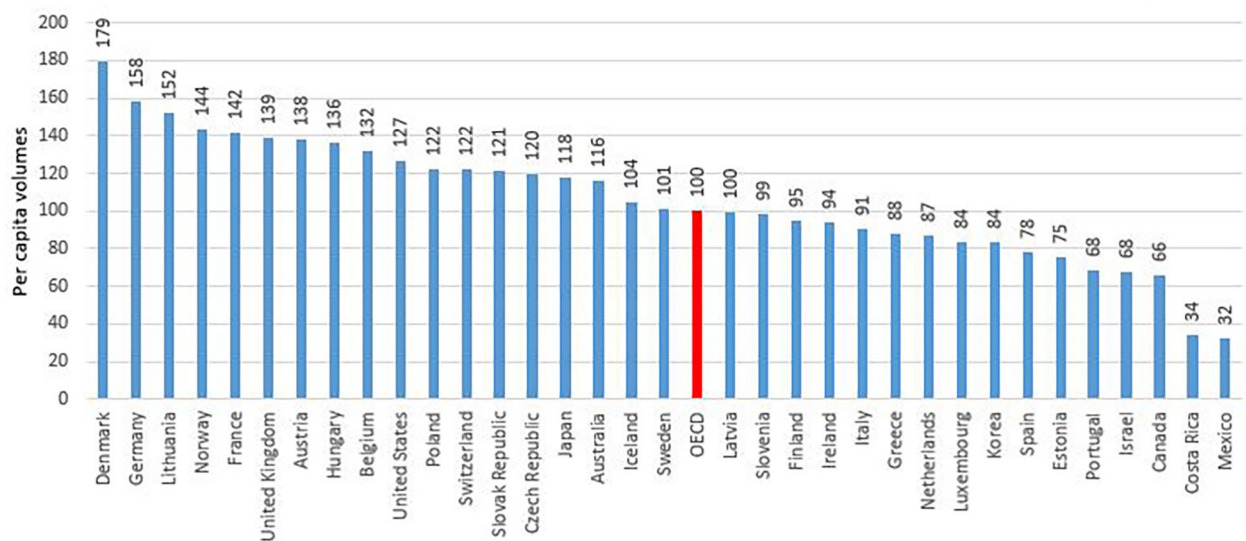**Figure 5.** Health care volumes per capita, 2017, OECD = 100.

Figure 6. Hospital volumes per capita, 2017, OECD = 100.

health care goods and services being consumed by the population ('the volume of care'). The United States remains the highest consumer of health care, at more than 2 times the OECD average, whereas the volume of care consumed per person in Mexico and Costa Rica is one-fourth of the OECD average (Figure 5).

Hospital services price levels could be applied to per capita hospital spending levels across countries to estimate the real (ie, price level adjusted) per capita expenditure or volume of hospital care consumed (Figure 6). We observe less variation in hospital consumption volumes per capita compared to health care consumption volumes per capita.

Regression analysis

The distributions of health volumes per capita generated used 3 different PPPs measures – that is GDP, overall AIC and health PPPs – are compared in Figure 7. The shape of the health PPPs distribution is closer to the normal distribution, with less outlier countries and smaller deviation from the
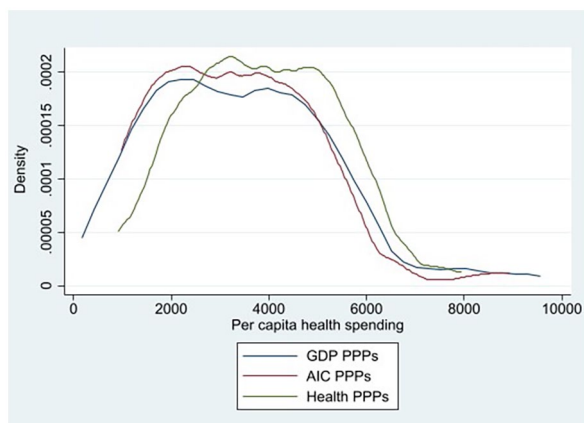
Figure 7. Kernel distributions of per capita health spending, 2017.

Table 2. Estimates of the elasticity of health spending from public sources and life expectancy to health and hospital price levels.

	HEALTH SPENDING	LIFE EXPECTANCY
Health price level	0.235** (0.11)	−0.326*** (0.07)
Hospital price level	0.238** (0.10)	−0.301*** (0.06)

Statistical significance: ** 5% level; *** 1% level.

OECD average. This is mainly due to a more representative and health-care specific basket of items used to compute health PPPs compared to GDP and AIC PPPs.

Our results show that relative price differences for health and hospital affect health spending from public sources and health outcomes. The estimate (Table 2) shows that a 10% higher health price level is correlated with 2.4% higher health spending from public sources, and 3.3% lower life expectancy, for health (and 3% for hospitals).

Discussion

This paper shows large variations in health and hospital prices and volumes across OECD countries. Health care prices tend to be correlated with overall economy prices, but are more accentuated. Differences in the volume of care consumed per capita may be related to factors such as the age and disease profile of a population, the organisation of service provision, use of prescribed pharmaceuticals, or difficulties in access leading to lower levels of care being used within a country.

Higher levels of household consumption correspond to even higher price level differences for hospitals services. This results in hospital volumes showing less variation compared to health volumes.

This paper shows also that the use of health PPPs significantly changes the expenditure distribution picture of OECD countries, demonstrating that their use is important to better capture the across country variation in the volume of health goods and services consumed.

Preliminary estimates suggest that higher relative health care prices may translate into higher public spending on health,

and even more importantly, higher health care and hospital prices appear to be correlated with worse outcomes in terms of lower life expectancy.

Our study has some limitations. We do not adjust for the underlying health status of the population and health system characteristics. Therefore, we are not able to capture the relationship between prices and volumes of care used and the prevalence of diseases, the health system capacity and access to care in the different countries. Second, there are differences in cost accounting and price setting approaches across countries that in turn may influence the results. For example, the use of an input-based method to estimate hospital PPPs for Korea, New Zealand, Turkey and the United States may underestimate the price levels for those countries. Finally, our analysis of the correlation between price levels and health spending and life expectancy is only illustrative. More research is needed to explore the direction of the relationship that we found and whether this is also related to other factors.

Our results have important implications for researchers interested in examining differences across countries to explain why a country spends so much more on health compared to peers. First, our results confirm previous findings suggesting that one of the main factors driving differences in health spending per capita across countries are prices.[2,4] This paper also shows that the lower the level of aggregation (ie, higher degree of disaggregation) of expenditure, the higher the variation across countries in price levels.

Second, our results reinforce previous findings that emphasise the importance of using the appropriate conversion rate for international comparisons of health spending.[1,18] By using health PPPs to standardise expenditure across countries, we found less variation in the volume of care consumed than what would be observed using other prices from the general economy or for actual individual consumption. The health PPPs are constructed from a basket of specific goods and services consumed by households and thus more representative of the true price levels that individuals are likely to face.

In short, (health) prices matter.

Author Contributions

LL: conceptualized, designed, prepared the original draft, and coordinated the work. SD: performed the statistical analysis and interpretation of data, and edited the manuscript. All authors supervised the findings of this work. All authors read and approved the final manuscript.

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