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Original Article

The Correlation between Economic Convergence and Health Indices in Developed Countries

***Hatice Mutlu** [1], **Gözde Bozkurt** [2], **Mesut Can Türkoğlu** [1]

1. Department of Health Management, Faculty of Health Sciences, Istanbul Beykent University, Istanbul, Türkiye
2. Department of Economics, Faculty of Economics and Administrative Sciences, Istanbul Beykent University, Istanbul, Türkiye

***Corresponding Author:** Email: haticemutlu@beykent.edu.tr

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Abstract

Background: Economic convergence signifies diminishing income disparities among global or regional economies and their eventual disappearance. It is also linked to economic growth and key health indicators. We aimed to assess the association between economic convergence and key health indicators in developed countries called G7 (USA, UK, Germany, France, Italy, Japan, and Canada).

Methods: We examined G7 health and economic indicators from 2000 to 2021 using panel data analysis. We compared balanced and unbalanced panel datasets to address missing data and applied suitable methods to handle missing health indicators.

Results: Little's MCAR test $(X^2 = 3.2872,\ P - value = 0.3494)$ confirmed random missing data in the unbalanced panel, enabling us to impute missing values as missing observations were below 5%. Unit root tests on balanced and unbalanced panel data validated the health convergence hypothesis, showing no unit roots in economic growth rate, current health expenditure, and female and male population indicators (P<0.05). Interestingly, the hypothesis for hospital bed counts in the unbalanced panel, differing from the balanced panel, offers new insights into addressing incomplete health data.

Conclusion: While G7 have economic similarities, their health indicators diverge (excluding hospital bed counts). Variations in health indicators stem from healthcare system structures, funding mechanisms, resource allocation, and health investments, even among economies of similar size. Therefore, G7 member states should develop tailored national health policies based on their specific circumstances and priorities, utilizing economic convergence data for effective health resource planning.

Keywords: Economic convergence; Health key indicators; Panel unit root

Introduction

Economic convergence suggests that income differences between global or regional economies decrease over time and eventually disappear (1). This concept is tied to market structure similarity, openness, technology transfer, innovation, policy harmonization, and economic mergers. The centralization of health policies among countries, the rapid rise in health expenditures, and, consequently, the convergence of health outcomes is crucial for global health (2).

According to the convergence hypothesis, economic growth in high-income countries slows down over time, and low-income countries grow faster and converge with them. A study conducted on the G7 and Emerging Seven (EM7) countries found that they responded similarly to global economic crises. However, post-crisis, the GDP growth rates of EM7 accelerated faster than those of the G7 (3). Health expenditures of countries with similar development levels may converge over time (4). Therefore, convergence in economic performance and living standards can lead to convergence in health expenditures (5).

There is a positive relationship between health expenditures and economic growth, and health expenditure convergence significantly contributes to convergence in growth (6). Economic convergence is closely linked to economic development. This study raises questions about whether the G7, representing the world's seven most advanced economies and accounting for 44.1% of global economic growth (7), are converging in terms of diverse economic and health indicators.

The G7 commits substantial resources to international health organizations and initiatives. The G7 Global Fund, a financing mechanism for AIDS, tuberculosis, and malaria prevention, treatment, and care programs, achieved an 83% commitment fulfillment on average from 2001 to 2020 (8). Every country possesses a distinct healthcare system shaped by its society's social, cultural, and traditional norms, lifestyles, and political structures.

The full convergence hypothesis is important in economic growth and development research, and the health convergence hypothesis is used in developing health policies and services. While studies on country groups such as the Organization for Economic Co-operation and Development (OECD), European Union (EU) or developing countries are common in the literature on economic convergence, studies on G7 are rare (9-11). There are positive and long-term relationships between economic growth and health expenditures (12). This situation has given rise to the motivation to test the economic convergence of countries with similar development levels using health performance indicators.

This study aims to determine to what extent the basic health indicator outputs of the G7, which has different health systems that affect the global economy and health, are related to economic convergence. In line with the findings, a perspective is presented so that decision-makers can approach the process multidimensionally and evaluate the situation from an economic perspective when evaluating the performance of health systems and structuring the system. In our study, unlike the literature, micro and macro data were used together. Our study provides an original evaluation because it contains arguments different from the analysis methods, sample size and data set available in the literature.

Materials & Methods

We investigated the health convergence hypothesis through micro and macro health indicators. The problem of missing observations in health data sets has been rarely addressed in empirical studies. Missing data methodologies are infrequently applied in panel data studies assessing the validity of the health convergence hypothesis. The study's aim gains significance by evaluating the efficacy of the econometric technique employed.

Data Collection and Sample Selection

Table 1 discusses the unbalanced panel data set containing the descriptive statistics of the G7 for the years 2000-2021 by using the World Bank data (13).

Table 1: Descriptive statistics of the unbalanced panel data set prepared within the scope of G7 countries (2000-2021)

Variable	*Shortening**	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*	*Observation*
Mortality rate, infant (per 1,000 live births)	*Infant*	4.043506	1.276122	1.7	7.1	154
Mortality rate, under-5 (per 1,000 live births)	*Under-5*	4.887013	1.386664	2.3	8.4	154
GDP growth (annual %)	*GDP*	1.26246	2.627622	-11.03086	7.52491	154
Population growth (annual %)	*Population*	.4526488	.4846741	-1.853715	1.436137	154
Population, female (% of total population)	*Female*	51.04637	.4341832	50.30795	51.65887	154
Population, male (% of total population)	*Male*	48.95363	.434183	48.34113	49.69205	154
Mortality from CVD, cancer, diabetes or CRD between exact ages 30 and 70 (%)	*Diseases*	12.25071	2.167334	8.3	18.1	140
Out-of-pocket expenditure (% of current health expenditure)	*Pocket*	14.77168	4.033477	7.137969	26.46448	140
Domestic private health expenditure (% of current health expenditure)	*Domestic*	27.71784	10.74507	15.73909	55.60621	140
Current health expenditure (% of GDP)	*Current*	10.51143	2.374579	7.034562	16.84432	140
Hospital beds (per 1,000 people)	*Beds*	5.949398	3.759359	2.46	14.69	133
Nurses and midwives (per 1,000 people)	*Nurses*	9.294127	2.302103	5.2102	15.685	126
Physicians (per 1,000 people)	*Physicians*	3.093667	.7020035	1.8871	4.4348	120

Source: World Bank (2023)
Note: * it refers to the short name of the variables used in the study.
It is seen that the number of observations for the variables examined varies due to missing data.

Analytic Methods

Panel data sets may contain the same observations at different time points or different observations at the same time points and are, therefore, unbalanced. To solve the problem of missing data, missing observations in your panel data set can be filled with appropriate techniques or models suitable for cutting data can be used. Missing data are unobserved values that would be meaningful to the analysis if observed; a missing value hides a significant discount. The most commonly used missing data identification system in the literature: Missing data types are examined in three groups: completely random missing data (MCAR), random missing data (MAR) and non-random missing data (MNAR). MCAR test is a test used for data gap analysis. This test helps determine whether the missing data is random or systematic. MCAR refers to a scenario where missing data is random, meaning missing values occur randomly, independent of other variables or data points. The MCAR test is used to assess whether missing data is random and uses a variety of statistical methods to examine whether there is a relationship between missing data and other variables.

Missing data in the unbalanced panel was examined using Little's MCAR (Missing completely at Random) test, and it was determined to have an MCAR mechanism. Missing value imputation can be performed due to random missingness and the missing observations remaining below 5%. It was determined that the imputation process would not pose a problem regarding the reliability and consistency of the results (14). The imputation process was performed on variables with missing data using the mean imputation method to create a balanced panel data set. When the missing data rate in a data set exceeds 5%, more advanced techniques and models should be used for data imputation (15).

The independence of units, meaning that all units are affected to the same extent in response to a shock occurring in any of the units, was examined using Pesaran's (2021) CD_{LM} test, which is based on the sum of correlation coefficients between cross-sectional residuals (16).

$$CD = \sqrt{\frac{2T}{N(N-1)}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}} \qquad (N > T)$$

[1]

Under the null hypothesis H_0 indicating the absence of relationships between cross-sections, this test statistic follows a standard normal distribution $(CD \sim N(0,1))$ (16). Depending on whether the null hypothesis is rejected or not, first-generation unit root tests (17, 18) are used in the former case, while second-generation unit root tests that consider cross-sectional dependence are used in the latter case (19). In second-generation panel unit root tests, it is assumed that the units in the series are affected differently by a shock occurring in one of the series, and equally in the first-generation. The LLC (Levin-Lin-Chu) test requires balanced panel data, while IPS (Im, Pesaran & Shin), Fisher ADF (Augmented Dickey-Fuller), and Pesaran unit root tests can be used for unbalanced panels (20-22). However, if the analysis continues with an unbalanced panel, it is not possible to benefit from most unit root tests and the tests for cross-sectional independence. Missing observations were completed using the mean imputation method, and the results were compared accordingly. The mechanism of missing data should be tested using Little's MCAR test. In this case, unobserved situations in the variables are completely random, and the results are unbiased due to the absence of a relationship between missing data in one variable and other variables (23). For the series with cross-sectional dependence in the unbalanced panel dataset, second-generation unit root analyses have been conducted using the Pesaran (2007) (19) Covariate Augmented Dickey-Fuller (CADF) test, while first-generation unit root tests, specifically the Fisher ADF test, have been applied to the series without cross-sectional dependence. Data analysis of the study was implemented in the Stata 15 package program.

Results

Figures 1-4 shows the time graphs for the variables in the unbalanced panel data set. In the G7, infant and under-5 mortality rates show a similar decreasing trend, but the highest rates are observed in the United States.

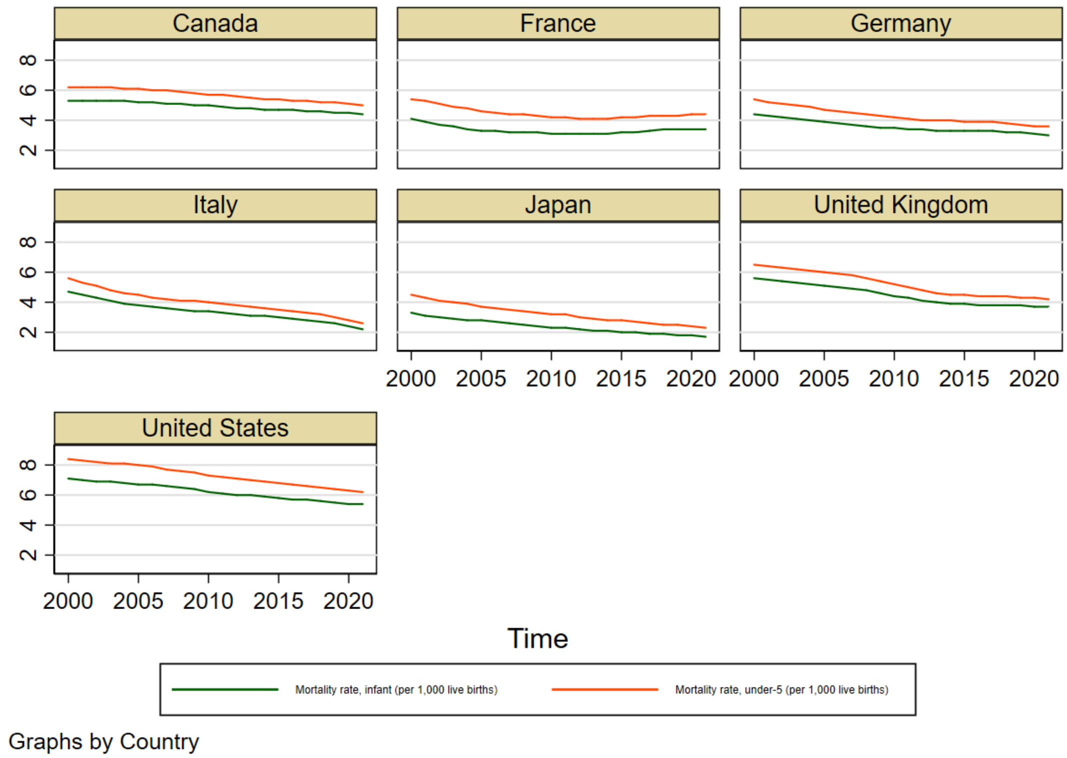

Fig. 1: G7 Mortality Rates

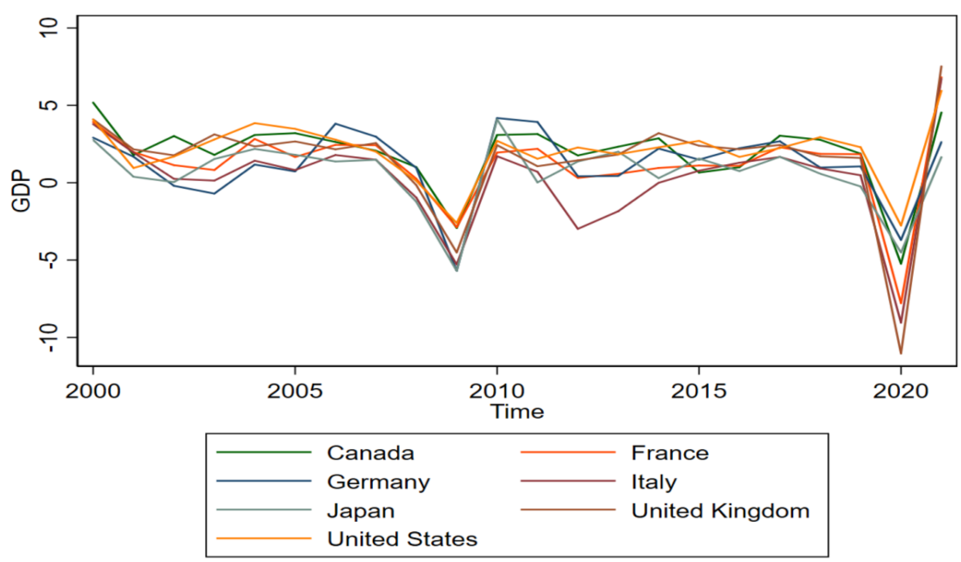

Fig. 2: G7 Economic Growth Rates

The course of economic growth in the G7 is similar, and all countries have experienced a decline in 2020. There was a decrease in all countries in 2009 and 2020. It can be said that this situation is the delayed effects of the 2008 global financial crisis and the 2019 COVID-19 pandemic.

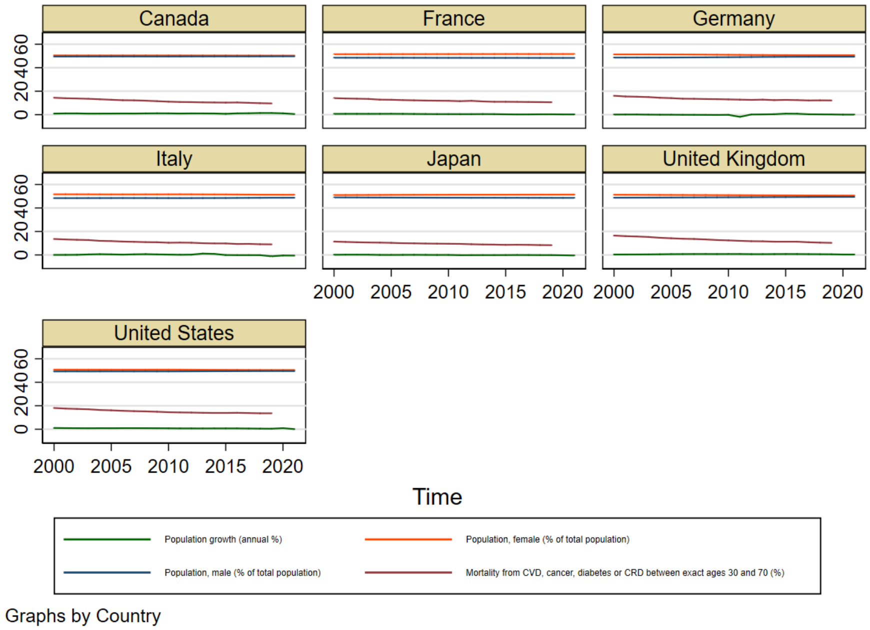

Fig. 3: G7 Population and Disease Rates

In the G7, the mortality rate from non-communicable diseases in individuals aged 30-70 years is highest in the United States and follows a similar trend in other countries. The population growth rate is also similar across the G7. This indicates that the variables are stationary on average in the years examined.

In the G7, the health expenditure rates have followed a similar trend over the years, but the highest domestic private health expenditures are observed in the United States. Findings regarding the cross-sectional dependence of the variables examined within the scope of the study are given in Table 2.

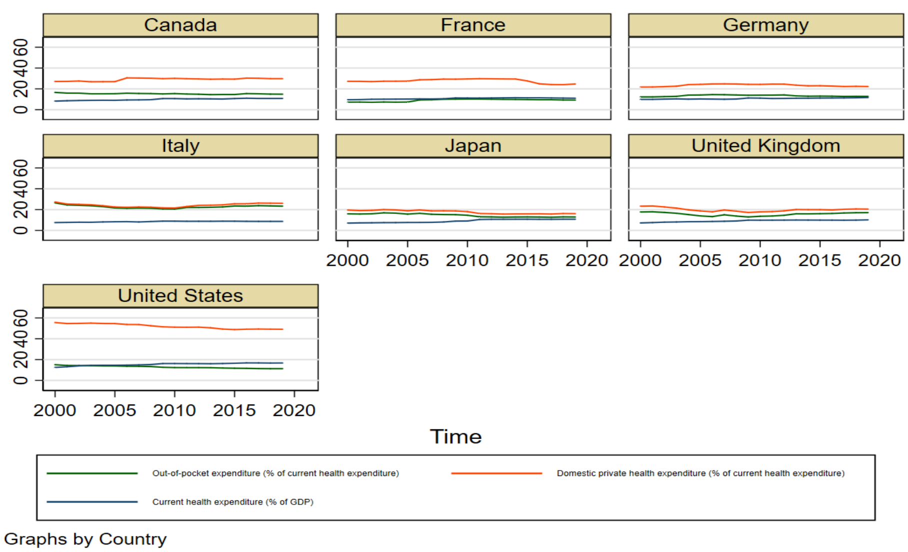

Fig. 4: G7 Health Expenditure Rates

Table 2: Cross-Sectional Dependence (CD)

Variables	*CD-test*	*P-value*	*Correlation*
		H_0 : No cross-sectional dependence	
Infant-Missing	18.48	0.000	0.860
Infant	21.81	0.000	0.879
Under-5-Missing	19.85	0.000	0.923
Under-5	23.17	0.000	0.933
GDP-Missing	18.00	0.000	0.837
GDP	19.00	0.000	0.766
Population-Missing	3.27	0.000	0.152
Population	4.49	0.000	0.181
Female-Missing	1.35	0.178	0.063
Female	-1.29	0.198	-0.052
Male-Missing	1.33	0.156	0.054
Male	-1.29	0.198	-0.052
Diseases-Missing	20.26	0.000	0.988
Diseases	24.44	0.000	0.985
Pocket-Missing	-0.48	0.632	-0.023
Pocket	1.40	0.161	0.057
Domestic-Missing	-1.54	0.123	-0.075
Domestic	-0.10	0.918	-0.004
Current-Missing	18.87	0.000	0.921
Current	13.89	0.000	0.560
Beds-Missing	18.86	0.000	0.956
Beds	11.64	0.000	0.469
Nurses-Missing	4.04	0.000	0.305
Nurses	6.17	0.000	0.249
Physicians-Missing	4.38	0.000	0.277
Physicians	6.41	0.000	0.258

Note: Horizontal sections are independent of each other. CD~N(0,1). Variables in the unbalanced panel data set are expressed with "Missing".

According to the results of the Pesaran test for cross-sectional dependence at 5% significance level, no cross-sectional dependence was detected in the series of female *P*>0.05 and male *P*>0.05 populations, out-of-pocket health expenditures *P*>0.05, and domestic private health expenditures *P*>0.05 in both balanced and unbalanced panel datasets. After detecting cross-sectional dependence in the variables, stationarity was checked, and the findings were presented in Table 3 respectively.

According to the Fisher ADF test, the fact that the male and female population series *P*=0.001 do not contain unit roots at the 5% significance level shows that there is convergence between these variables. In the Pesaran (2007) test, it was determined that there was convergence at a 5% significance level only in the variables of GDP *P*=0.021 and current health expenditures *P*=0.002.

Table 3: Panel Unit Root Tests *(Unbalanced)*

Variables	*Constant Term+Trend (Second-Generation)*			*Constant Term+Trend (First-Generation)*				*Result*
	H_0 : There is a unit root							
	t-bar	Z-bar	P-value	χ^2	*P*-value	Z-stat	*P*-value	
Infant	-1.712	0.130	0.552					I(1)
Under-5	-1.673	0.238	0.594					I(1)
GDP	-2.503	-2.028	0.021					I(0)
Population	-1.515	0.669	0.748					I(1)
Female				94.986	0.000	-5.726	0.000	I(0)
Male				94.976	0.000	-5.724	0.000	I(0)
Diseases	-2.167	0.297	0.617					I(1)
Pocket				11.891	0.751	0.437	0.669	I(1)
Domestic				10.195	0.856	0.381	0.648	I(1)
Current	-2.872	-2.935	0.002					I(0)
Beds	-2.295	-1.451	0.073					I(1)
Nurses	-1.9280	0.377	0.973					I(1)
Physicians	-1.0491	0.502	0.694					I(1)

Table 4: Panel Unit Root Tests *(Balanced)*

	LLC		*IPS*		*Fisher ADF*		*Pesaran*			*Result*
Variables	t-stat	*P*-value	Z-stat	*P*-value	χ^2	*P*-value	t-bar	Z-bar	*P*-value	
Infant							-1.621	2.095	0.982	I(1)
Under-5							-2.205	0.318	0.625	I(1)
GDP							-3.927	-4.918	0.000	I(0)
Population							-2.141	0.512	0.696	I(1)
Female	-9.014	0.000	-2.476	0.006	94.986	0.000				I(0)
Male	-9.012	0.000	-2.474	0.006	94.976	0.000				I(0)
Diseases							-2.487	-0.538	0.295	I(1)
Pocket	-0.361	0.3587	1.573	0.942	9.426	0.894				I(1)
Domestic	-0.686	0.246	1.483	0.931	8.714	0.924				I(1)
Current							-3.080	-4.845	0.000	I(0)
Beds							**-3.585**	**-3.878**	**0.000**	**I(0)**
Nurses							-2.616	-0.931	0.176	I(1)
Physicians							-2.031	0.847	0.802	I(1)

According to Table 4, the stationarity of the series in balanced panel data is parallel to the unbalanced panel data results presented in Table 3. In the balanced panel, it was determined that there was convergence at the 5% significance level only in the hospital bed number series *P*=0.001.

Discussion

We aimed to determine to what extent economic convergence relates to basic health indicator results in the G7. Our study decided that there was no convergence trend in the mortality rates of children under five and infants. No G7-specific analysis regarding this indicator has been found in the literature. In studies conducted with panel unit root test within the scope of G20 (24), Turkey, Middle East North Africa (MENA) (11) and OECD (25), it was determined that there was a convergence in the infant mortality rate. A different study determined that there was no convergence in the infant mortality rate (26).

In our study, the highest infant and under-five mortality rates are observed in the United States. This may be because of ethnic/racial disparities, rural-urban differences, and health inequalities (27,28). When the health expenditures of G7 were examined in our study, it was seen that the current health expenditures of the state were at similar levels over the years, and the rates of current state health expenditures of the countries converged in the examined time series. A study conducted within the EU determined a convergence in per capita health expenditures and the share of health expenditures in GDP (29). Regarding the health expenditure trends in the G7, all countries have had similar levels of governmental current health expenditures over the years, and their governmental current health expenditure rates have converged in the time series examined in the study. Some studies about the European Union (EU) and OECD countries have found convergence in their health expenditures (4,29), while others have not found such convergence (25,30). A study conducted specifically on the G7 reported that there is no convergence in per capita health expenditures (31). The results vary depending on the period examined and the groups of countries.

The highest domestic private health expenditure is also observed in the United States, and there is no convergence in out-of-pocket and private health expenditures in the G7. This result is consistent with OECD statistics and the literature (32,33). A study about the convergence of per capita health expenditures in OECD countries showed a convergence trend for almost all countries except the USA (34). The private health expenditures in the USA are higher than in other countries due to the country's health financing structure. While the healthcare financing system in the USA is based on private insurance and out-of-pocket payments (35), the healthcare systems of the UK, Italy, and Canada are based on the tax-financed Beveridge model, and the healthcare systems of Germany, France, and Japan are based on the Bismarck model, which is financed by premiums paid by employees and employers (36,37). Each country's health financing method is shaped according to the socio-economic situation and political preferences, and the society shares the financing burden through various methods.

The economic growth rates in the G7 have a similarity over the years, and there was a decline in all countries in 2020, which coincided with the beginning of the COVID-19 pandemic that has disrupted the world and national economies (38). The GDP growth rates of the G7, which experienced a similar situation discussed in our study, have converged over the years. This result is consistent with studies involving OECD and G7 countries, where economic growth rates have been observed to converge (39, 40).

Our study found that the population growth rates in the G7 have progressed similarly over the years. Economies with similar characteristics, such as population growth and technology, converge to a steady state known as absolute convergence (41). Significant relationships have been identified between the convergence of Europe's aging population and economic convergence (42). The result of our study regarding the similarity in population growth rates parallel to economic convergence in the G7 is consistent with those in the literature.

In our study, the death rate from non-communicable diseases among the 30-70 age group in the G7 has been highest in the USA over the years, while other countries have shown a similar trend. One of the Sustainable Development Goals, the "Goal 3: Good Health and Well-being," aims to promote healthy lives and well-being for all ages. In line with this goal, the G7 measures and reports the age-standardized death rates (%) due to cardiovascular diseases, cancer, diabetes, or chronic respiratory diseases among adults aged 30-70 years as a performance indicator. The results for this indicator are as follows: Italy 9.5, United Kingdom 10.9, Canada 9.8, USA 14.6, France 10.6, Germany 12.1, and Japan 8.4 (43). In this context, our results are consistent with those in the report. It is stated that countries with similar economic sizes have similar characteristics in chronic diseases (44).

The study also explored micro health infrastructure indicators, including doctor, nurse, and hospital bed counts, to assess the hypothesis across micro and macro variables. The health convergence hypothesis is not supported by the health infrastructure indicators, except for hospital bed counts in the balanced panel data. These variables included in the health service indicators reveal the healthcare infrastructure of the countries (45). Economic similarities make similarities in the distribution of hospital beds and healthcare workers between regions (46). There is no evidence in the literature regarding these indicators for the G7. A study conducted in China determined that as the number of beds and healthcare workers converged over the years, resources were distributed more evenly (47). Health resources are distributed similarly in G7 with similar economies.

Based on the results, the validity of the health convergence hypothesis shows parallelism in terms of balanced panel and unbalanced panel data. Only the hospital bed count series was found to differentiate and remain stationary in the balanced panel data. Although the unbalanced panel data model has fewer observations, it provides unbiased estimates based on the available data. However, it should be noted that while the obtained estimation results generally show similarities, imputing missing data might lead to variations in the results.

Strengths of the study: The method of analysis used and the health indicators selected for the G7 are rarely addressed in the literature. The problem of missing data was addressed with two different alternative solutions by using panel data in the study, which offers an innovative contribution in terms of method.

Limitations of the study: Although the G7 is economically similar, their health systems differ, so that study results may vary depending on period intervals and estimation methods.

Conclusion

G7 did not differ in economic indicators and government health expenditures but did differ in health indicators (except for the number of hospital beds). There are structural differences in the provision and financing of health services among the G7. This may affect the results of health indicators. It is important to develop national health policies and programs to address varying health indicators, considering each country's unique conditions and needs. In addition, it is recommended that decision-makers benefit from economic convergence findings when planning health resources. In future research, the similarity of results can be examined according to alternative missing data imputation methods, and different health systems can be discussed comparatively.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of Interest

The authors declare that there is no conflict of interests.

References

1. Desli E, Gkoulgkoutsika A (2020). World economic convergence: Does the estimation methodology matter? *Economic Modelling,* 91:138-147.
2. Gächter M, Theurl E (2011). Health status convergence at the local level: Empirical evidence from Austria. *Int J Equity Health,*10:34.
3. Jakovljevic M, Timofeyev Y, Ranabhat CL, et al (2020). Real GDP growth rates and healthcare spending – comparison between the G7 and the EM7 countries. *Global Health,*16(1):64.
4. Kızılkaya F, Dağ M (2021). Convergence of health expenditures in OECD countries: Evi-

dence from Fourier unit root test with break. *Journal of Yasar University,*16(62):587-600.
5. Hitiris T (1997). Health care expenditure and integration in the countries of the European Union. *Appl Econ,*29(1):1-6.
6. Atilgan E, Kilic D, Ertugrul HM (2017). The dynamic relationship between health expenditure and economic growth: Is the health-led growth hypothesis valid for Turkey? *Eur J Health Econ,*18:567-574.
7. Ayhan F, Kartal MT, Kılıç Depren S et al, (2023). Asymmetric effect of economic policy uncertainty, political stability, energy consumption, and economic growth on CO2 emissions: Evidence from G-7 countries. *Environ Sci Pollut Res,*30(16):47422-47437.
8. Millar L (2021). G7 global fund commitments, compliance and financial contributions, 2001-2021. University of Toronto, Canada. http://www.g7.utoronto.ca/evaluations/millar-global-fund.html#top
9. Çelik EU, Omay T, Tuzlukaya Ş (2022). Testing health expenditure convergence in 21 OECD countries by using nonlinear unit root tests. *Konuralp Medical Journal,*14(S1):192-205.
10. Albulescu CT (2022). Health care expenditure in the European Union countries: New insights about the convergence process. *Int J Environ Res Public Health,*19(4):1991.
11. Şahin D (2018). Convergence of health in Turkey and MENA countries: Panel unit root test. *Karadeniz Technical University Social Sciences Institute Journal of Social Sciences,*8(16):235-252.
12. Serdar Y (2020). The relationship between health expenditures and economic growth in G7 countries. *Journal of Statistics & Applied Science,*1(1):23-39.
13. World Bank (2023). Health nutrition and population statistics. https://databank.worldbank.org/
14. Kelly S (2011). Do homes that are more energy efficient consume less energy? A structural equation model of the English residential sector. *Energy,*36(9):5610-5620.
15. Osman MS, Abu-Mahfouz AM, Page PR (2018). A survey on data imputation techniques: Water distribution system as a use case. *IEEE Access,*6:63279-63291.
16. Pesaran MH (2021). General diagnostic tests for cross-sectional dependence in panels. *Empirical Economics,*60(1):13-50.
17. Im KS, Pesaran MH, Shin Y (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics,* 115(1):53-74.
18. Levin A, Lin CF, Chu CS (2002). Unit root tests in panel data: Asymptotic and finite-sample properties. *Journal of Econometrics,*108(1):1-24.
19. Pesaran MH (2007). A simple panel unit root test in the presence of cross-section dependence. *J Appl Econ,* 22(2):265-312.
20. Baltagi BH (2005). *Econometric analysis of panel data.* Chichester: John Wiley & Sons Ltd.
21. Tian XL, Bélaïd F, Ahmad N (2021). Exploring the nexus between tourism development and environmental quality: Role of renewable energy consumption and income. *Struct Chang Econ,*56:53-63.
22. Sezgin V (2022). Exploring a scientific research methodology in social sciences: Steps for analyzing non-stationary heterogeneous panel data. *AYBU Business Journal,*2(1):10-22.
23. Little RJA, Rubin DR (2002). *Statistical analysis with missing data.* New York: Wiley.
24. Nixon J (2000). *Convergence of health care spending and health outcomes in the European Union, 1960-95.* University of York, Centre for Health Economics, Discussion Paper 183.
25. Tülümce S, Zeren F (2013). Convergence analysis of health in the OECD countries: Panel unit root test. *Suleyman Demirel University The Journal of Faculty of Economics and Administrative Sciences,*18(2):287-300.
26. Goli S, Moradhvaj, Chakravorty S, et al (2019). World health status 1950-2015: Converging or diverging. *PLoS One,*14(3):e0213139.
27. Bailey ZD, Krieger N, Agénor M, et al (2017). Structural racism and health inequities in the USA: Evidence and interventions. *Lancet,*389(10077):1453-1463.
28. Miller CE, Vasan RS (2021). The southern rural health and mortality penalty: A review of regional health inequities in the United States. *Soc Sci Med,*268:113443.
29. Hitiris T, Nixon J (2001). Convergence of health care expenditure in the EU countries. *Applied Economics Letters,* 8(4):223-228.
30. Albulescu C, Oros C, Tiwari AK (2017). Is there any convergence in health expenditures across EU countries? *Econ Bull,* 37(3):2095-2101.
31. Atılgan D, Özbek S (2021). The validity of the conversion of health hypothesis in G7 coun-

tries: Evidence from panel unit root tests. *Journal of Economics, Business and Finance Studies,* 3(3):231-242.
32. OECD (2022). Understanding differences in health expenditure between the United States and OECD countries. https://www.oecd.org/health/Health-expenditure-differences-USA-OECD-countries-Brief-July-2022.pdf
33. Lorenzoni, L, Dougherty S (2022). Understanding differences in health care spending: A comparative study of prices and volumes across OECD countries. *Health Serv Insights,*15: 11786329221109755.
34. Panopoulou E, Pantelidis T (2012). Convergence in per capita health expenditures and health outcomes in the OECD countries. *Appl Econ,*44(30):3909-3920.
35. Dickman SL, Himmelstein DU, Woolhandler S (2017). Inequality and the health-care system in the USA. *Lancet,*389(10077):1431-1441.
36. Roderick P, Pollock AM (2022). Dismantling the National Health Service in England. *Int J Health Serv,*52(4):470-479.
37. Şahin K, Cezlan EÇ (2023). Comparison of health indicators and health financing models of OECD countries. *Hacettepe University Journal of Economics and Administrative Sciences,*41(1):44-61.
38. Jackson JK (2021). Global economic effects of COVID-19. Congressional Research Service. https://sgp.fas.org/crs/row/R46270.pdf
39. Meligkotsidou L, Tzavalis E, Vrontos ID (2012). A Bayesian panel data framework for examining the economic growth convergence hypothesis: Do the G7 countries converge? *Journal of Applied Statistics,* 39(9):1975-1990.
40. Nahar S, Inder B (2002). Testing convergence in economic growth for OECD countries. *Appl Econ,*34(16):2011-2022.
41. Saroha J (2018). Types and significance of population pyramids. *Worldwide. Journal of Multidisciplinary Research and Development,* 4(4):59-69.
42. Kashnitsky I, De Beer J, Van Wissen L (2020). Economic convergence in ageing Europe. *J Econ Human Geogr*, 111(1),28-44.
43. Sachs JD, Kroll C, Lafortune G, et al (2021). Sustainable development report 2021: The decade of action for the sustainable development goals. University of Cambridge, United Kingdom. https://s3.amazonaws.com/sustainabledevelopment.report/2021/2021-sustainable-development-report.pdf
44. Nakatani H (2016). Global strategies for the prevention and control of infectious diseases and non-communicable diseases. *J Epidemiol,*26(4):171-178.
45. Loş N. Comparative analysis of health services and health expenditures in health economics framework: In case of OECD countries and Turkey [PhD thesis]. Institute of Social Sciences, University of İstanbul, Türkiye; 2016.
46. Song C, Wang Y, Yang X, et al (2020). Spatial and temporal impacts of socioeconomic and environmental factors on healthcare resources: A county-level bayesian local spatiotemporal regression modeling study of hospital beds in Southwest China. *Int J Environ Res Public Health,*17(16):5890.
47. Liang D, Zhang D, Huang J, et al (2016). Does rapid and sustained economic growth lead to convergence in health resources: The case of China from 1980 to 2010. *Inquiry,* 53:0046958016631699.