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ORIGINAL PAPER

The convergence of health care financing structures: empirical evidence from OECD-countries

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Abstract The convergence/divergence of health care systems between countries is an interesting facet of the health care system research from a macroeconomic perspective. In this paper, we concentrate on an important dimension of every health care system, namely the convergence/divergence of health care financing (HCF). Based on data from 22 OECD countries in the time period 1970–2005, we use the public financing ratio (public financing in % of total HCF) and per capita public HCF as indicators for convergence. By applying different concepts of convergence, we find that HCF is converging. This conclusion also holds when we look at smaller subgroups of countries and shorter time periods. However, we find evidence that countries do not move towards a common mean and that the rate of convergence is decreasing over time.

Keywords Convergence · Health care system · Health care financing

JEL Classification I11 · I18 · H55

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Introduction

Within the health care system, health care financing (HCF) fulfils different functions [6]: Collecting revenues, pooling revenues (risks) and purchasing services. These three tasks can be unified in one organisational entity or can be split up between different institutions.

HCF is important for several reasons: (i) Public and private financing may have different effects on equity of financing, health care utilization and health status [44, 45]. (ii) Different degrees of risk pooling and risk reduction are associated with this dichotomy. While out-of-pocket (OOP) payments do not include risk pooling at all and private health insurance only reduces the health expenditure risks, public financing via taxes or income-based contributions also includes some element of reducing the income risk. Hence, the risk spectrum covered by public financing is broader compared to that of private financing. (iii) In a normative perspective, specific forms of collecting (e.g. public insurance) are able to reduce market failures in the coverage of health care risks [20]. (iv) Finally, there exists a link between the financing structure and the efficiency in the provision of health care services [13, 14, 16, 41]. This link includes much more than the well-known moral hazard phenomenon. Hence, HCF is a promising topic of economic analysis per se. But why should one study its convergence/divergence over time?

In a world of increasing economic integration, a change in the nature of health care financing between countries is worth investigating. The convergence across countries enhances the mobility in the labour market and reduces the transaction costs of cross-border shopping within the health care sector. Furthermore, convergence in HCF reduces the incentive and benefit to follow the outside option. By studying the (conditional) convergence, we additionally

learn about the determinants of the public–private share. Understanding the patterns and drivers of the adaption processes could help to answer questions such as what future financing systems will look like and whether there exists something like a 'best response' to the financing challenge.

Compared to the previous research, the main value added of the paper is to test the convergence issue from a broader perspective. This broader approach includes several dimensions. We focus on an important dimension of the governance of the health care system, namely, the role of the public sector in financing health care services. Most of the studies that analyse the convergence issue focused on total health care expenditures, without considering its components. Such an approach may mask the existence of different patterns of behaviour of the private and the public sector. Therefore, it seems to be fruitful to carry out a disaggregated analysis. We use a comparatively long time period (1970–2005) and the broadest sample of OECD countries (22 countries) possible with the data on hand. We check for the influence of different types of health care systems and, hence, for different convergence clubs using the concepts of σ-convergence (measured as coefficient of variation) and absolute and conditional β-convergence. We additionally tested a relatively broad set of variables for the existence of conditional convergence.

The structure of the paper is as follows. The Section "Previous research" provides a brief discussion of previous literature on convergence in the health care sector. In Section "Empirical framework", we present the methodological framework indicators and data used in the paper. Section "Results" presents the empirical results including descriptive statistics, empirical estimates and robustness analyses. Concluding remarks and suggestions for future research are offered in the last section.

Previous research

Our research question falls into the broader range of studies that focus on the convergence in health care systems. Overall, this literature reveals a rather heterogeneous picture. Several authors identify a trend towards convergence [19, 34], others find no signs for convergence at all [16, 28], while the third strand of authors draws a mixed picture [42, 47], finding convergence for some and divergence for other indicators. To some extent, this heterogeneity arises from methodological differences in the study designs. In this respect, we have to separate at least the following approaches.

(i) Based on the unit of analysis, we can separate between intra-state studies and international comparisons of health care systems, the latter being far more frequent. There exist two recent intra-state studies: Wang [46] examines convergence in real per capita health expenditures in the 50 US states over the period 1980–2004 and Montero-Granados et al. [28] analyse the convergence/divergence in the health status in Spain on a provincial and regional level.

(ii) Depending on the indicator of convergence, the research can be classified into multidimensional and single dimensional studies. Within the former, a three-dimensional concept of the health care system dominates. It includes the dimensions financing, regulation and service provision [47]. This structure allows the authors to analyse simultaneously the financing mix, the provision mix and the extent of state regulation in financing and provision. It therefore enables statements on the overall convergence in the health care systems. So far, studies of this type have been characterised by (very) small sample sizes [2, 15, 16]. The majority of the studies on convergence are single-dimensional, thereby preferring total health expenditures—either per capita or as a ratio to GDP—as indicators of convergence/divergence [9, 11, 19, 21, 33, 34]).[1] Studies on convergence in the financing structure (e. g. private vs. public) of the health care sector are missing.

(iii) The methods applied for testing convergence allow for a third classification of previous literature. The first type of studies is heavily influenced by the convergence hypothesis derived from the neoclassical growth theory and uses the concepts of σ-convergence and absolute and conditional β-convergence. Initially, this concept was based on cross-section data, in recent studies this approach was also applied to panel data sets and methods [19, 21, 34, 43]. The second strand of literature is based on time series analyses.[2] These studies define convergence as transitory deviations from identical long-run trends, either deterministic or stochastic. Several empirical studies follow this approach highlighting different aspects of the convergence topic [9, 29, 30, 46]. A third strand of literature analyses convergence implicitly by using different methodological approaches. For example, Alcalde-Unzu et al. [1] present a factor decomposition of the differences in health expenditure growth. Okunade and Suraratdecha [39] examine the inertia of pharmaceutical expenditures. Clemente et al. [7]

[1] Some studies focus on the outcome indicator health status. For example, Mayer-Foulkes [26] asks whether there are convergence clubs in cross-country life expectancy dynamics.

[2] For the discussion of testing convergence using cross-section or time series data and methods, see Bernard and Durlauf [4]. For the closely related problem of stationarity of health care expenditures and their determinants, see for example Hansen and King [18], McCoskey and Selden [27], Gerdtham and Löthgren [12], Okunade and Karakus [37], MacDonald and Hopkins [25], Dreger and Reimers [11].

focus on the differences in the expenditure functions of the private and public health care sector.

(iv) Last but not least, insights into the convergence hypothesis in the health care system can also be gained from studies which focus on the broader perspective of convergence in the welfare state. It is the merit of these studies to stress the importance of the institutional design of the welfare state for the impact of internal and international changes and shocks for convergence/divergence [10, 22, 40, 48]. This aspect is crucial as the convergence studies—especially those which use time series methods—are to a high extent a-institutional.

Empirical framework

Dependent variables

Our dependent variables refer to the public–private dimension of HCF. Basically, public funding means that there exists an element of transfer between the individual contribution and the coverage offered. Therefore, the collecting institutions are endowed with coercive power [35]. Public HCF is based on two sources: (i) general taxation and (ii) contributions to social health insurance. Private financing includes: (i) contributions to private health insurance[3] and (ii) direct financing by private households such as OOP-spending for services and different types of cost-sharing.[4]

To examine convergence in public–private HCF, we use two different dependent variables. The first indicator refers to public financing in % of total HCF (*public*). As this variable is strictly bounded between zero and one (it ranges from 36 to 98%), we use a logg-odds transformation as suggested in Wooldridge [49], p. 662. This results in a dependent variable that ranges over all real values so that the parameters can be consistently estimated by OLS. The second variable represents real public health financing per capita (*rphfpc*) as constant 2,000 US$ purchasing power parity (PPP). In the following, we refer to the latter as per capita public HCF.

[3] Private health insurance can offer primary, duplicate, complementary and supplementary coverage. For a detailed discussion of these different functions, see OECD [36].

[4] Disaggregated information on the different sources of HCF focused on the collecting stage is not available yet. Hence, health expenditures of public institutions (consisting of central government, provinces/states, municipalities/local governments, social security funds and selected private non-profit institutions) are taken as an indicator for public financing.

Explanatory variables

The public–private-HCF-ratio and the public financing level are not only an instrument of health care policy but they also picture the private behaviour in the health care sector including the private reactions to changes in the health care policy. Consequently, we have to use a perspective that is able to explain the joint allocation of resources to the public and private sectors of the health care system. Gouveia [17] offers such an approach. According to his results, private and public expenditures are determined by the distribution of individual characteristics (e. g. morbidity risk distribution, income) and institutional features (financing structure in the public sector, decision rule in the public sector, shape of private insurance contracts, etc.). Which implications can be drawn for the convergence in HCF from this perspective?

We expect that the public health care ratio (level) of financing is the same for different countries only, if the distribution of individual characteristics and preferences and the institutional features are the same across all countries. Only in this extreme case, the steady state in the financing ratio (level) is expected to be the same for all countries. If, under these assumptions, differences in the financing ratio (level) are observable, these can only result from institutional rigidities or path dependencies after previous shocks. If the institutional design of the financing system differs between the countries, similar changes in the individual characteristics may have different effects on the financing ratio (level). The variations in these effects are intensified, if cross-country differences in the financing systems as well as individual characteristics coincide. In a nutshell, this may lead to convergence clubs and not to a general convergence [22]. In summarising these arguments, we conclude that the concept of conditional β-convergence seems to be a more appropriate approach. We take these considerations into account by controlling for the following characteristics:

- Public health insurance coverage (*publiccov*): We expect a positive relationship between the proportion of the population with public health insurance coverage and the public ratio (level) in financing. The increase of this proportion includes a crowding out effect of private financing, especially when the two insurance options are substitutes. In addition, at least in health care systems of the social health insurance (SHI) type, public health insurance coverage broadens the basis of public financing.
- Demographic burden (*elderly*): All health care systems face an increasing burden due to the increase of life expectancy and the shifting in the proportion of the different generations. In general, previous empirical

evidence of the effect of an increasing demographic burden on health care expenditures is ambiguous. Particularly, the effect on the public financing ratio seems to be unclear and strongly depends on the institutional design of the health care system. One might argue that an increasing number of the elderly positively influences the public financing ratio (level), as a rising demographic burden intensifies the need for intergenerational redistribution, and this is more likely to be insured by public financing. But these shifts in the public burden could induce counter effects resulting in an increase in private financing. We control for potential effects by including a variable capturing the proportion of a country's population older than 65 years.

- Openness of the economy (*openc*): We argue that differences in the openness of an economy might lead to country-specific steady states of public health care financing at different levels. In this context, there exist two strands of arguments. On the one hand, the 'compensation hypothesis' claims that the emerging internationalisation of economies leads to an increasing demand for public assistance to cover social risks [22]. On the other hand, the 'race to the bottom hypothesis' claims a downsizing of the public institutions for social assistance to their efficient level or even to a level below the efficient one [48]. In the present study, we use total trade (sum of exports and imports) in % of GDP as an indicator for economic openness.
- Political orientation of the government (*taxrev, union*): At least to some extent, the financing ratio and the level of public financing are fixed in a political decision process and therefore reflect the preferences of the political agents on public provision in general. We include information on: (i) the overall tax revenues as a % of GDP (*taxrev*) and (ii) on the proportion of the working population organised in trade unions (*union*) as indicators for the political orientation.
- Income (*gdpcap*) as a driver of health care expenditures: Empirical literature on the health expenditure/GDP relationship widely agrees that GDP per capita is one of the major drivers of health care expenditures [38]. This is not only true for the overall health care expenditures but also for the two components private and public financing. But as Gouveia [17] and Clemente et al. [7] demonstrate, the effect of differences in the level and growth of GDP per capita on the two components might be different, depending on the institutional design of the public and private financing scheme. In addition to this, preferences for different forms of risk coverage might change when income rises. If we assume that the variety of health care packages is a superior good, we would expect that an increase in GDP would strengthen the private health care provision (financing). On the other hand, the coverage of health care risks could be interpreted as a superior good and public coverage is an important—in some situations preferable—option of protection. Consequently, we are not able to conclude that the convergence in GDP per capita automatically leads to a convergence in the financing ratio. Information on income is included in the form of logarithmic GDP per capita as constant 2,000 US$.
- Time effects: Time dummies are included in the regression analysis to control for time trends.[5]
- Type of the health care system: As already highlighted, the institutional design of the health care system acts as a 'filter' which transforms external changes/shocks in the economic and demographic surroundings into decisions and outcomes. The term 'institutional design' captures more than just budget constraints and financing schedules in a narrow economic sense. It also includes informal institutions such as the 'culture' of decision-making and conflict resolution. We control for these potential differences by separating the sample into three different country groups: countries that follow the principles of national health services (NHS), countries with social health insurance (SHI) and others. The separation of NHS and SHI countries is only applied to the European countries taking into account the specific history of the European health care systems.

Data sources and sample design

Data employed for the analyses in the present paper are taken from different sources. Information regarding HCF (*public, rphfpc, publiccov, gdpcap, elderly*) stems from the OECD health statistic database. This source originally includes information on 30 countries with a time coverage starting in the year 1960. Information on public health insurance coverage for the USA is taken from Cohen et al. [8]. Data on the countries' trade volume *openc* and GDP per capita *gdpcap* are reported in the World Development Indicators (WDI) published by The World Bank for over 200 countries, starting in the year 1960. Total tax revenues stem from the OECD Tax Statistics, Revenue Statistics that reports values for a large number of OECD countries from 1955 on. Finally, trade union density for OECD members from 1960 on is collected in the OECD's online Employment database[6]. Our final data set covers a period of 36 years (1970–2005) for which most of the relevant

[5] Overall, time invariant, country-specific characteristics and differences in the countries' health care systems that cannot be addressed specifically are accounted for by the specific estimation method (biased corrected LSDV estimator) applied.

[6] http://www.oecd.org/document/21/0,3343,en_2649_33927_40917154_1_1_1_1,00.html

variables are available. The remaining few gaps are filled by linear inter- or extrapolation provided that we observe a strong temporal relation between the entries observed.[7] A brief description on the variables included and their measurement is summarised in Table 7 in the "Appendix".

Econometric specifications

To test convergence in HCF, we apply the concepts of σ-convergence as well as absolute and conditional β-convergence.[8] In particular, we examine the convergence in public financing in % of total HCF (*public*) and per capita public HCF (*rphfpc*) towards their respective steady state level using cross-section and panel data analyses. We start with analysing σ-convergence pictured by the coefficient of variation (CV) and its development over time. It is calculated from cross-section information by dividing a variable's standard deviation σ by its mean μ where σ and μ are averaged over countries:

$$\mathrm{CV} = \frac{\sigma}{\mu} \tag{1}$$

The concept of β-convergence is the second convergence measure applied. In these regression analyses, the focus is on examining whether a series moves towards its mean over time. Barro and Sala-i Martin [3] show that the average growth rate (based on the neoclassical growth model) of y over a time period between 0 and T is

$$\frac{1}{T}\ln\left(\frac{y_T}{y_0}\right) = x + \frac{1-e^{-\beta T}}{T}\ln\left(\frac{y^*}{y_0}\right) \tag{2}$$

where x denotes the steady-state growth rate and y^* represents the steady state of y. The base equation, we estimate in this paper, is a reformulation of Eq. 2 and reads as

$$\frac{1}{T}\ln y_{iT} = \alpha_i + b\ln y_{i0} + \epsilon_i \tag{3}$$

where y stands either for *lopublic*—which is the transformation suggested by Wooldridge [49], p. 662: $\ln\frac{\text{public}}{1-\text{public}}$ or *rphfpc*, $\alpha_i = x_i + \frac{1-e^{-\beta T}}{T}\ln y_i^*$, b pictures the convergence coefficient and consists of $\frac{e^{-\beta T}}{T}$ and ε refers to the error term. T indicates for how many years data are available, the index 0 describes the initial period. i stands for country as the cross- sectional unit. Equation 3 examines convergence in the cross- section. If $\alpha_i = \alpha$, i. e., the same for all countries, and $b < 1$, this implies that countries unconditionally move towards a uniform steady state.[9]

In order to analyse convergence based on panel data, we use an extension of Eq. 3 which applies for discrete periods:

$$\ln y_{it} = \alpha_i + b\ln y_{it-1} + \gamma z_{it-1} + \eta_t + \epsilon_{it} \tag{4}$$

with $\alpha_i = x_i + (1-e^{-\beta T})\ln y_i^*$ and $b = e^{-\beta}$. y again represents the dependent variables *lopublic* and *rphfpc*, respectively. The parameter α_i introduces a shift that may be different for each country, i. e., it allows for a movement towards country-specific means. Beside this 'general' country dummies, the lagged dependent variable y_{t-1} and time fixed effects η_t, we include lagged country characteristics as further explanatory variables z_{t-1} as discussed in "Explanatory variables".[10] ε_{it} is the disturbance term.

Nerlove [31] and Nickell [32] point at the bias of the fixed effects estimator when the lagged dependent variable is included in the RHS of the equation. Although this dynamic panel bias is declining with an increasing number of time periods, we opt for applying the bias corrected least square dummy variable (LSDV) estimator as suggested by Kiviet [23] and implemented by Bruno [5].

Before analysing convergence in *public* and *rphfpc* using panel data, we test for stationarity of the variables included. We apply the panel unit root test developed by Levin et al. [24]. We consider that the bias corrected estimator applies a within transformation that removes the group and time means from all variables on both sides of the regression. Hence, we test whether these demeaned variables exhibit a unit root including variable specific lag lengths in the test equation.[11] This test rejects the null hypothesis of non-stationarity at the 1% significance level for the two dependent and all independent variables used in our model.

Equation 4 (as well as 3) implies that the convergence coefficient b and, hence, the speed of β-convergence do not vary across countries. We relax this assumption and test for potential differences in convergence patterns by running

[7] Only for data on union density and total tax revenues in Iceland, we cannot justify this replacement of missing entries which results in a loss of 13 observations.

[8] The latter concepts were developed within the framework of neoclassical growth models to explain the convergence in aggregate output (see [3] for convergence in income per capita) and assume the existence of a steady-state in economic development.

[9] Note that our dependent variable refers to its quantity in period t (instead of its growth). If we subtracted 1 from the parameter b, we would get the corresponding coefficient if the growth rate was the dependent variable. The speed of β-convergence can be calculated from the regression coefficient b on the initial level y_0. For example, for the specification at hand, the speed of convergence equals $-\frac{\ln(Tb)}{T}$.

[10] One may doubt the exogeneity of the explanatory variables included. Although public HCF may shape the regressors used, such influences do not occur contemporaneously. Rather, it is adequate to assume that the effects of public HCF on the regressors occur with some time lags meaning that today's HCF influences tomorrow's insurance coverage, proportion of elderly, GDP, … but not today's levels.

[11] We determine the number of lags to be included based on the Schwartz Bayesian information criterion and the Akaike information criterion.

Table 1 Descriptive statistics

Variable	Obs	Mean	SD	Min	Max
Dependent variables					
Public financing as % of HCF	792	75.68	11.74	36.30	98.30
Public health financing/capita[a]	792	1239.23	551.834	102.66	3300.36
Independent variables					
Public health insurance coverage[b]	792	92.43	19.79	5.00	100.00
Population > 65[b]	792	13.31	2.46	7.10	20.20
Total trade (exports + imports)[c]	792	69.24	41.90	11.25	289.10
Trade union density[d]	779	42.65	20.86	0.00	96.40
Total tax revenue[c]	784	35.13	7.47	15.92	52.74
GDP per capita[e]	792	19920.08	7895.03	4282.11	52307.02
Variables used for calculation					
Health expenditure per capita[a]	792	1669.80	803.74	174.00	5616.00

[a] As constant 2,000 US$ PPP,
[b] As % of total population,
[c] As % of GDP, [d] As % of the working population,
[e] As constant 2,000 US$

separate regressions for particular subgroups classified through: (i) a country's health care system (NHS vs. SHI) and (ii) specific time periods. For convergence to occur, b has to be significantly lower than one.[12]

Results

Descriptive statistics

Table 1 reports descriptive statistics of the variables included in the final data set.

On average, public financing in % of total HCF (*public*) accounts for three-quarters of HCF. Annual per capita public HCF (*rphfpc*) amounts to 1,240 US$ on average.[13] The mean of public health insurance coverage indicates that a high proportion –92%—has public health coverage and 13.3% of the countries' population is older than 65. On average, the countries' proportion of trade is 69% of GDP and the total tax revenue is approx. one-third of GDP. Finally, union density in the sample is on average 43%, and GDP per capita averages at 20,000 US$.

Figure 3 in the "Appendix" depicts the average share of public financing for the total sample as well as for two subgroups. The subgroups consist of 10 European countries which run a National Health Service (NHS) and 6 countries characterised by Social Health Insurance (SHI).[14] Considering the total sample, the proportion of public financing starts at a value of 73.5% in 1970 and ends with an average of 75.1% in 2005. The minimum (maximum) appears in 1971 (1979) and amounts to 72.9% (78.6%). The series reveals similar tendencies for European NHS countries with a minimum of 77.0% in 1999 and a peak at 85.3% in 1979. For the group of European SHI states, the series follows a different pattern with a minimum (maximum) of 75.5% (81.2%) in 1992 (1993).[15]

The temporal development of per capita public HCF (*rphfpc*) is shown in Fig. 4. The initial values are rather similar for each group and range between 509 and 559 US$. The respective value for the total sample (which again includes all 22 countries) averages at 545 US$. *rphfpc* increases over the years and amounts to 2,069 US$ (2,367 US$) in the European NHS (SHI) countries in the year 2005.

Figures 5 and 6 in the "Appendix" provide a first answer to the question whether convergence is observable regarding the level of *public* and *rphfpc* (β-convergence). Figure 5 (Fig. 6) depict the countries' average annual growth rate of *public* (*rphfpc*) in % on the y-axis and its initial value on the x-axis. The data points indicate a negative relationship between growth and initial level. In other words, countries with initially low levels of *public* and *rphfpc*, respectively, grow faster on average than countries with high initial values, implying that the countries finally converge to each other.

Empirical estimates

This section presents the outcome of the analysis described in "Econometric specifications". We examine

[12] If $b = 1$, the series follows a random walk.

[13] These values were calculated by multiplying *public* with the real health expenditures per capita that range from 174 to 5,616 US$ with a mean of 1,670 US$.

[14] NHS countries are Denmark, Finland, Ireland, Iceland, Italy, Norway, Portugal, Sweden, Spain and the United Kingdom. Austria, Belgium, Germany, France, Luxembourg and the Netherlands represent the group of SHI countries. Australia, Canada, Japan, New Zealand, Switzerland and the United States together form the group 'Others' as they can neither be classified as NHS nor as SHI countries (Switzerland, USA) or do not belong to Europe.

[15] In order to improve clarity, we forgo plotting *public* for the third group. The corresponding values are lower at each point in time. The minimum (maximum) is 63.2% (69.3%) in 1971 (1984). The line in Fig. 3 referring to the total sample includes these values. This explains why the curve picturing the total sample always runs below the curves for the two other subsamples.

σ-convergence (measured as CV according to Eq. 1) for the total sample and for the NHS and SHI subsamples using *public* and *rphfpc*. Figures 1 and 2 graphically picture the trend of the CV.[16] Table 2 presents the annual average growth in σ-convergence for both series and different time periods.

For the total sample, the CV decreases from 0.180 to 0.133 (Fig. 1) and from 0.409 to 0.222 (Fig. 2), respectively. The annual average growth in σ-convergence amounts to -0.8% for *public* and to -1.7% in case of *rphfpc*. However, the rate of convergence differs across the time periods. For both series, we find the most pronounced decline in the period 1970–1979.

Figures 1, 2 and Table 2 picture that the rate of convergence differs not only across time but also across European NHS and SHI countries. We find that with respect to *public* (Fig. 1), the CV is almost identical, i.e., 0.14, for NHS and SHI countries in the year 1970. However, the two CV series considerably fluctuate over time with phases of partly pronounced divergence patterns. This trend averages in convergence in the SHI countries in the first two periods and in divergence between 1995–2005. In NHS countries, we observe convergence between 1970 to 1979 and 1995 to 2005, while divergence occurs between 1980 and 1994. In 2005, the CV is considerably higher for SHI than for NHS countries (0.111 vs. 0.068). This trend is also pictured in the annual average growth in σ-convergence (see Table 2), indicating a more distinctive convergence pattern for NHS than for SHI countries.

With respect to *rphfpc*, the CV is smoother (Fig. 2). The NHS and SHI countries start from different levels and approximate over the years. For NHS (SHI) countries, CV falls from 0.573 (0.214) in 1970 to 0.260 (0.199) in 2005 which implies a higher rate of convergence for NHS than for SHI countries (see columns (5) and (6) in Table 2). In fact, for the latter the growth rate for the whole period indicates that SHI countries actually diverge. This average divergence pattern is mainly a result of the pronounced increase in CV between 1995 and 2005.

Our first set of regression estimates refers to the concept of absolute convergence using cross-section data. Due to the small sample size at this level, we desist from running separate calculations for each subsample and from investigating conditional convergence. However, for both of our dependent variables, *lopublic* and ln *rphfpc*, we conduct regressions for the whole time span 1970–2005 as well as for smaller time segments to test whether the coefficients on the initial values vary across time. The estimates given in column (1) in Tables 3 and 4 cover 36 years, columns

[16] As before, we do not plot the values for the other countries for clarity reasons but their values are included in the plot representing the total sample.

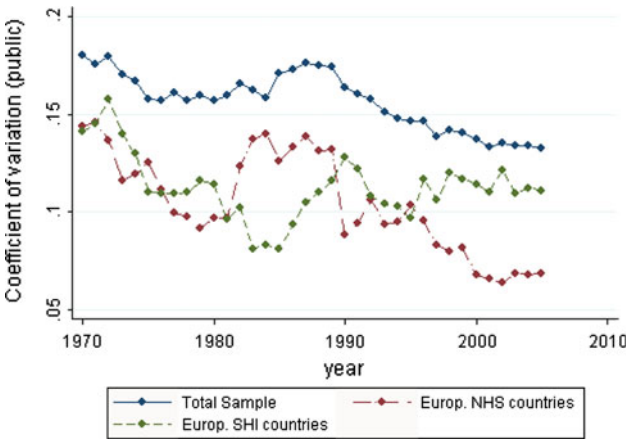

Fig. 1 Coefficient of variation—public financing in % of total HCF

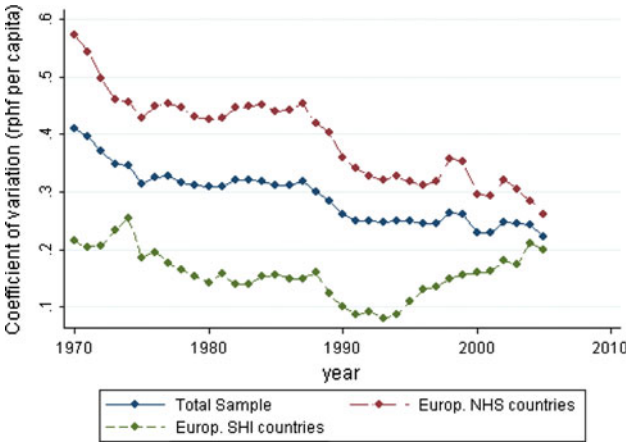

Fig. 2 Coefficient of variation—per capita public HCF

Table 2 Annual average growth in σ-convergence

Period	Public financing					
	In % of total HCF			Per capita		
	(1) All (%)	(2) NHS (%)	(3) SHI (%)	(4) All (%)	(5) NHS (%)	(6) SHI (%)
1970–2005	−0.83	−1.54	−0.27	−1.65	−2.08	0.48
1970–1979	−1.32	−4.69	−1.86	−2.92	−3.01	−2.93
1980–1994	−0.45	1.19	−0.30	−1.41	−1.76	−3.25
1995–2005	−0.95	−2.69	1.09	−0.92	−1.75	8.36

σ-Convergence refers to the coefficient of variation

(2), (3) and (4) refer to the periods 1970–1979, 1980–1994 and 1995–2005, respectively. The coefficients associated with the initial values of each time period always reveal a significant impact. They indicate that the lower a country's initial level of public financing—measured either as a % of total HCF or per capita—the more pronounced its

Table 3 Absolute β convergence in *lopublic*—cross-section analysis

Variable	(1) 1970–2005	(2) 1970–1979	(3) 1980–1994	(4) 1995–2005
Lopublic70	0.015 (0.003)***	0.098 (0.009)***		
Lopublic80			0.047 (0.006)***	
Lopublic95				0.074 (0.007)***
Obs	22	22	22	22
Adj R^2	0.53	0.80	0.68	0.83

Constant not reported. Bootstrap standard errors in parenthesis. *** Indicate the 1% level of significance

Table 4 Absolute β convergence in *lnrphfpc*—cross section analysis

Variable	(1) 1970–2005	(2) 1970–1979	(3) 1980–1994	(4) 1995–2005
Lnrphfpc70	0.007 (0.002)***	0.065 (0.004)***		
Lnrphfpc80			0.047 (0.005)***	
Lnrphfpc95				0.063 (0.012)***
Obs	22	22	22	22
Adj R^2	0.24	0.81	0.70	0.70

Constant not reported. Bootstrap standard errors in parenthesis. *** Indicate the 1% level of significance

subsequent corresponding growth is. This means that countries with low initial values catch up in terms of public financing.

The following estimates take advantage of the panel structure of the data and are based on the bias corrected LSDV estimator [5, 23]. We include time dummies in order to control for time fixed effects. In addition to the lagged dependent variable and the time dummies, we introduce further explanatory variables (once lagged) to examine whether specific differences across countries induce a movement to a country's own steady state which is known as conditional convergence (see Eq. 4). We conduct separate regressions for the NHS and SHI countries as well as for three different time periods, 1970–1979, 1980–1994 and 1995–2005, respectively. Table 5 shows the results for *lopublic*, Table 6 presents the estimates for ln *rphfpc*.

For *lopublic*, the coefficients on the lagged dependent variables are always significantly (at a 1% significance level) smaller than one implying that countries with low initial public financing move faster towards their respective steady state. This holds for the total sample, the NHS and SHI subsamples as well as each time period. These estimates additionally reveal that the rate of convergence[17] is highest in the first period (1970–1979) and decreases (not monotonically) over time. For ln *rphfpc*, similar patterns occur with one exception: during the period 1980–1994 we cannot reject the H_0 hypothesis that the series follows a unit root, i.e., that the coefficient on the lagged dependent variable equals one.

As for *public*, the explanatory variables included indicate that a country's public health insurance coverage *publiccov*, the openness of its economy *openc*, union density *union*, total tax revenues *taxrev* and GDP per capita *gdpcap* induce a movement towards a country specific mean but the impact of these variables differs across health care systems and time periods.

Regarding per capita public HCF ln *rphfpc* (see Table 6), the independent variables play a stronger role and provide evidence that the country's public health insurance coverage *publiccov*, the proportion of elderly *elderly*, union density *union*, total tax revenues *taxrev* and GDP per capita ln *gdpcap* are important determinants which promote country specific means. As before, the influence of these characteristics is not equally present across health care systems and time periods.

The results given in the Tables 5 and 6 are in line with the findings of the graphical and cross-section analyses as they indicate convergence in public financing in % of total HCF and per capita public HCF, respectively.

Robustness analysis

By running separate regressions for NHS and SHI, we examined whether these groups differ in their rate of convergence. Variations may occur considering even smaller entities. Therefore, we further split the NHS countries into old and new NHS countries.[18] With respect to *lopublic*, the rate of convergence in old and new European NHS countries is rather similar (0.811 vs. 0.882) and differs

[17] For the panel specification, the rate of convergence is given by $\beta = -(ln\ b)$.

[18] We classify those countries as old NHS countries which were already NHS-systems at the beginning of the observation period (Denmark, Great Britain, Finland, Iceland, Ireland, Norway, Sweden). Countries that changed to a NHS-system during the past 36 years are defined as new NHS countries (Italy in 1978, Portugal in 1979, Spain in 1987).

Table 5 Conditional β convergence in public financing in % of total HCF—panel data

Variable	(1) All	(2) NHS	(3) SHI	(4) 1970–1979	(5) 1980–1994	(6) 1995–2005
$lopublic_{t-1}$	0.8879 (0.0233)***	0.8590 (0.0399)***	0.8304 (0.0574)**	0.3965 (0.0764)***	0.6365 (0.0475)***	0.6324 (0.0554)***
$publiccov_{t-1}$	−0.0012 (0.0013)	−0.0006 (0.0018)	−0.0045 (0.0043)	−0.0012 (0.0037)	−0.0090 (0.0046)*	0.0110 (0.0089)
$elderly_{t-1}$	0.0028 (0.0070)	0.0029 (0.0175)	−0.0368 (0.0237)	−0.0149 (0.0727)	0.0413 (0.0296)	0.0027 (0.0057)
$openc_{t-1}$	0.0002 (0.0010)	0.0015 (0.0018)	−0.0013 (0.0015)	−0.0034 (0.0062)	0.0020 (0.0026)	−0.0024 (0.0007)***
$union_{t-1}$	−0.0017 (0.0012)	−0.0024 (0.0011)**	−0.0020 (0.0038)	−0.0012 (0.0039)	0.0029 (0.0018)	−0.0008 (0.0053)
$taxrev_{t-1}$	−0.0012 (0.0022)	0.0005 (0.0046)	0.0000 (0.0058)	0.0031 (0.0083)	−0.0097 (0.0057)*	0.0014 (0.0042)
ln $gdpcap_{t-1}$	0.0469 (0.0676)	−0.0543 (0.1420)	0.0265 (0.2627)	0.0022 (0.4451)	0.7292 (0.1357)***	0.2430 (0.1581)
Obs.	758	338	210	189	308	218
F tests						
Time effects	28.98***	19.03**	5.79	38.14***	475.16***	31.88***
$b = 1$	23.12***	12.48***	8.74***	62.45***	58.54***	43.98***

Constant and time effects not reported. Bootstrap standard errors in parenthesis

*, ** and *** Indicate the 10%, 5% and 1% level of significance

Table 6 Conditional β convergence in per capita public HCF - panel

Variable	(1) All	(2) NHS	(3) SHI	(4) 1970–1979	(5) 1980–1994	(6) 1995–2005
$lnrphfpc_{t-1}$	0.8974 (0.0142)***	0.8563 (0.0300)***	0.8080 (0.0450)***	0.7047 (0.0663)***	0.9311 (0.0472)***	0.7241 (0.0352)***
$publiccov_{t-1}$	−0.0008 (0.0005)*	−0.0005 (0.0006)	0.0004 (0.0018)	−0.0003 (0.0012)	0.0008 (0.0017)	0.0100 (0.0048)**
$elderly_{t-1}$	0.0005 (0.0021)	0.0110 (0.0059)*	−0.0122 (0.0074)*	−0.0179 (0.0206)	0.0044 (0.0100)	−0.0043 (0.0028)
$openc_{t-1}$	0.0000 (0.0003)	0.0000 (0.0005)	0.0002 (0.0005)	−0.0004 (0.0017)	0.0006 (0.0009)	0.0000 (0.0004)
$union_{t-1}$	−0.0013 (0.0004)***	−0.0015 (0.0003)***	−0.0010 (0.0010)	−0.0016 (0.0012)	−0.0021 (0.0007)***	0.0002 (0.0027)
$taxrev_{t-1}$	0.0004 (0.0007)	−0.0013 (0.0015)	0.0055 (0.0019)***	0.0052 (0.0025)**	−0.0039 (0.0020)*	0.0018 (0.0020)
ln $gdpcap_{t-1}$	0.1113 (0.0256)***	0.1654 (0.0386)***	0.1157 (0.0775)	0.3011 (0.1258)**	0.1481 (0.0651)**	0.3287 (0.0912)***
Obs.	758	338	210	189	308	218
F tests						
Time effects	25.56***	23.29***	184.39***	412.79***	12.63	1152.97***
$b = 1$	52.11***	23.02***	18.18***	19.84***	2.13	61.29***

Constant and time effects not reported. Bootstrap standard errors in parenthesis

*, ** and *** Indicate the 10%, 5% and 1% level of significance

significantly from 1. For public financing per capita, the results picture similar patterns as for *lopublic*. *b* is significantly different from 1 indicating convergence and amounts to 0.825 (old NHS) and 0.705 (new NHS), respectively.

One may argue that the influences observed are due to short-run changes and may diminish once one looks at a longer time span instead of using yearly data. In order to check the robustness of our results, we pooled the data for every 3 years (this results in a sample size of 218 observations) and run the same regressions as above. The respective estimates confirm the finding from our basic specification: The coefficient on *b* is significantly lower than one and indicates that convergence occurs. In both specifications, the country's public health insurance coverage *publiccov*, trade union density *union* and GDP per capita *ln gdpcap* are significant determinants that confirm that the countries convert towards a country specific mean.

Finally, we introduce interaction terms of the convergence parameter *b* with each country dummy as suggested by Nixon [33] and test whether the corresponding coefficients are jointly significant. We can reject the H_0 hypothesis of jointly insignificant slope differences (at a 5% level) and that of $b = 1$ (at a 1% level) for both measures of public financing. Hence, these tests support our conclusion that the rate of convergence is country specific and that countries move towards a country specific mean.

Conclusions and suggestions for future research

Convergence in health care financing is one source to promote workers' mobility, to harmonise policies and to boost cross-border shopping within the health care sector. Hence, we are interested in learning about the corresponding convergence patterns. The analysis in this paper refers to the question whether the financing structure (public–private financing mix) of the health care systems in 22 OECD countries converges. To answer this research question, we focus on the public financing ratio which we measure by two variables: public financing as % of total health care financing (HCF) and real public financing per capita as constant US$ PPP.

Beside the focus of the hitherto disregarded financing side, this paper contributes to the existing literature by providing a long-run perspective (36 years) of convergence patterns using a broad sample of 22 OECD countries. σ-convergence (measured as coefficient of variation), absolute and conditional β-convergence are used to examine whether public financing converges. We split this sample into subgroups to test whether different developments occur across the health care systems (NHS vs. SHI) in Europe and time segments (1970–1979, 1980–1994, 1995–2005). Country-specific characteristics are captured by information on a country's public health insurance coverage, proportion of a country's population older than 65 years, openness of the economy, trade union density, total tax revenues and GDP per capita.

Our major finding is that convergence takes place. This conclusion is independent of the specification of the dependent variable (public financing in % of total HCF as well as per capita public HCF), the different methods of testing for convergence (σ-convergence, absolute and conditional β-convergence) and the different assignments of countries to subsamples (NHS and SHI states). Furthermore, in both series the explanatory variables included indicate a movement towards a different mean although the impacts are not equally pronounced for each dependent variable across the health care systems and time periods. Splitting the observation period into three time segments further highlights that the rate of convergence is decreasing (although not monotonically) over time.

We are aware that the change in the share and level of public financing only gives a first impression of the convergence issue in health care financing. For a deeper understanding of the determinants and effects of convergence, we have to consider how the relationship between public and private financing is structured in detail. There exist at least five basic designs of this relationship: (i) Parallel public and private financing systems: for a given range of services, a separate privately financed system exists as an alternative to public financing. (ii) Co-payment: Across a broad range of services, financing is partially subsidised through public payment, with the remainder financed through out-of-pocket (OOP) payment or private health insurance. The degree of co-payment can follow different schedules and may be scaled according to the income and/or other individual characteristics of the patient. (iii) Group-based: Certain population groups are eligible for public coverage, others rely on private health insurance or are free to choose private options. (iv) Sectoral: Certain health care sectors are entirely financed publicly (e.g. inpatient care) while others mainly rely upon private finance (e. g. pharmaceuticals). (v) In addition to the differences in the private–public relationship, the internal structure of public (tax and/or SHI) and private (private health insurance and/or OOP) seems to be important.

In a nutshell, this means that the same shares and levels of public financing we observe in reality are compatible with different links in the designs (i) to (v). The approaches to explain the public–private financing structure offered so far [7, 17] do not account for this institutional diversity. E.g., in the Gouvea-Model the private sector only acts as a complement to an obligatory publicly financed health care sector and only consists of private health insurance. OOP payments that account for a substantial part of private health care financing in reality are not included in their political economic perspective.

We are convinced that deeper insights into the convergence issue could be derived by studying the financing structure in more detail. On the one hand, this means splitting up public/private financing into its most important building blocks. On the other hand, it seems to be promising to take a closer look at the financing structure in the different sectors of health care provision such as outpatient care, inpatient care and pharmaceuticals. This detailed analysis of the financing structure requires disaggregated data about HCF (public–private relationships). No reliable data on the dimensions mentioned are available for the time period 1970–2005. Information on a very limited sample of OECD-countries exists only since 1990. However, a disaggregated study needs to be on future research agendas to capture and understand the ongoing processes in HCF in their complexity.

Appendix

See Table 7; Figs. 3, 4, 5, and 6.

Table 7 Variables used for analysis

Variable	Description
Dependent variables	
public	Public financing as % of total health care financing
rphfpc	Real public health care financing per capita as constant 2,000 US$ PPP (calculation: *healthexpcap*public*)
Independent variables	
publiccov	% of population with public health insurance coverage
elderly	% of population older than 65
openc	Total trade (sum of imports and exports) as % of GDP
union	Trade union density as % of the working population
taxrev	Total tax revenue as % of GDP
gdppc	GDP per capita as constant 2,000 US$
Variables used for calculation	
healthexpcap	Health expenditure per capita as constant 2,000 US$ PPP

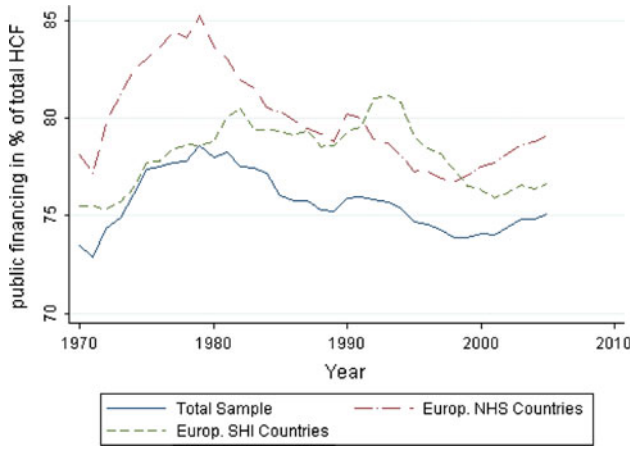

Fig. 3 Average public financing in % of total HCF

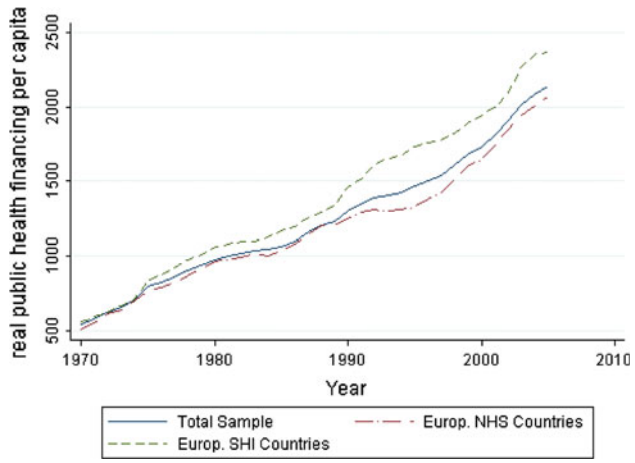

Fig. 4 Average public financing per capita

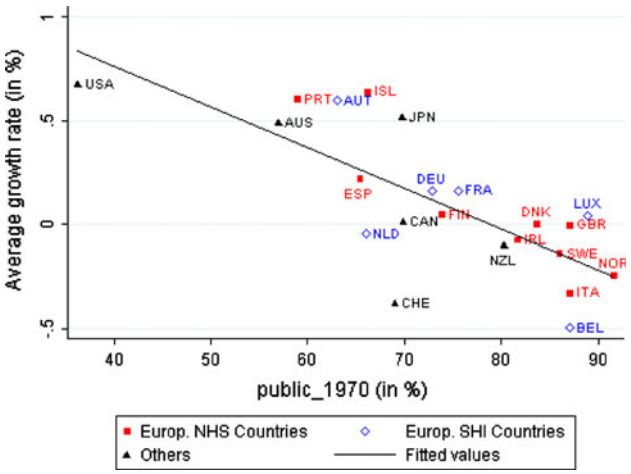

Fig. 5 Average growth rate of public financing in % of total HCF

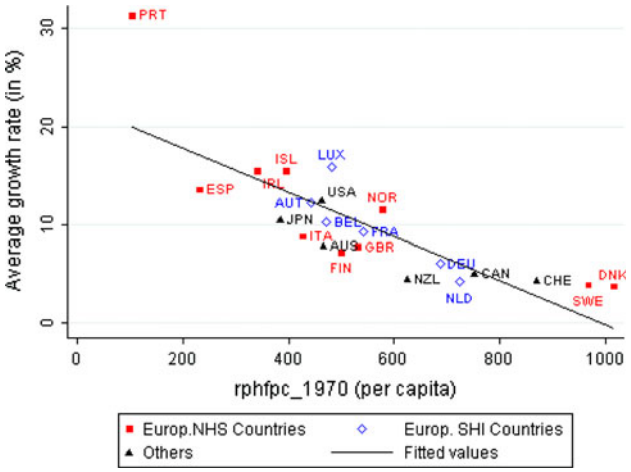

Fig. 6 Average growth rate of public financing per capita

References

1. Alcalde-Unzu J., Ezcurra R., Pascual P.: Cross-country disparities in health-care expenditure: a factor decomposition. Health Econ. **18**, 479–485 (2009)
2. Aldridge, S.C., Sundarapandiyan, S.: The convergence model in health care reform: experience from Singapore, the United Kingdom and the United States. Asian J. Public Admin. **17**, 60–104 (1995)
3. Barro, R.J., Sala-i Martin, X.: Convergence. J. Politic. Econ. **100**, 223–251 (1992)
4. Bernard, A.B., Durlauf, S.N.: Interpreting tests of the convergence hypothesis, technical working paper series 159, NBER (1994)
5. Bruno, G.S.F.: Estimation and inference in dynamic unbalanced panel data models with a small number of individuals, working paper 165, Universita Bocconi-CESPRI (2005)
6. Busse, R., Schreyögg, J., Gericke, C.: Analyzing changes in health financing arrangements in high-income countries—a comprehensive framework approach, health, nutrition and population (HNP) discussion paper of the World Bank's Human Development Network, World Bank. http://www.worldbank.org/hnppublications (2007)

7. Clemente, J., Marcuello, C., Montañes, A., Pueyo, F.: On the international stability of health care expenditure functions: are government and private functions similar? J. Health Econ. **23**, 589–613 (2004)
8. Cohen, R.A., Makuc, D.M., Bernstein, A.B., Bilheimer, L.T., Powel-Griner, E.: Health insurance coverage trends: estimates from the national health interview survey. Natl. Health Stat. Rep. **17**, 1–28 (2009)
9. Comas Herrera, A. Is there a convergence in the health expenditures of the EU member states. In: Mossialos E., Le Grand J. (eds) Health Care and Cost Containment in the European Union. Ashgate, Aldershot, pp. 197–218 (1999)
10. Corrado, L., Londoño, B.D.A., Mennini, F.S., Trovato, G.: The welfare states in a United Europe. Eur. Politic. Econ. Rev. **1**, 40–55 (2003)
11. Dreger, C., Reimers, H.-E.: Health care expenditures in OECD countries: a panel root and cointegration analysis. Int. J. Appl. Econ. Quant. Stud. **2**, 5–20 (2005)
12. Gerdtham, U.-G., Löthgren, M.: On stationarity and conintegration of international health expenditure and GDP. J. Health Econ. **19**, 461–475 (2000)
13. Glied, S.A.: Health care financing, efficiency, and equity, working paper No. 13881, NBER. http://www.nber.org/papers/w13881 (2008)
14. Glied, S.A.: Universal public health insurance and private coverage: externalities in health care consumption, working paper No. 13885, NBER. http://www.nber.org/paperss/w13885 (2008)
15. Globerman, S., Hodges, H., Vining, A.: Canadian and US health care systems performance and governance: elements of convergence, technical report, EconWPA. http://www.129.3.20.41/eps/pe/papers/0404/0404003.pdf (2001)
16. Globerman, S., Vining, A.: A policy perspective on 'mixed' health care financial systems of business and economics. J. Risk Insur. **65**, 57–80 (1998)
17. Gouveia, M.: The public sector and health care. Int. Tax Public Financ. **3**, 329–349 (1996)
18. Hansen, P., King, A.: The determinants of health care expenditure: a cointegration approach. J. Health Econ. **15**, 127–137 (1996)
19. Hitiris, T., Nixon, J.: Convergence of health care expenditure in the EU countries. Appl. Econ. Lett. **8**, 223–228 (2001)
20. Hurley, J.: An overview of the normative economics of the health care sector. In: Culyer A.J., Newhouse J.P. (eds) Handbook of Health Economics, vol. 1A. Elsevier, Amsterdam, pp. 55–118 (2000)
21. Kerem, K., Puss, T., Maldre, R.: Health and convergence of health care expenditure in EU. Int. Business Econ. Res. J. **2**, 29–43 (2008)
22. Kim, T.-K., Zurlo, K.: How does economic globalisation affect the welfare state? focusing on the mediating effect of welfare regimes. Int. J. Soc. Welf. **17**, 1–12 (2008)
23. Kiviet, J.F.: On bias, inconsistency, and efficiency of various estimators in dynamic panel data models. J. Econ. **68**, 53–78 (1995)
24. Levin, A., Lin, C.-F., Chu Chia-Shang, J.: Unit root tests in panel data: asymptotic and finite sample properties. J. Econ. **108**, 1–24 (2002)
25. MacDonald G., Hopkins S.: Unit root properties of OECD health care expenditure and GDP data. Health Econ. **11**, 371–376 (2002)
26. Mayer-Foulkes, D.: Convergence clubs in cross-country life expectancy dynamics, discussion paper No. 2001/124, World Institute for Development Economics Research (2001)
27. McCoskey, S., Selden, T.: Health care expenditures and GDP: panel data unit root test results. J. Health Econ. **17**, 369–376 (1998)
28. Montero-Granados, R., De Dios Jimenez, J., Martin, J.: Decentralisation and convergence in health among the provinces of Spain. Soc. Sci. Med. **64**, 1253–1264 (2007)
29. Narayan P.K.: Do health expenditures 'catch-up'?. Evidence from OECD countries. Health Econ. **16**, 993–1008 (2007)
30. Narayan, P.K., Narayan, S.: The role of permanent and transitory shocks in explaining international health expenditures. Health Econ. **17**, 1171–1186 (2008)
31. Nerlove, M.: Further evidence on the estimation of dynamic economic relations from a time series of cross-sections. Econometrica **39**, 359–387 (1971)
32. Nickell, S.: Biases in dynamic models with fixed effects. Econometrica **49**, 1417–1426 (1981)
33. Nixon, J.: Convergence analysis of health care expenditure using two approaches, Discussion Papers in Economics No. 99/3, University of York (1999)
34. Nixon, J.: Convergence of health care spending and health outcomes in the European Union, 1960-95, Discussion Paper Series No. 183, Centre for Health Economics (2000)
35. OECD: A System of health accounts, Paris (2000)
36. OECD: Private health insurance in OECD countries, Paris (2004)
37. Okunade, A., Karakus, M.C.: Unit root and cointegration tests: time series versus panel estimates for international health expenditure models. Appl. Econ. **33**, 1131–1137 (2001)
38. Okunade, A., Murthy, V.: Technology as a 'major driver' of health care costs: a cointegration analysis of the Newhouse conjecture. J. Health Econ. **21**, 147–159 (2002)
39. Okunade A., Suraratdecha C.: The pervasiveness of pharmaceutical expenditure inertia in the OECD countries. Soc. Sci. Med. **63**, 225–238 (2006)
40. Pierson, P.: Increasing returns, path dependence, and the study of politics. Am. Politic. Sci. Rev. **94**, 251–267 (2000).
41. Propper, C., Green, K.: A larger role for the private sector in health care? a review of arguments, working paper series no. 99/009, Centre for Market and Public Organisation (CMPO) (1999)
42. Saltman, R.B.: Convergence versus social embeddedness. Eur. J. Public Health **7**, 449–453 (1997)
43. Sanz I., Velázquez, F.J.: The evolution and convergence of the government expenditure composition in the OECD countries. Public Choice **119**, 61–72 (2004)
44. van Doorslaer, E., Koolman, X., Jones, A.: Explaining income-realted inequalities in doctors utilisation in Europe. Health Econ. **13**, 629–647 (2004)
45. Wagstaff, A., van Doorslaer.: Equity in health care finance and delivery. In: Culyer A., Newhouse J. (eds) Handbook of Health Economics, vol. 2. Elsevier, Amsterdam, pp. 1803–1862 (2000)
46. Wang, Z.: The convergence of health care expenditure in the US States. Health Econ. **18**, 55–70 (2009)
47. Wendt, C., Grimmeisen, S., Rothgang, H.: Convergence or divergence of OECD health care systems?. In: Cantillon B., Marx I. (eds) International Cooperation in Social Security. Antwerpen, Oxford, pp. 15–45 (2005)
48. Wolf, H.: Globalization and the convergence of social expenditure in the European union, occasional paper series, GW Center of the Study of Globalization (2002)
49. Wooldridge, J.M.: Econometric Analysis of Cross Section and Panel Data. Cambridge and London: MIT-Press(2002)