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Türkiye in the Framework of the Preston Curve And Wilkinson Hypothesis: The Transformation of Income Growth, Income Distribution, and Life Expectancy

Preston Eğrisi ve Wilkinson Hipotezi Çerçevesinde Türkiye: Gelir Artışı, Gelir Dağılımı ve Yaşam Beklentisinin Dönüşümü

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ABSTRACT

This study examines the validity of the Preston Curve and Wilkinson Hypothesis in the context of the Turkish economy, analyzing the impact of per capita income, income inequality, and public health expenditures on life expectancy. Using data from 1960 to 2022, graphical analysis and time series methods were employed to investigate the relationships between these variables. The key findings indicate that the Preston Curve is valid for Türkiye, as higher per capita income increases life expectancy, but the effect diminishes beyond a certain income level. A negative and statistically significant relationship was found between income inequality and life expectancy, supporting the Wilkinson Hypothesis. Additionally, public health expenditures positively and significantly influence life expectancy, highlighting the importance of government investments in healthcare. The findings suggest that the impact of economic growth on health indicators is not solely determined by rising income levels but also by the reduction of income inequality and increased public health expenditures. Policy recommendations include expanding healthcare spending, implementing social policies to mitigate income inequality, and addressing regional disparities in healthcare access.

Anahtar Kelimeler
Preston eğrisi, Wilkinson hipotezi, gelir eşitsizliği, yaşam beklentisi, Türkiye

ÖZ

Bu çalışma, Türkiye ekonomisi bağlamında Preston Eğrisi ve Wilkinson Hipotezi'nin geçerliliğini inceleyerek kişi başına düşen gelir, gelir eşitsizliği ve kamu sağlık harcamalarının ortalama yaşam beklentisi üzerindeki etkilerini analiz etmektedir. 1960-2022 dönemine ait veriler kullanılarak, grafiksel analiz ve zaman serisi yöntemleri yardımıyla değişkenler arasındaki ilişkiler incelenmiştir. Çalışmanın temel bulgularına göre, Preston Eğrisi Türkiye için geçerli olup, kişi başına düşen gelir arttıkça yaşam beklentisinin arttığı, ancak bu etkinin belirli bir gelir seviyesinden sonra azaldığı tespit edilmiştir. Gelir eşitsizliği ile yaşam beklentisi arasında negatif ve anlamlı bir ilişki bulunmuş, bu da Wilkinson Hipotezini destekler niteliktedir. Ayrıca, kamu sağlık harcamalarının yaşam beklentisini pozitif ve istatistiksel olarak anlamlı şekilde etkilediği belirlenmiştir. Elde edilen bulgular, ekonomik büyümenin sağlık göstergeleri üzerindeki etkisinin yalnızca kişi başına düşen gelirin artırılmasıyla sınırlı olmadığını, aynı zamanda gelir dağılımı eşitsizliklerinin giderilmesi ve kamu sağlık harcamalarının artırılması gerektiğini ortaya koymaktadır. Politika önerileri kapsamında, sağlık harcamalarının artırılması, gelir eşitsizliklerini azaltacak sosyal politikaların uygulanması ve sağlık hizmetlerine erişimde bölgesel dengesizliklerin giderilmesi gerekmektedir.

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1. Introduction

Health is defined as a state of complete physical, mental, and social well-being (World Health Organization, 1946). This definition emphasizes that health is not merely the absence of disease and disability but also a comprehensive concept that encompasses the improvement of quality of life by ensuring mental and social well-being. The concept of health is not only a fundamental aspect of well-being in itself but also enables individuals to work and enjoy the fruits of their labor (Deaton, 1999: 1). In addition to being one of the most valuable assets desired by individuals and society, health indicators reflect the welfare level of economic agents and serve as key indicators of a country's economic and social development. Among these indicators, life expectancy (LE) is considered a fundamental reflection of economic conditions, health, healthcare systems, and environmental quality (Chen, Ma, Hua, Wang and Guo, 2021). LE refers to the average number of years a newborn in a given country is expected to live, based on current mortality rates. This indicator is frequently used, particularly in developing countries, to measure the impact of economic prosperity on health outcomes (Rjoub, Odugbesan, Adebayo and Wong, 2021).

A country's per capita national income not only serves as a direct indicator of living standards but also contributes to improvements in health indicators through indirect channels such as access to healthcare services, infrastructure investments, nutrition, and living conditions (Preston, 1975). Pritchett and Summers (1993) summarized this relationship succinctly: *"Richer countries are healthier countries."* Therefore, the relationship between economic development and health has been a central focus in development economics. Samuel Preston's (1975) seminal study introduced the Preston Curve, which illustrates a positive but nonlinear relationship between per capita income (PCI) and LE. The curve suggests that economic growth significantly improves health outcomes at lower income levels, but the marginal impact weakens as income surpasses a certain threshold. However, focusing solely on PCI is insufficient to fully understand the impact of economic growth on health. Income distribution is recognized as a key determinant of health indicators within societies, and in this context, the Wilkinson Hypothesis provides an important analytical framework (Wilkinson, 1992; Deaton, 1999). The Wilkinson Hypothesis highlights the role of income distribution, arguing that higher income inequality negatively affects public health. In societies with more equitable income distribution, individuals tend to have higher LE and better overall health indicators. Conversely, in economies with pronounced income disparities, increased stress levels, reduced access to healthcare, and social exclusion contribute to lower LE (Wilkinson, 1996; Siegrist and Marmot, 2004).

This study examines the validity of the Preston Curve (1960–2022) and the Wilkinson Hypothesis for the Turkish economy over the period 1980–2022. To investigate these relationships, this study employs graphical analysis and time series econometric methods using data from 1960 to 2022. Specifically, unit root tests (URT) (ADF and RALS LM URT) are utilized to examine stationarity, while regression model is employed to quantify the impact of PCI, income inequality, and public healthcare expenditures (PHE) on LE. This comprehensive approach ensures a robust analysis that accounts for potential structural breaks and evolving economic dynamics. The primary research questions of the study are as follows: *What is the relationship between PCI and LE in Türkiye within the framework of the Preston Curve? ** How does income inequality impact health indicators in Türkiye within the context of the Wilkinson Hypothesis? ***What is the effect of PHE on health indicators? ****How have changes in income, healthcare expenditures, and income distribution influenced health indicators in Türkiye throughout the 1960–2022 period? This study seeks to bridge the gap in the literature by systematically examining the interplay between income growth, income distribution, and health outcomes in Türkiye. While previous studies have analyzed the Preston Curve and Wilkinson Hypothesis in global contexts, limited research has focused on Türkiye, particularly using contemporary econometric methods. By incorporating advanced time series techniques this research aims to provide a more nuanced understanding of how these economic factors influence public health over time. The structure of the study is organized as follows: Following the introduction, the theoretical explanations of the Preston Curve and the Wilkinson Hypothesis are provided, along with a discussion of the trends observed in the relevant variables within the Turkish economy. The subsequent section reviews the findings of previous studies on the subject in the literature. In the following section, the relationship between LE and PCI in the Turkish economy is analyzed both graphically and using time series analysis methods. The study concludes with a discussion of the results and policy recommendations.

2. The Theoretical Framework of the Preston Curve and the Wilkinson Hypothesis

Samuel Preston's (1975) seminal work established the Preston Curve, a theoretical and empirical framework that examines the relationship between PCI and LE. The Preston Curve remains one of the first systematic studies in this field. As noted by Bloom and Canning (2007), Preston's work continues to be regarded as a foundational study within the contexts of public health policies and development economics. The Preston Curve has a concave shape, emphasizing the positive but non-linear effect of income growth on LE (Dalgaard and Strulik, 2014). The mechanisms through which income growth affects LE have been identified as improvements in nutrition conditions, access to clean water and sanitation, and access to medical treatment (Bloom and Canning, 2007). The positive relationship between income growth and LE is highly pronounced at lower income levels; however, as income surpasses a certain threshold, this relationship gradually weakens (Preston, 1975). This phenomenon provides a significant insight, particularly for developing countries, in understanding the marginal benefits of economic growth on health indicators.

As suggested in Preston's (1975) study, the relationship between PCI and LE is generally examined in three distinct stages. First, at low-income levels, income growth has a strong impact on health indicators. During this stage, factors such as increased access to basic healthcare services, improved nutrition, and a reduction in child mortality positively influence LE (Cutler et al., 2006). In the second stage, as countries reach a middle-income level, improvements in health indicators continue; however, the rate of improvement slows down.

Finally, when income levels reach very high levels, the impact of economic growth on health indicators becomes almost negligible, and other socioeconomic factors take precedence. Preston's (1975) study emphasizes the existence of a threshold point in the relationship between income and LE. This threshold typically emerges when PCI surpasses a certain level. In the case of the Turkish economy, which is the focus of this study, this income level has been identified as 6,000 USD. Beyond this income level, data indicate that the marginal effect of income growth on health declines. The Preston Curve demonstrates that income growth has a much more pronounced impact on LE, particularly in developing countries; however, as income levels rise, this effect diminishes. This finding suggests that the contribution of economic development to health is not solely determined by income but also by factors such as healthcare services, infrastructure, and technology, which play a crucial role in this process (Bloom and Canning, 2007).

On the other hand, according to the Wilkinson hypothesis, in addition to income levels, the fairness of income distribution within an economy also affects health outcomes (Çukur and Bekmez, 2011). Wilkinson proposed a different connection between income and health. According to Wilkinson (1992), income inequality itself is one of the fundamental determinants of poor health (Deaton, 1999:10). Rodgers (2002) also argued that a direct relationship cannot be established solely between LE and income level, emphasizing that income distribution should also be included in the equation. In this context, the Wilkinson hypothesis suggests that income inequality negatively affects the overall health level of societies. According to this hypothesis, while income growth may lead to improvements in health indicators at the individual level, increasing income inequality deteriorates health indicators at the societal level. Wilkinson (1996) demonstrated that in countries with more equal income distribution, individuals tend to have higher LE and more favorable health indicators. Conversely, in countries with unequal income distribution, factors such as stress, social exclusion, and unequal access to healthcare services have negative effects on LE (Wilkinson, 1996; Siegrist and Marmot, 2004).

3. Income, Income Distribution, and Health Indicators in the Turkish Economy

The economic growth process in Türkiye has been shaped by various structural changes over different periods. Since the 1980s, the implementation of a free-market economy and an export-oriented growth model has led to a significant increase in Türkiye's PCI (Rodrik, 1990; Pamuk, 2007). In the early 2000s, structural reforms and globalization processes implemented in response to economic crises contributed to economic stability and accelerated growth The trajectory of per capita real income in the Turkish economy between 1960 and 2022 is presented in Figure 1. The most notable observation is the significant increase in PCI within the Turkish economy over this period. According to World Bank data, Türkiye's real PCI was approximately 2,500 USD in 1960, whereas by 2022, this figure had exceeded 10,000 USD.

Figure 2 presents data on the average LE of the population living in Türkiye. As observed in the graph, there have been significant increases in the LE of the population living in Türkiye. In addition to income growth,

improvements in access to clean water and sanitation services, along with advancements in medical technology, have made the increase in LE a global phenomenon (Dağdemir, 2009; He and Li, 2020). According to World Bank data, the LE worldwide was 50.89 years in 1960, increasing to 71.99 years by 2022. In Türkiye, during the same period, LE rose from 50.74 years in 1960 to 78.475 years as of 2022 (World Bank, 2025). These data indicate that both global economies and Türkiye have made significant progress in their economic growth processes, leading to notable improvements in health indicators. As a multidimensional concept, health is influenced by various economic factors such as income and income distribution, which represent only one aspect of this complex relationship.

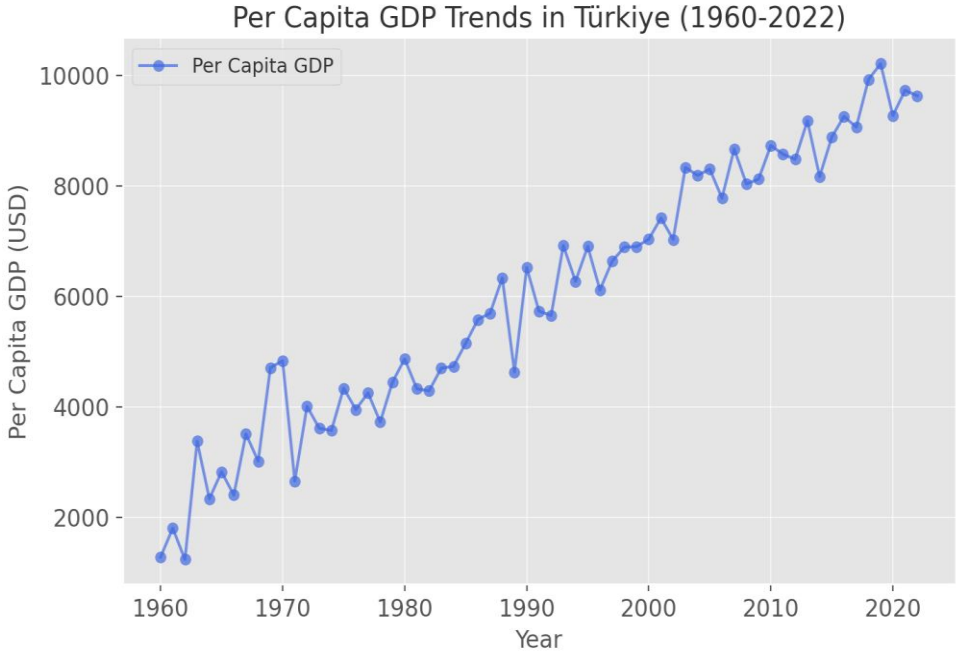

Figure 1. GDP Trends in Türkiye

Other key factors contributing to the increase in LE include the control of infectious diseases, improved access to clean water, the development of infrastructure services, rising education levels, public healthcare services, and advancements in medical technology. These structural improvements, often associated with broader economic growth and policy reforms, have played a critical role in enhancing overall health outcomes (Rodgers, 2002; Acemoglu and Johnson, 2007; Georgiadis, Pineda and Rodriguez, 2010; De la Escosura, 2023).

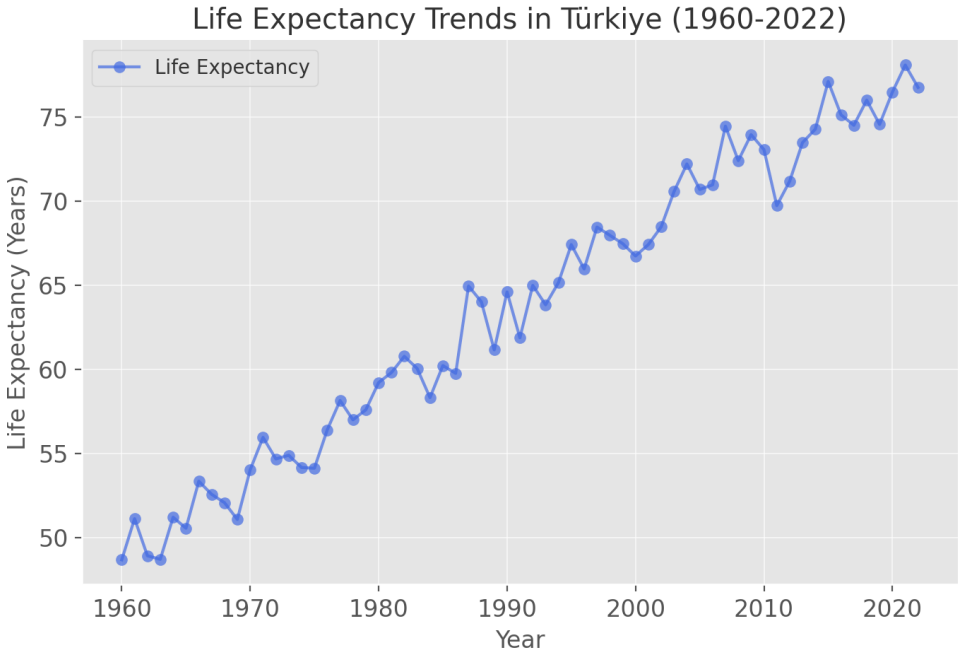

Figure 2. LE in Türkiye

The improvement in health indicators in Türkiye has closely followed the trajectory of income growth, while factors such as the share of healthcare expenditures in GDP, infrastructure investments, and the impact of social policies have played a fundamental role in shaping this relationship. For instance, the Health Transformation Program, launched in 2003, significantly improved LE by enhancing individuals' access to healthcare services (OECD, 2021). The share of healthcare expenditures in GDP increased from around 2% in the 1990s to approximately 5%, leading to notable improvements in infant mortality rates and maternal health indicators (TURKSTAT, 2022). These structural transformations have further reinforced the impact of economic growth on health indicators. A key limitation of country-specific studies is the lack of external benchmarks for evaluating the generalizability of findings. To provide a broader perspective, this section compares Türkiye's income-LE relationship, income inequality, and PHE with other OECD and similar developing countries. The Preston Curve suggests a positive relationship between PCI and LE, though with diminishing marginal returns at higher income levels. Comparing Türkiye with OECD and upper-middle-income developing countries reveals several important patterns. Türkiye lags behind most OECD nations in terms of both PCI and LE. For instance, while Western European OECD members such as Germany, France, and the UK exhibit PCI above $40,000 and LE exceeding 80 years, Türkiye remains at a lower PCI ($10,000) with a LE of around 78 years (World Bank, 2025). On the other hand, comparing to upper-middle-income developing nations like Mexico, Brazil, and South Africa, Türkiye has relatively higher LE despite having a similar income level. This indicates that Türkiye's healthcare investments and infrastructure improvements may have played a positive role in extending LE beyond what income alone predicts (OECD, 2021).

The Gini coefficient is one of the key indicators used to measure the level of income inequality in an economy. Ranging between 0 and 1, this coefficient indicates that as it approaches 0, income distribution becomes more equal, whereas as it nears 1, income inequality increases (Hasell, 2023). When examining data on the Turkish economy, fluctuations in income inequality have been observed since the 1980s. In particular, the Gini coefficient, which was at high levels in the early 1980s, showed a declining trend over time but experienced periodic increases in certain periods. After 2000, healthcare reforms and social policies had a positive impact on income distribution, helping to relatively reduce income inequality (Çukur and Bekmez, 2011). However, recent economic developments in Türkiye, including the 2016 military coup attempt, the 2018 currency crisis, the COVID-19 pandemic, and the Russia-Ukraine war, have exacerbated income distribution imbalances, driven by high inflation and depreciation of the domestic currency.

According to the Wilkinson Hypothesis, income inequality has a significant impact on a society's overall health indicators. In societies with a more equitable income distribution, health indicators tend to be more favorable, whereas in societies with high levels of inequality, factors such as LE and access to healthcare services are adversely affected (Wilkinson, 1996).

Türkiye's Gini coefficient (around 0.40–0.42) places it in a middle position relative to OECD and similar emerging markets. Most Western European OECD nations (e.g., Sweden, Germany, Netherlands) exhibit lower income inequality (Gini ~0.25–0.30) and superior public health indicators. Their strong social policies mitigate health disparities, contributing to higher LE. Emerging markets countries with higher Gini coefficients (~0.45–0.55) tend to have lower LE and higher health disparities. Türkiye, with its moderate income inequality, shows better LE than Brazil and South Africa, suggesting that income distribution plays a role but is not the sole determinant.

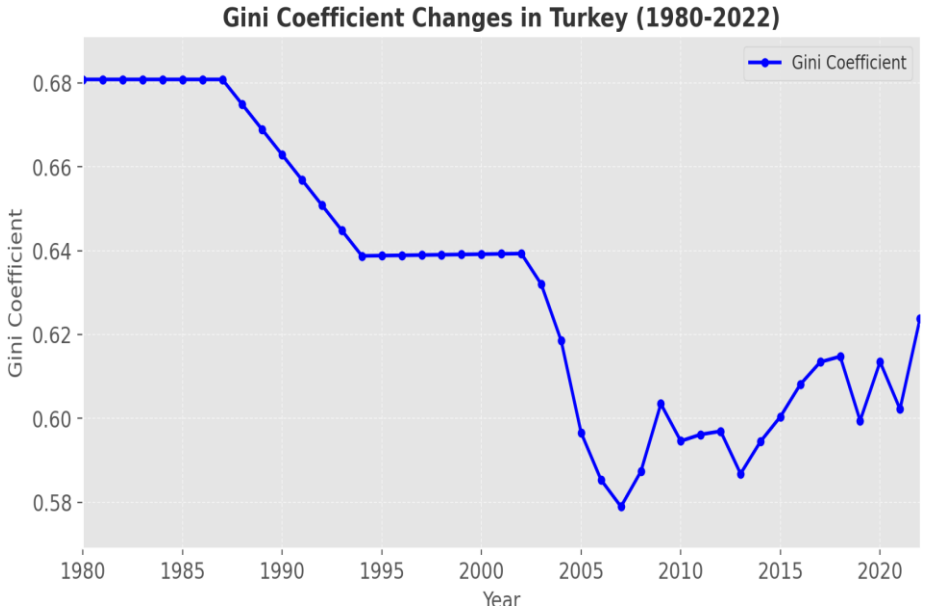

Figure 3. Gini Coefficient in the Turkish Economy

4. Literature Review

In Preston's (1975) study, data from the years 1930, 1940, and 1960 were used to demonstrate the positive correlation between PCI and LE. Preston found that income growth leads to rapid improvements in LE, particularly in low- and middle-income countries, whereas the rate of increase slows in high-income countries. This finding reinforces the view that access to healthcare services, nutrition, and housing conditions are directly linked to income growth. Wilkinson (1992) examined the relationship between income distribution and LE in 19 developed countries. The results indicated that countries with relatively equitable income distribution tend to have lower mortality rates, thereby supporting the validity of the Wilkinson hypothesis. Anand and Ravallion (1993) stated that income growth has a strong impact on LE in developing countries; however, this effect needs to be supported by PHE and infrastructure investments. Their analysis, based on data from Asian and Latin American countries, demonstrates that income growth serves as a crucial tool for improving health indicators. Pritchett and Summers (1993) examined the impact of economic growth on health indicators using data from over 100 countries for the period 1960–1990. Their study found that income growth plays a critical role in reducing child mortality and increasing LE. The researchers argue that growth-oriented policies are among the most effective tools for improving health indicators. Wilkinson (1996) demonstrated that while income growth has positive effects on individual well-being, income inequality negatively impacts LE. The study emphasizes that in addition to economic growth, fairness in income distribution is also crucial for improving health indicators. Bloom and Canning (2000) analyzed the relationship between PCI and LE using data from 70 countries for the period 1960–1995. Their study found that at low income levels, economic growth leads to significant improvements in health indicators; however, as income levels rise, this relationship

weakens. The researchers explain this phenomenon through the concept of diminishing marginal returns. Rodgers (2002) tested the validity of the Wilkinson hypothesis in 56 countries. The results indicate that the difference in LE between a relatively egalitarian country and a relatively unequal country can range from five to ten years. Fogel (2004) stated that economic growth increases LE by improving nutritional conditions and reducing infectious diseases. According to Fogel's findings, the increase in LE observed in 19th-century Europe was closely linked not only to economic growth but also to advancements in health infrastructure. Georgiadis et al. (2010) tested the validity of the Preston Curve in 136 countries for the period 1970–2010. The authors concluded that in countries far from the health technology frontier, PCI is insignificant in determining LE. However, for countries closer to the health technology frontier, income may have some importance, albeit minimal. Additionally, they pointed out that the income elasticity coefficient in the Preston Curve tends to be overestimated. Çukur and Bekmez (2011) examined the impact of income and income inequality on health in five regions of the Turkish economy for the period 1975–2001 using the Pooled OLS method. Their findings indicate that while income growth is negatively associated with infant and child mortality rates, income inequality has a positive effect on infant mortality, meaning that higher inequality leads to increased infant mortality rates. Husain (2011) examined the relationship between PCI and LE in 47 countries for the period 1930–2001. The author identified a cointegration relationship between the two variables, finding that in 30 countries, LE influenced PCI, while in 21 countries, the causality ran from LE to PCI. In 9 countries, the causality was found to be in the opposite direction.

Dalgaard and Strulik (2014) tested the validity of the Preston Curve for 65 countries using data from the year 2000. Compared to the traditional Preston Curve, the relationship between income and LE appeared more linear. Their analysis suggests that the Preston Curve reflects a causal effect from income to LE, primarily mediated through healthcare expenditures.

Tamberi (2015) tested the validity of the "alternative Preston Curve" for 154 countries over the period 1990–2012. The study found that improvements in nutrition, sanitation, medical technology, and treatment facilities play at least as significant a role as income in explaining variations in LE. Edwards (2016) found that in countries with large mining sectors, the expected relationship between income and health/education outcomes deviates, resulting in outcomes that fall below the Preston Curve. The findings suggest that countries with larger mining sectors tend to have worse health and education outcomes than expected based on their income levels, highlighting the potential negative effects of mining on these areas. Lutz and Kebede (2018) tested the validity of the Preston Curve by incorporating the education level variable in 174 countries for the period 1970–2010. The authors found that increasing education levels has a greater impact on improving LE and reducing child mortality rates than income. Ergün and Polat (2019) investigated the relationship between healthcare expenditures, PCI, and CO_2 emissions in 119 countries using the Panel ARDL method. The authors identified a cointegration relationship among the variables and concluded that all explanatory variables have a positive impact on healthcare expenditures. Jetter, Laudage and Stadelmann (2019) tested the validity of the Preston Curve for 197 countries over a 213-year period (1800–2012). Their findings indicate that per capita GDP alone explains more than 64% of the variation in LE. When additional explanatory variables such as healthcare expenditures, malaria prevalence, and political institutions were incorporated into the model, the Preston Curve remained valid across different countries and time periods.

He and Li (2020) examined the relationship between LE and PCI for 65 countries over the period 1980–2014 using panel cointegration and causality tests. The findings indicate that in most countries, there is a significant and positive long-term relationship between the two variables. The causality analysis reveals that in the younger population group, there is a short-term unidirectional causality from LE to economic growth, whereas in the older population group, there is only unidirectional causality from economic growth to LE. Rahman, Rana and Khanam (2022) tested the validity of the Preston Curve in the 31 countries with the highest levels of pollution. The findings confirm the validity of the Preston Curve, indicating that economic growth has a positive impact on LE. Additionally, while increasing environmental pollution negatively affects LE, factors such as healthcare expenditures, access to clean water, and improved sanitation have a positive effect on LE in these countries. De la Escosura (2023) tested the derivation of the Preston Curve for the period 1870–2015 using data from 115 countries. Furthermore, the study confirms that the relationship between LE and PCI has progressively shifted outward over time, maintaining the validity of the Preston Curve. It also shows that, at higher levels of PCI, proportional increases in LE are larger.

The results show that the Preston Curve indicates that increases in PCI improve LE, but this effect diminishes at higher income levels (Bloom and Canning, 2000; Jetter et al., 2019). Studies examining the income inequality hypothesis (Wilkinson hypothesis) (Wilkinson, 1996; Rodgers, 2002; Çukur and Bekmez, 2011) support the validity of the hypothesis, concluding that deterioration in income distribution has a negative impact on health. Additionally, the effects of education and healthcare expenditures may be stronger than income growth (Lutz and Kebede, 2018).

5. Testing the Preston Curve and Wilkinson Hypothesis

The Preston Curve provides an important theoretical framework explaining the positive relationship between PCI and LE at birth. Following the works of Lutz and Kebede (2018) and Jetter et al. (2019), this study will examine the relationship between the variables using graphical analysis and time series methods, a technique also employed by Preston (1975) in his original study. Using data from the Turkish economy for the period 1960–2022, the relationship between these two variables is clearly observed in the graph. As PCI increases, significant improvements in LE are observed; however, after reaching a certain income level, this increase gradually slows down.

This situation supports the concept of diminishing marginal returns, as highlighted by Preston (1975). This concept, which explains the increases in LE, is rooted in advancements in medical technology (such as developments in treatment and pharmaceutical technologies). It also supports the conclusion that factors external to a country's income level contribute to 75–90% of the increase in LE, as noted by Jetter et al. (2019).

In the graph, it can be seen that at low-income levels (in the range of 2000–4000 USD), LE increases rapidly. This indicates that the effect of economic growth on health indicators is significantly more pronounced at the initial stages. During this period, income growth leads to improvements in access to healthcare services, nutrition, and sanitation, which in turn results in a rapid increase in LE. Particularly in developing countries, the rise in PCI is reflected in improvements in health outcomes such as reduced child mortality rates and the control of infectious diseases (Pritchett and Summers, 1993).

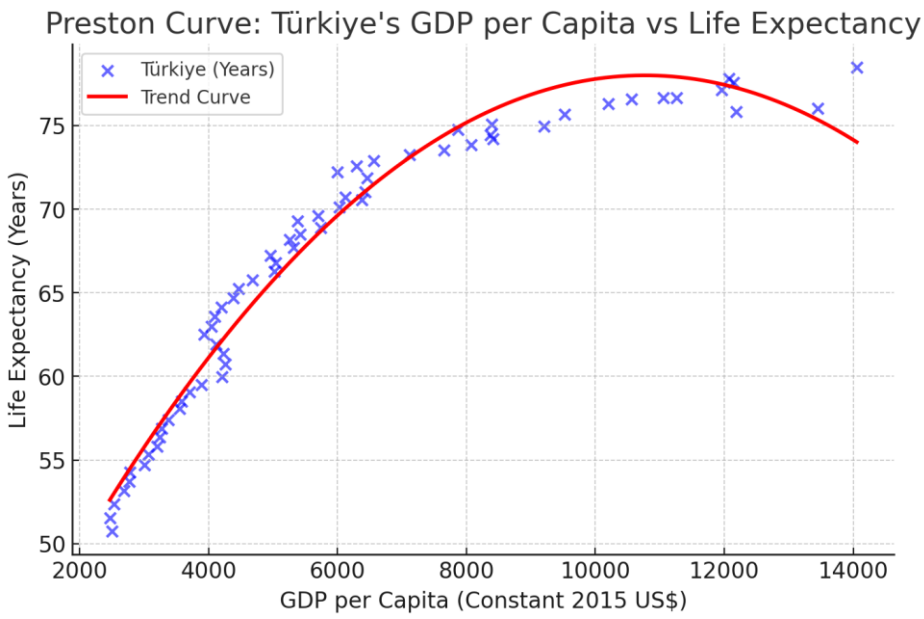

Figure 5. Preston Curve in Türkiye

However, the graph also shows that as income levels increase, the rate of increase in LE slows down. At middle and high income levels (approximately 6000 USD and above), despite income growth, LE follows a more horizontal trend, meaning that the impact of economic growth on LE becomes limited. This suggests that factors improving health indicators are not solely dependent on income growth, and that health policies,

education levels, and infrastructure investments also play significant roles (Cutler et al., 2006). In particular, education level contributes significantly to LE by enhancing individuals' ability to access healthcare services (Lutz and Kebede, 2018).

As predicted by the Preston Curve, the impact of economic growth on health indicators varies depending on income levels. In Türkiye, during the 1960s and 1970s, when low-income levels prevailed, economic growth led to a rapid improvement in LE. However, starting from the 2000s, as income levels increased, the rate of increase in LE slowed down, and the marginal effect of economic growth began to diminish. This suggests that Türkiye's position on the Preston Curve has changed over time.

In this study, the validity of the Preston Curve has also been tested using time series analyses. Descriptive statistics for the variables are provided in Table 1. Due to the limited data fo PHE and the Gini index, the relationships between LE, PCI, square of PCI, PHE, and income inequality (represented by the Gini coefficient) for the period 1980–2022 have been tested using URTs and RALS regression method. Following the study by Jetter et al. (2019), the model outlined below was constructed:

$$llife = \beta_0 + \beta_1 trend + \beta_2 lgddpc + \beta_3 lgdppc^2 + \beta_4 lgini + \beta_5 lgov + \varepsilon_t \quad (1)$$

Table 1. Descriptive Statistics

Variable	Definition	Mean	Standart D.	Jarque-Bera Probability Value	Data Source
llife	LE Year	71.4479	4.6082	0.2390	World Bank Data
lgdppc	Per Capita Gross National Income (in USD) at 2015 Prices	7475.200	2869.299	0.1035	World Bank Data
lgini	Pre-Tax National Income Gini Index	0.6326	0.0330	0.2226	Ourworldindata.org
lgov	Per Capita PHE	417.5791	379.3581	0.1041	OECD

When examining the descriptive statistics for the variables, it is observed that all series follow a normal distribution. PHE play a crucial role in enhancing access to medical services, preventive care, and overall healthcare quality, which in turn influences life expectancy. Grossman's (1972) health investment model conceptualized health expenditures as a form of human capital investment, emphasizing their long-term benefits for individual well-being. Several empirical studies have reinforced this idea, demonstrating that PHE significantly contribute to improving health outcomes (Acemoglu and Johnson, 2007; Ergün and Polat, 2019; Rahman et al., 2022). In the case of Türkiye, the Health Transformation Program (HTP) initiated in 2003 introduced extensive reforms, including an increase in PHE and expanded healthcare coverage (OECD, 2021). These policies have been associated with improvements in LE and reductions in infant and maternal mortality rates (TÜİK, 2022). Examining the impact of these expenditures on LE is essential for understanding whether such policy interventions yield measurable health benefits in the long run. Also, the inclusion of the PHE variable in the model aims to measure the impact of advancements in health technology and public health policies on LE. The income inequality variable is included to test the income inequality hypothesis proposed by Wilkinson (1992). In his study, Wilkinson discusses a different relationship between income and health, stating that income inequality creates negative effects on LE. Income inequality, as measured by the Gini coefficient, has been widely studied for its potential adverse effects on public health. The Wilkinson Hypothesis argues that greater income inequality negatively impacts health outcomes by limiting access to healthcare, increasing psychosocial stress, and reducing social cohesion. Deaton (2003) further supports this argument, demonstrating that disparities in income distribution can lead to significant variations in life expectancy across different socioeconomic groups.

Understanding this relationship is particularly relevant for policymakers seeking to balance economic growth with social equity. For Türkiye, fluctuations in income inequality have been particularly pronounced, especially following the economic crises of the early 2000s. The 2001 financial crisis led to a sharp increase in income inequality, which was later partially mitigated by structural economic reforms. By including the Gini coefficient in the model, this study aims to capture the extent to which income inequality affects health outcomes in Türkiye. The inclusion of PHE and the Gini coefficient enhances the robustness of the model by incorporating both economic and social determinants of health. While the Preston Curve primarily explains the relationship between PCI and LE, this study extends the framework by considering additional socioeconomic factors that shape health outcomes. By integrating these variables, the model provides a more comprehensive analysis of the determinants of life expectancy in Türkiye, accounting for both economic growth and social disparities

For the Preston Curve to be valid for the Turkish economy, the coefficient $\beta_2$must be positive, while β_3 should be negative to reflect non-linearity (Jetter et al., 2019). For the validity of the Wilkinson (1992) hypothesis, the coefficient β_4 must be negative. Theoretically, the coefficient β_5 is expected to be positive.

In its basic definition, a time series is considered stationary if its mean and variance remain constant over time, and the covariance with its own lagged values is independent of time, varying only with the lag length (Mert and Çağlar, 2019:98). In this context, the stationarity of the series will be tested using the traditional ADF URT and the RALS-LM URT. In time series analysis, determining whether the variables are stationary is an essential step. Non-stationary series can lead to spurious regression problems, hence, the stationarity level of the series should first be identified using the URT (Gujarati and Porter, 2009). In traditional URTs that do not account for structural breaks can lead to incorrect and biased results (Perron, 1989). Therefore, the RALS-LM URT, developed by Meng et al. (2017), has been used in this study. The RALS-LM URT has higher statistical power compared to traditional LM tests and produces more reliable results when the error terms are not normally distributed (Meng et al., 2017). In this study, the RALS-LM test, which allows for a structural break in both the intercept and the trend, has been utilized.

In the context of this test, the test statistic is calculated as follows:

$$\Delta Y_t = \alpha + \beta_t + \gamma Y_{t-1} + \sum_{i=1}^{j} \delta_i \Delta Y_{t-i} + \theta D_t + \zeta DT_t + \varepsilon_t \quad (2)$$

After calculating the second and third moments of the residual series from this equation, the residuals are added to the extended variables**,** referred to as w_{2t} and w_{3t}, in the LM test regression shown in equation 2, leading to the RALS LM test regression (Hepsağ, 2022: 227).

$$\Delta Y_t = \alpha + \beta_t + \gamma Y_{t-1} + \sum_{i=1}^{j} \delta_i \Delta Y_{t-i} + \theta D_t + \zeta DT_t + \phi_2 w_{2t} + \phi_3 w_{3t} + + \mu_t \quad (3)$$

After this equation is estimated using the OLS method, the test statistic is calculated as follows:

$$\tau_{RALS-LM} = \rho \tau_{LM} + \sqrt{1 - \rho^2 Z} \quad (4)$$

In equation 4**,** the parameter $\rho^2$is obtained by calculating the ratio of the variance of the error term in the RALS-LM equation to the variance of the error term in the LM equation (Hepsağ, 2022: 227-228). Finally, since the residuals of the error terms are not normally distributed and the variables are stationary according to the RALS-LM URT**,** the coefficients between the variables have been examined using the RALS regression method.

In the study, the ADF URT was first applied to determine whether the variables are stationary. Subsequently, the results were validated using the RALS-LM URT, which accounts for structural breaks and non-normality in the residuals of the error term.

Table 2. ADF URT Result

Variable	**Test Statistic**		**Jarque-Bera Stats. /Significance Stats.**
	Constant	**Constant and Trend**	

llife	-4.7675***	-0.0280	680.796664/ 0.000000
Δllife	-6.1325***	-7.0947***	
lgdppc	0.500	-2.1024	8.512469/ 0.014176
Δlgdppc	-6.7240***	-6.7645***	
lgini	-1.4463	-0.6856	3.157351/ 0.206248
Δlgini	-5.2564***	-5.3991***	
lgov	-1.0453	-2.0877	174.357664 / 0.000000
Δlgov	-11.4704***	-12.6225***	

Note: *** represents the 1% significance level.

According to the ADF URT results, the llife variable is not stationary at the level in the model with both intercept and trend, but becomes stationary in a statistically significant manner after taking the first difference. Similarly, the variables lgddpc**,** lgini, and lgov were found to be non-stationary at the level, but became stationary after taking their differences. The findings indicate that the variables contain unit roots, and once the differences are taken, all series become stationary. On the other hand, it is known that not accounting for structural breaks in the series and the failure of the normality assumption for the residuals of the error terms (except for the gini variable) in the normality test could lead to misleading results using traditional URTs.

Table 3. RALS-LM URT Result

Variable	Lag Length	ρ^2 values	Test Stats.	Break Date	%5 Critical Value
llife	1	0.5073	-6.0688	2017	-3.274
lgdppc	3	0.92610	-5.1832	1999	-3.698
lgini	2	0.8929	-6.6564	2008	-3.698
lgov	3	0.60471	-9.7839	1988	-3.404

According to the results of the RALS-LM URT**,** when the test statistics for all variables are compared with the critical values, it is observed that the test statistics for the series are significantly stationary. The findings indicate that it is important to consider the non-normality of the residuals of the error term and the impact of structural breaks on the variables. In particular, the overlap of the break dates with economic and political changes (such as 1988, the year when economic transformations began, 1999, the economic crisis, and 2008, the global crisis) highlights the lasting impact of these processes on the variables. The breakpoints identified in 2017 for life expectancy, 1999 for PCI, 2008 for income inequality, and 1988 for PHE, point to critical periods in Türkiye where the long-term trends of these variables underwent significant changes.

Table 4. RALS Regression Result

Variable	Coefficient	Std. Error	T- Stat.	Significance
Constant	2.9981***	0.0771	38.8563	0.0000
Trend	0.0030***	0.0004	6.2143	0.0000
lgdppc	0.1227***	0.0121	10.0765	0.0000
lgdppc^2	-0.0640***	0.0218	-2.9362	0.0056
lgini	-0.3965***	0.0862	-4.5965	0.0000
lgov	0.0201***	0.0021	9.4559	0.0000
W2	0.5590	6.8224	0.0819	0.9351
W3	622.9420*	369.4092	1.6863	0.0999

Note: * and *** represent the 10% and 1% significance levels, respectively.

Finally, the RALS regression results have been evaluated to test the validity of the hypotheses within the context of the Preston Curve and Wilkinson Hypothesis. Since the variables have undergone logarithmic transformations, the estimated coefficients represent the elasticities**,** indicating the proportional change in the dependent variable in response to a percentage change in the independent variables. The coefficient for PCI is positive and statistically significant. This finding indicates that the Preston Curve is valid in the context of Türkiye, meaning that as income increases, LE also rises. However, the coefficient for the square of the relevant variable is negative and statistically significant, suggesting that as income increases, the marginal effect on LE decreases, and after reaching a certain income level, health improvements become limited. This supports the validity of the curvilinear structure proposed by Preston (1975) for the Turkish economy.

On the other hand, the income inequality coefficient was found to be negative and statistically significant. This result indicates that the Wilkinson Hypothesis is valid in the context of Türkiye, and that income inequality has a negative impact on LE. The negative coefficient observed for Türkiye suggests that as income inequality increases, LE decreases, highlighting the need for public policies to be restructured in a way that balances income distribution. Studies such as those by Wilkinson (1992) and Rodgers (2002) have highlighted the negative impact of income inequality on health indicators. In this study, a negative relationship between income inequality and LE was found, further supporting the validity of the Wilkinson Hypothesis in the context of Türkiye. Additionally, the study conducted by Çukur and Bekmez (2011) specifically for Türkiye found that inequality in income distribution has a pro-cyclical effect on infant mortality rates. This study provides findings consistent with the Wilkinson Hypothesis, aligning with similar studies in the literature.

The PHE variable is positive and statistically significant. This indicates that an increase in public healthcare spending has a positive effect on LE. The findings, which suggest that healthcare expenditures improve individuals' health through advancements in medical technology and increased access to healthcare services, thereby increasing LE, are widely supported in the literature (Ergün and Polat, 2019; Rahman et al., 2022). This result underscores the critical role of public health policies in improving health indicators in the long run.

In conclusion, the RALS regression results indicate that the Preston Curve is valid in Türkiye and that the effect of income on LE diminishes after a certain point. Additionally, in line with the Wilkinson Hypothesis, it was found that income inequality has a negative impact on health indicators, and that PHE are effective in increasing LE. These findings suggest that for economic growth to generate health gains, it is not sufficient for PCI to increase alone; instead, it is also necessary to address inequities in income distribution and ensure that PHE are effectively directed.

6. Conclusion and Policy Recommendations

This study examines the relationship between PCI, income distribution, and LE within the framework of the Preston Curve and the Wilkinson Hypothesis in the Turkish economy over the period 1960–2022. With Türkiye's economic transformation processes, there has been a significant increase in PCI, along with relative improvements in income distribution, leading to notable advancements in health indicators. Based on the results from graphical analysis and time series analysis, it has been shown that the Preston Curve is valid for the Turkish economy. As PCI increases, LE also rises, but it has been found that this effect diminishes once income surpasses a certain threshold level. This finding indicates that the curvilinear structure proposed by Preston (1975) is also validated in the context of Türkiye. On the other hand, within the framework of the Wilkinson Hypothesis, it has been found that income inequality has a negative impact on LE. It has been determined that during periods of increased income inequality, LE decreases, and this effect is statistically significant. Finally, it has been observed that PHE positively affect LE, which demonstrates that the effective use of health policies and public resources in the healthcare sector directly improves public health.

The findings indicate that the impact of economic growth on health indicators is not limited to increasing PCI alone, but also highlights the need to address income distribution inequalities and increase PHE. Türkiye's long-term health policies should not focus solely on economic growth, but must include measures that ensure fairness in income distribution and increase access to healthcare services. While national-level trends in LE, income, and PHE provide valuable insights, regional disparities within Türkiye must also be considered to capture the full scope of health and economic inequalities. Specifically, the effective management of PHE, reducing regional disparities in access to healthcare, and increasing investments in healthcare technologies are essential. In addressing income inequality, social policies should be reinforced to enhance access to healthcare for low-income groups and elevate education levels.

In conclusion, the findings obtained in the context of the Turkish economy reveal that the relationship between economic growth and LE, as predicted by the Preston Curve, weakens beyond a certain threshold. Additionally, the results confirm the negative impact of income inequality on health, as advocated by the Wilkinson Hypothesis. Overall, the study has shown that the relationship between economic growth and health indicators in Türkiye has changed over time, income, income distribution and healthcare expenditures serving as significant determinants in this process. Future research could contribute to more targeted health policies by elaborating on how this relationship varies across different demographic groups and regional levels.

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