Research Article

The Relationship Between Economic Dynamics and Fertility: As an Existential Issue of Baby Shortage in Türkiye

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Abstract: Spanning from the classical insights of Malthus and Marx to the contemporary perspectives of Dumont and Becker, theorists have consistently underscored the pivotal role of economic factors in explaining fertility trends, weaving a narrative that connects historical and modern economic theories in the study of demographic dynamics. This study examines the impact of economic factors on Türkiye's fertility rates from 1990 to 2022, focusing on how changes in the consumer price index, GDP per capita, and social protection expenditure have influenced population trends. As more than one structural break was observed in the series, Clemente Montanes Reyes, Hatemi-J and Maki analyses were carried out. The results of the study do not indicate that the fertility rate in Türkiye is significantly affected by economic factors. No evidence of long-run cointegration between these variables was found. Therefore, changes in economic factors have little or negligible direct impact on the fertility rate. This research offers a crucial benchmark for shaping fertility policies in both developed and developing nations, as it thoroughly examines how economic progress influences population trends. These results highlight the complex dynamics of fertility and underline the need to understand the effects of increased female labor force participation, childcare costs, fertility anxiety and work-family conflict fertility decline.

Keywords: Fertility rate, Economic factors, Baby shortage
Jel Codes: C32, J13, I18

Ekonomik Dinamikler ve Doğurganlık Arasındaki İlişki: Türkiye'de Varoluşsal Bir Sorun Olarak Bebek Kıtlığı

Öz: Malthus ve Marx'ın klasik görüşlerinden Dumont ve Becker'in çağdaş perspektiflerine kadar uzanan teorisyenler, ekonomik faktörlerin doğurganlık eğilimlerini açıklamadaki önemli rolünü sürekli olarak vurgulamış, demografik dinamiklerin incelenmesinde tarihsel ve modern ekonomik teorileri birbirine bağlayan bir anlatı oluşturmuşlardır. Bu çalışma, 1990'dan 2022'ye kadar ekonomik faktörlerin Türkiye'deki doğurganlık oranları üzerindeki etkisini inceleyerek, tüketici fiyat endeksi, kişi başına düşen GSYİH ve GSYİH'nın yüzdesi olarak sosyal koruma harcamalarındaki değişimlerin nüfus eğilimlerini nasıl etkilediğine odaklanmaktadır. Serilerde birden fazla yapısal kırılma gözlemlendiği için Clemente Montanes Reyes, Hatemi-J ve Maki analizleri gerçekleştirilmiştir. Çalışmanın sonuçları, Türkiye'deki doğurganlık oranının ekonomik faktörlerden önemli ölçüde etkilenmediğini göstermektedir. Bu değişkenler arasında uzun vadeli bir eşbütünleşme kanıtı bulunamamıştır. Dolayısıyla, ekonomik faktörlerdeki değişikliklerin doğurganlık oranı üzerinde çok az veya ihmal edilebilir düzeyde doğrudan bir etkisi vardır. Bu araştırma, hem gelişmiş hem de gelişmekte olan ülkelerde doğurganlık politikalarının şekillendirilmesi için önemli bir kıstas sunmakta, ekonomik gelişmenin nüfus eğilimlerini nasıl etkilediğini kapsamlı bir şekilde incelemektedir. Bu sonuçlar, doğurganlığın karmaşık dinamiklerini ortaya koymakta ve artan kadın işgücüne katılımı, çocuk bakım maliyetlerini, doğurganlık kaygısını ve iş-aile çatışmasının doğurganlık düşüşü üzerindeki etkilerini anlamanın önemini vurgulamaktadır.

Anahtar Kelimeler: Doğurganlık hızı, Ekonomik faktörler, Bebek kıtlığı
Jel Kodları: C32, J13, I18

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1. Introduction

The origins of modern population dynamics can be traced back to the Age of Enlightenment in the late 18th century and the pioneering work of Thomas Malthus (Güneş, 2009; Vidal, 1994). Malthus's work "On the Principle of Population" opened up the debate on the potential effects of population growth on socio-economic structures; this debate was extended by Marx's opposition based on socio-economic factors (Hartmann, 1988; Savaş, 1997) Marx argued that population policies served to create a reserve army of labour and that this situation was in the interests of employers, and argued that it was possible to improve the economic situation of workers by controlling fertility (Brezis & Warren, 2003; Jermain, 1975).

At the end of the 19th century, when the world economy seemed to be following the path predicted by Malthus, anti-Malthusian views were particularly strong in France. The French sociologist Arsène Dumont (1890), in his work 'Dépopulation et Civilisation', explained the decline in fertility as a result of individualisation and the desire to improve social status, arguing that families tended to have fewer children in order to provide them with more resources and opportunities (Zuanna, 2007).

In the 20th century, and especially after the 1929 global financial crisis, fertility research (Jermain, 1975) has considered the impact of factors such as unemployment (Goldstein et al., 2013; Schneider, 2015; Vignoli et al., 2020), GDP (Luci-Greulich & Thévenon, 2014; Matysiak & Vignoli, 2008), consumer confidence and economic development (Comolli, 2017; Schneider, 2015). These studies have argued that socio-economic development increases the costs and reduces the benefits of children, allowing families to develop strategies to reduce their desired number of children and fertility rates (Bongaarts & Hodgson, 2022).

In addition, Becker's (1993), analyses show that couples with economic resources are more likely to have more children, while at the same time individuals in developed societies postpone childbearing in the face of economic uncertainty and support this tendency during periods of economic growth (Sobotka et al., 2011). As modern economies increase the opportunity cost of childbearing through higher human capital requirements and higher wages, the labor, savings and risk-reducing benefits of children are reduced (Leibenstein, 1981). This observation encourages parents to invest in their own and their children's human capital rather than in the number of children. This highlights the impact of economic developments on family planning decisions and the complex dynamics of fertility rates (G. Becker, 1993).

In this context, the present study, which focuses on the effects of economic factors on fertility in Türkiye, offers a unique perspective by specifically analyzing the impact of economic indicators—such as social protection expenditure as a percentage of GDP, the consumer price index, and GDP per capita—on fertility rates over the period from 1990 to 2022. Unlike previous studies that may have examined these variables in isolation or within different contexts, this study uniquely integrates these indicators in the Turkish context, providing a comprehensive analysis using national-level data spanning 32 years.

The contributions of this study are twofold. First, it fills a gap in the demographic and economic literature by systematically examining the relationship between economic factors and fertility in Türkiye, a topic that has been underexplored in previous research. Second, by highlighting the limited impact of economic factors on fertility rates in Türkiye, the study challenges existing assumptions and offers critical insights that can inform the design of fertility policies not only in Türkiye but also in other developed and developing countries facing similar demographic challenges.

The strengths of this study are that it uses comprehensive data sets and analyses in detail the effects of economic factors on fertility in a developing country like Türkiye. The Maki cointegration test offers a robust framework for evaluating the presence of long-term equilibrium relationships among various economic variables impacting fertility. However, the study also has some weaknesses. In particular, the impact of social and cultural factors on fertility may have been less emphasised, which may limit the

completeness of the analysis. In addition, the lack of international comparisons may raise questions about the general validity of the findings.

This study first focuses on the economic factors affecting fertility rates and then consolidates the theoretical foundations through a comprehensive review of the relevant literature in section two. Section 3 contains the research questions and hypotheses of the analysis. The methodology and analytical methods used are explained in detail in the fourth section, while the empirical results are carefully presented and discussed in the fifth section. The final section summarises the main findings, draws conclusions on the impact of economic variables on fertility and provides recommendations for policy makers. This study aims to provide an important reference point for the design of fertility policies in Türkiye and in developing countries in general.

2. Background

2.1. Economic Conditions and Its Effects on Fertility Trends

Around the world, economic conditions have profound and multidimensional effects on family size and fertility decisions. These effects range from household income to employment stability, from educational attainment to urbanisation processes, from external economic shocks to global crises such as the COVID-19 pandemic (CoR, 2021). Each is an important factor in shaping the lifestyles of families and individuals and their plans.

Research generally shows that increasing household income reduces the likelihood of having children by increasing the opportunity cost of time. According to the theory of Becker & Lewis (1973), as family income increases, parents may tend to allocate more resources to fewer children. However, in a different situation, when dark clouds are gathering, such as economic uncertainty and unemployment, individuals may postpone having children or prefer to have fewer children. Jones, Schoonbroodt & Tertilt (2008) underlines this relationship and draws attention to people's different desires to have children. From this perspective, some individuals may prefer to invest more in their careers, while others may invest more in children and thus have lower income levels (Greil et al., 2020; Jones et al., 2008).

Education and urbanisation are other factors that have a significant impact on fertility. In general, individuals with higher levels of education are more likely to focus on career goals and postpone having children (Preston & Hartnett, 2010). This relationship is often driven by women's educational attainment, as childcare is mostly undertaken by women and women's educational attainment has a more dominant effect on opportunity costs (Jain, 1981). Higher levels of education tend to lead to better positions and wages in the labour market and thus to lower fertility (Kaur, 2000; Schultz, 2005).

The increase in the cost of living and the changes in lifestyle brought about by urbanisation point to the dynamics of urban life favouring small families. Rising housing prices in metropolitan areas may make individuals more cautious about marriage and childbearing (Guo et al., 2012; White et al., 2008). Du & Lin (2022) suggests that economic development in China has widened the gap between urban and rural areas, leading to a decline in fertility rates, especially as the cost of living in cities increases. This leads families to adopt smaller family structures as they try to balance costs and quality of life (Blair & Madigan, 2021; Yang & Zhang, 2023).

Finally, external economic shocks and global events such as the COVID-19 pandemic have a profound impact on family planning and fertility rates. As Karacsony (2020) points out, economic crises can make families uncertain about their future plans and cause them to postpone or change their decision to have children. What happened during the pandemic is a concrete example of the impact of economic uncertainty on individuals' life choices. During this period, many people re-evaluated their decisions about their future, and economic factors played an important role in this process. Historical data supports this observation, suggesting that, like natural disasters, pandemics initially decrease birth

rates, which then gradually increase, potentially followed by a baby boom, influenced by economic conditions, mental health, fear, and mortality (Ullah et al., 2020). Additionally, studies indicate that strict social controls and norms during the pandemic, such as restrictions on gatherings, lowered the willingness and demand for marriage and childbearing, further contributing to reduced fertility rates (Lin & Kong, 2023).

The above findings support the claim that adverse economic conditions are negatively associated with fertility. In addition to the unemployment rate, a significant body of literature has considered GDP (Luci-Greulich & Thévenon, 2014; Matysiak & Vignoli, 2008), consumer confidence (Comolli, 2017; Schneider, 2015) and measures of economic uncertainty (Dribe & Smith, 2021; Guetto et al., 2021; Schneider, 2015). Saguin (2021) offers compelling empirical evidence from Singapore, illustrating that housing affordability is a pivotal factor in family planning. The research highlights the intricate connection between housing conditions and economic factors, and how they significantly shape decisions regarding childbearing in Singapore. Each of these factors has a complex influence on fertility trends around the world, shaping individuals' decisions about family size and timing of childbearing (Kaur, 2000). These studies highlight that economic factors have important effects on individuals' decisions to have children and that fertility policies need to take these interactions into account (Kreyenfeld et al., 2012; Kreyenfeld & Andersson, 2014).

2.2. The Role of Economic Factors on Fertility: Empirical Observations in Türkiye

Türkiye's fertility story tells a journey with sharp turns and smooth transitions from 1959 to 2016 (İğdeli, 2019). The reasons for low fertility rates range from education to urbanisation, from non-agricultural labour force participation to economic and institutional changes. According to Özgür (2004), these factors significantly affect the fertility rate, while Özbay Daş (2020) finds that economic and institutional variables - such as per capita income, government expenditure and democracy play a crucial role in fertility. The study finds that per capita income and government expenditure have a negative dance with fertility, while democracy has a positive rhythm.

In another study, Kutlar et al. (2012), reported that there is a positive relationship between the wage index and fertility in the long run, but periodically fertility responds negatively to wage rates. Studies by Deliktaş et al. (2008) and Selim & Üçdoğruk (2005) concluded that an increase in per capita income reduces fertility. Selim and Üçdoğruk (2005), found that increases in women's earned income are negatively related to the number of children, but household income is positively related to the number of children.

When the curtain is lifted on migration, Selim & Bilgin (2021) show that migration has a positive effect on fertility, but with the increased participation of women in the labor force in 2013, the opportunity cost of raising children has increased, reducing the number of children.

Another study shows that there are deep inequalities between low fertility rates in western provinces and high fertility rates in eastern provinces (Eroğlu et al., 2021). The study focusing on the reproductive behaviour of women in Şanlıurfa, the city with the highest fertility rate in Türkiye, found that women with lower levels of education have more children, and that child gender preference also has a significant impact on fertility.

As far as existing studies are concerned, the focus of previous research has been on identifying the effects of women's educational attainment and their role in the labour market on fertility. The causal chains between economic conditions and fertility are not clear. This study examines the impact of economic factors on fertility, a topic that is rarely discussed in the literature. Understanding these factors affecting fertility is important for shaping Türkiye's demographic structure and determining future population policies.

3. Research Questions and Hypotheses

This study analyses the relationship between economic conditions and fertility rates in Türkiye in depth and aims to provide evidence on the impact of economic conditions

on fertility. In this context, the study analyses the impact of economic factors on fertility rates and the potential impact of economic factors and social protection expenditures to reduce poverty on fertility rates in Türkiye between 1990 and 2022. This analysis aims to provide policy makers with a sound basis for strategic interventions and policy changes.

My research questions are:

1. How have economic factors such as per capita income, consumer price index and social protection expenditures in GDP affected fertility rates in Türkiye between 1990 and 2022?

2. What are the effects of social protection expenditures, economic development and changes in the cost of living on fertility rates in Türkiye?

The hypotheses of this study are the following

H_1: There is a cointegration effect between per capita income, consumer price index, and fertility rates in Türkiye. This suggests that these variables, though independent, have a long-term equilibrium relationship, which influences fertility rates in concert over time.

H_2: There is no cointegration effect between per capita income, consumer price index, and fertility rates in Türkiye. This suggests that these variables do not move together in the long term, indicating that changes in economic factors and cost of living do not consistently influence fertility rates over time.

H_3: There is a negative relationship between per capita income and consumer price index and fertility rates in Türkiye; that is, increases in economic development and cost of living reduce fertility rates. This suggests that increases in economic welfare may affect families' decisions to have children.

H_4: There is a positive relationship between the social protection expenditures in GDP and fertility rates. This suggests that social protection and supportive policies provided by the state may encourage families to have children.

In the light of these questions and hypotheses, a comprehensive understanding of the impact of economic factors on fertility is developed by rigorously analysing the relationships between Türkiye's demographic and economic indicators. This approach helps to assess the impact of economic factors on fertility from a broader perspective and to understand the long-term effects of general economic trends on fertility, independent of specific events.

4. Data And Analytical Strategy

4.1. Data Sources and Descriptive Statistics

In this study, a time series analysis was conducted to examine the relationship between fertility rates and economic factors in Türkiye. The primary reason for selecting this model is its capacity to analyze the complex dynamics between long-term economic variables and demographic indicators. The study not only provides a snapshot of the current situation but also reveals the long-term trends in how economic factors impact fertility. Furthermore, in developing countries like Türkiye, economic crises or other structural factors (e.g., political changes, international shocks) can lead to significant breaks in time series. By selecting the period from 1990 to 2022, this study accounts for the effects of various economic crises (e.g., the 1994, 2001, and 2008 crises) and other significant economic and social changes in Türkiye, thus ensuring a more accurate understanding of the relationship between economic variables and fertility rates. Advanced econometric methods, such as Clemente Montanes Reyes, Hatemi-J, and Maki analyses, play a critical role in detecting these structural breaks in time series and identifying long-term cointegration relationships.

The study considers various economic factors as independent variables, including the Consumer Price Index (CPI), Gross Domestic Product (GDP) per capita, and social protection expenditure as a percentage of GDP. These economic indicators reflect the overall economic conditions in Türkiye and their potential impact on fertility. For instance, the CPI is used as an indicator of economic stability, explaining the impact of

inflation on household income; GDP per capita indicates the country's economic growth rate and the average income level of individuals, highlighting the effect of economic prosperity on fertility. Social protection expenditure assesses the level of government investment in the social security network and its potential impact on fertility decisions, particularly for low-income families.

The fertility rate, as the dependent variable, serves as an important indicator for understanding the impact of these economic factors on society. The data used in this study were provided by the State Statistical Institute (SSI) for the period from 1990 to 2013 and by the Turkish Statistical Institute (TURKSTAT) for the period from 2014 to 2022 (see Table 1). The integration of data from these two institutions enhances the reliability of the study and enables a comprehensive analysis of Türkiye's economic and demographic development over time.

Table 1. Descriptive Statistics

Variable	Data Sources	Obs	Mean	Std. dev.	Min	Max
Fertility Rate (%)	1990-2013 SSI 2014-2022 TURKSTAT	33	2.336	0.398	1.62	3.19
CPI (%)	1990-2013 SSI 2014-2022 TURKSTAT	33	36.730	33.498	6.16	125.49
GDP per capita ($)	1990-2013 SSI 2014-2022 TURKSTAT	33	7181.576	3602.546	2240	12582
Social protection expenditures in GDP (%)	1990-2013 SSI2014-2022 TURKSTAT	33	11.936	4.585	4.1	17.6

Source: Author's own calculations using Stata version 18.

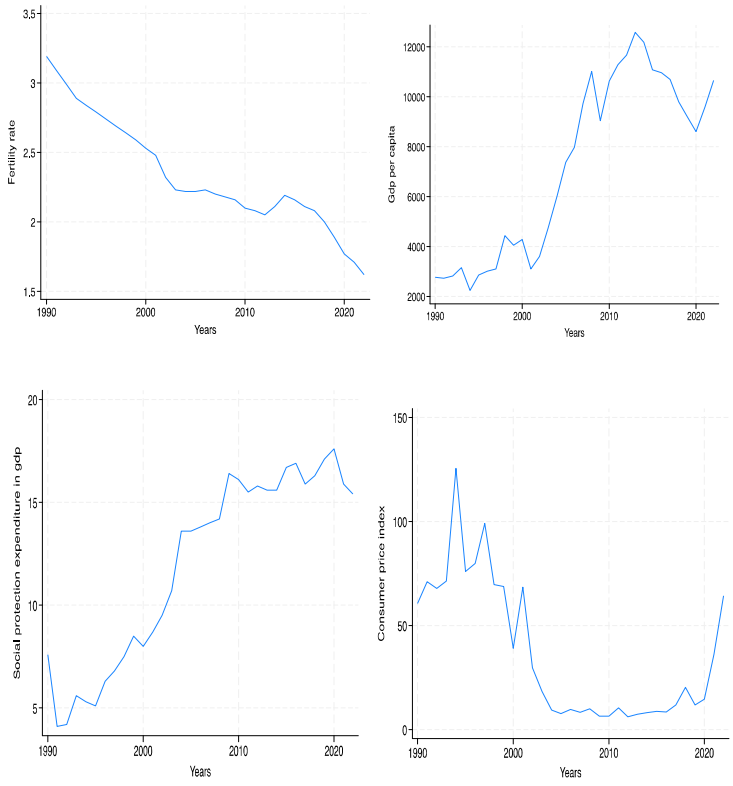


Figure 1. Time Series Plots of Variables (**Source:** Author's own calculations using Stata version 18.)

Consumer price index, GDP per capita and social protection expenditure in GDP show significant structural breaks. The structural break in the fertility rate is less pronounced. The changes in these graphs show that economic cycles change with different policy changes (see Figure 1).

4.2. Statistical Analysis

The research tests whether changes in economic factors lead to a decline in fertility rates in Türkiye. The basic test procedure is carried out in two steps. The first step is to test whether the variables contain unit roots to confirm the stationarity of each variable. This is done using the Augmented Dickey-Fuller (ADF) (1979) and Philips-Perron (PP) (1988) tests. The ADF test controls for autocorrelation within the series, while the PP test addresses autocorrelation and heteroskedasticity using the Newey-West method. However, both tests do not account for structural breaks within the series. Therefore, in a country like Türkiye, where economic crises are frequent, the Bai-Perron (1998) and Clemente-Montañés-Reyes (1998) tests were also employed to accurately identify any potential structural breaks in the data. The Bai-Perron test has the capacity to detect multiple structural breaks in the model, while the Clemente-Montañés-Reyes test can identify unknown structural breaks in unit root tests. As a result of these tests, 2 structural breaks were found in the variables.

Finally, cointegration tests were applied to determine whether there is a long-term equilibrium relationship between the variables. The cointegration test helps us understand whether the variables move together over time. Moreover, if a long-term relationship exists, it is crucial for developing policies aimed at this relationship. In this study, since all variables are integrated of order I(1), the Hatemi-J (2008) and Maki (2012) cointegration tests were used. The Hatemi-J test allows for two structural breaks, while the Maki test offers a more flexible approach, allowing up to five structural breaks. These tests were chosen to evaluate the impact of frequent structural breaks in Türkiye's economic history on long-term relationships.

Here's a brief summary of the general forms of the test equations for the ADF (1), PP (2), Bai-Perron (3), Clemente-Montañés-Reyes (4), Hatemi-J (5) and Maki (6) tests.

$$\Delta_{yt} = \propto + \boldsymbol{\beta t} + \boldsymbol{\gamma} y_{t-1} + \sum_{i=1}^{p} \emptyset_i \ \Delta_{yt-i} + \epsilon_t \quad (1)$$

$$y_t = p y_{t-1} + \epsilon_t \quad (2)$$

$$y_t = \propto + \boldsymbol{\beta t} + \sum_{j=1}^{m} \gamma_j \ 1_{t \geq Tj} + \epsilon_t \quad (3)$$

$$\Delta_{yt} = \propto + \beta_{yt-1} + \sum_{i=1}^{k} \emptyset_i \ \Delta_{yt-i} + \boldsymbol{\delta} D_t + \boldsymbol{\theta} D_{tyt-1} + \epsilon_t \quad (4)$$

$$\Delta_{yt} = \boldsymbol{\Pi} y_{t-1} + \sum_{i=1}^{p} \emptyset_i \ \Delta_{yt-i} + \boldsymbol{\delta} D *_t + \epsilon_t \quad (5)$$

$$\Delta_{yt} = \propto + \boldsymbol{\beta}_t + \boldsymbol{\gamma} y_{t-1} + \sum_{i=1}^{p} \emptyset_i \ \Delta_{yt-i} + \sum_{i=1}^{m} \boldsymbol{\theta}_i \ D_{j,t} + \epsilon_t \quad (6)$$

5. Results

5.1. Unit Root Tests

Initially, ADF unit root test was applied to check for stationarity in our data series. According to Schwert (1989), appropriate lag lengths were determined for each variable. Considering the low power of the ADF test, the PP test was also employed as an alternative, which corrects t-tests non-parametrically unlike the ADF. This adjustment allows for more robust results even in the presence of serial correlation and heteroskedasticity. The results are presented in Table 2. The test statistics for both tests are statistically insignificant. When unit root tests are applied to the first differences of all variables, both tests indicate that the variables are stationary at the 1% level. Only the fertility rate is stationary at the 10% level. Consequently, the results from all tests indicate that each variable is integrated of order one.

Table 2. Results of the ADF and PP Tests for Unit Root

Variable	ADF		PP		Lag	Order of Integration
	Level	1st difference	Level	1st difference		
Fertility rate	-2.001	-2.845*	-2.129	-2.817*	2	I (1)
CPI	-0.111	-7.689***	-1.781	-7.685***	8	I (1)
GDP per capita	-1.447	-4.928***	-1.408	-4.968***	1	I (1)
Social protection expenditure in GDP	-0.682	-6.392***	-1.968	-6.576***	1	I (1)

Source: Author's own calculations using Stata version 18.
Note: Includes intercept and trend.
* 10%, *** 1% significance.

Unit-root tests such as ADF and PP have the potential to confuse structural breaks in series as evidence of non-stationarity. Many econometricians use unit-root tests that allow for structural instability to deal with this confounding.

5.2. Unit-Root Tests Allowing for Structural Change

The Bai Perron test was performed to determine whether there is more than one break point in the series and the location of these points (see Table 3). The Bai Perron test is a statistical method used to detect the presence of more than one structural break in time series data and the timing of these breaks. The main purpose of the test is to accurately identify and integrate changes in parameters in econometric models over time by identifying one or more structural break points.

Table 3. Bai Perron Test for Multiple Breaks at Unknown Break Dates

Variable	Test Statistic	Estimated break dates
Fertility rate	1810.25	2000, 2018
CPI	1273.76	2001, 2018
GDP per capita	3374.90	2002, 2006
Social protection expenditure in GDP	4839.58	1997, 2003

Source: Author's own calculations using Stata version 18.

The results of the Bai-Perron test indicate several structural breaks in the variables analyzed during the 2000s, which can generally be linked to significant economic, social, or political changes (Bai & Perron, 2003). During and after the 2001 financial crisis, critical reforms were implemented to stabilize the economy. This period marked the transition from a fixed to a floating exchange rate regime, along with significant adjustments in the banking sector (Akyüz & Boratav, 2003). Cooperation with the International Monetary Fund (IMF) played a pivotal role in reducing public debt and stabilizing inflation (Rodrik, 2001). From 2002 to 2018, Türkiye experienced sustained economic growth and enhanced global integration (Kose & Ozturk, 2004). The economic crisis of 2018 precipitated a sharp depreciation of the Turkish lira and led to financial imbalances (Yilmaz, 2019).

According to the results of the Bai-Perron test, it is necessary to perform a unit root test that takes into account the structural breaks. The Zivot-Andrews test and the Clemente-Montañés-Reyes test are both unit root tests that take into account structural breaks in time series. These tests help to model and analyse the impact of economic, political or other exogenous events on time series data. However, while the Zivot-Andrews (2012) test usually works under the assumption of a single structural break point in the series, the Clemente-Montañés-Reyes (1998) test takes into account two structural

break points in the series. This is advantageous in more complex business cycles or when several exogenous shocks are involved.

The Clemente-Montańés-Reyes test in Stata 18 can represent both single and two breaks. clemao2 and clemio2 apply the additive outlier (AO) and innovative outlier (IO) models for two structural breaks, respectively. If their estimates show that there is no evidence of a second break in the series, the clemao1 and clemio1 tests can be run to test for a unit root in the presence of a single structural break. When applying the Dickey-Fuller tests to time series that may have structural breaks, the results obtained with the Clemente-Montańés-Reyes test should be taken into account. If this test provides evidence of significant structural breaks in the time series, the results obtained from unit root tests such as ADF or PP are questionable (Baum, 2005).

The results of the Clemente-Montañés-Reyes AO and IO unit root test with two structural breaks are reported in Figure 2 and Table 4-5 below.

Table 4. Clemente-Montañés-Reyes Unit Root Test with Double Mean Shifts, IO Model

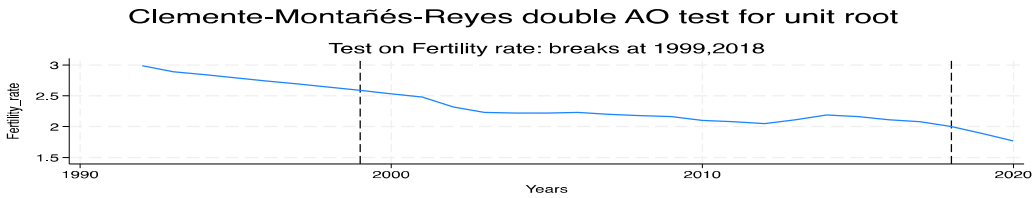
Variable	Breaks	Coef.	t-statistic	p-value	Estimated break dates
Fertility rate	Du1	-0.083	-2.493	0.019	1999
	Du2	-0.136	-5.341	0.000	2017
CPI	Du1	-24.777	-1.747	0.092	1998
	Du2	-33.438	-2.190	0.001	2001
GDP per capita	Du1	2322.664	3.614	0.444	2002
	Du2	-342.990	-0.778	0.000	2017
Social protection expenditure in GDP	Du1	2.126	3.816	0.001	1994
	Du2	3.541	3.938	0.000	2002

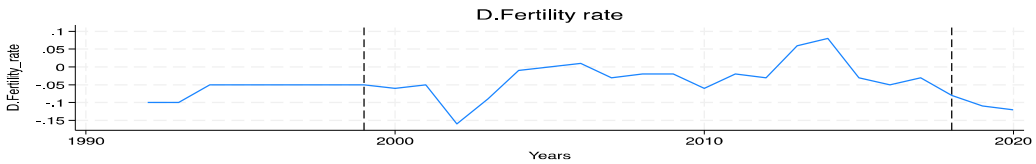
Source: Author's own calculations using Stata version 18.

Table 5. Clemente-Montañés-Reyes Unit Root Test with Double Mean Shifts, AO Model

Variable	Breaks	Coef.	t-statistic	p-value	Estimated break dates
Fertility rate	Du1	-0.652	-10.863	0.000	1999
	Du2	-0.444	-5.253	0.000	2018
CPI	Du1	-19.923	-2.052	0.049	1997
	Du2	-46.513	-5.376	0.000	2001
GDP per capita	Du1	3310.433	4.299	0.000	1999
	Du2	4142.452	5.786	0.000	2008
Social protection expenditure in GDP	Du1	4.947	6.381	0.000	1994
	Du2	4.591	6.279	0.000	2002

Source: Author's own calculations using Stata version 18.


Clemente-Montañés-Reyes double AO test for unit root
Test on Fertility rate: breaks at 1999,2018
Fertility_rate
Years


D.Fertility rate
D.Fertility_rate
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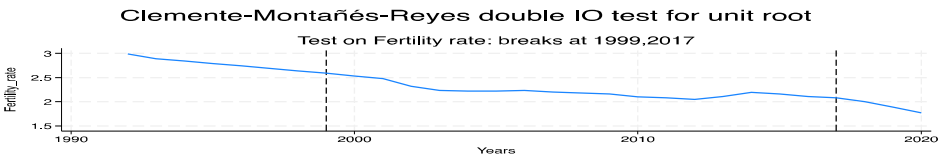
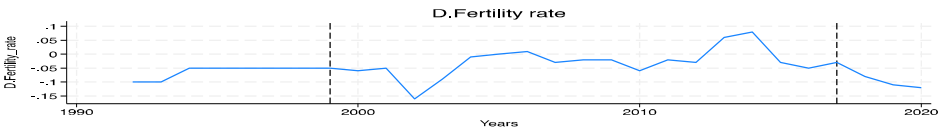

Clemente-Montañés-Reyes double IO test for unit root
Test on Fertility rate: breaks at 1999,2017
Fertility_rate
Years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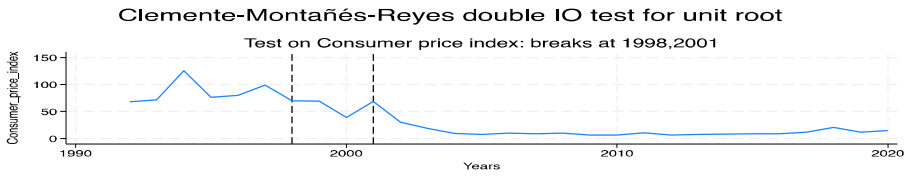
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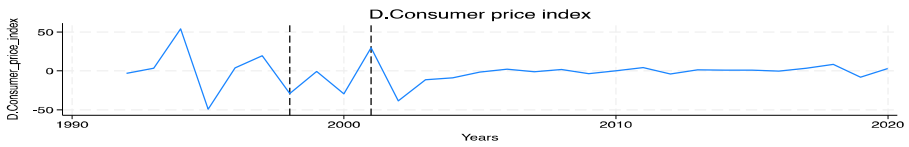
Test on Consumer price index: breaks at 1998,2001
Consumer_price_index
Years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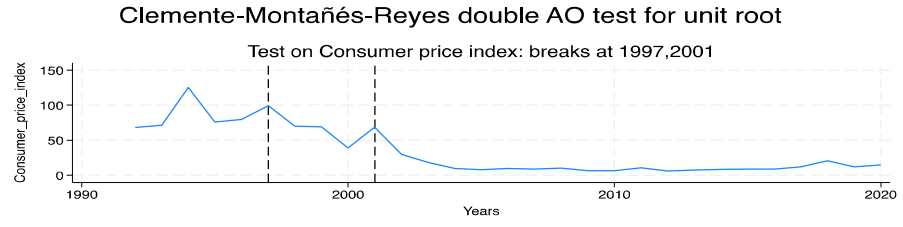
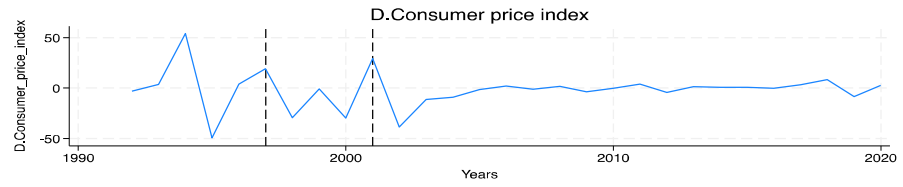
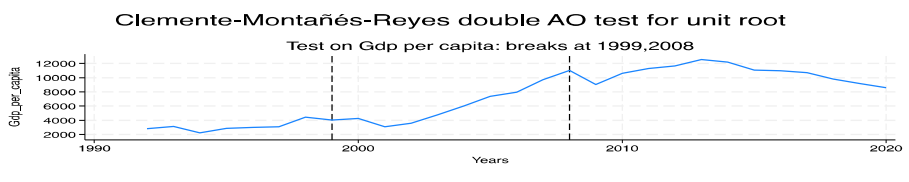
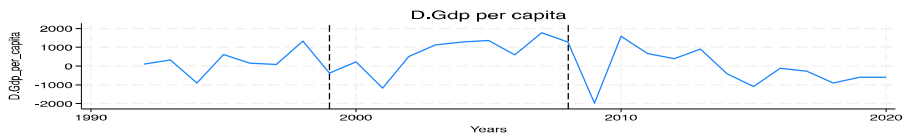

Clemente-Montañés-Reyes double AO test for unit root
Test on Consumer price index: breaks at 1997,2001
Consumer_price_index
Years


D.Consumer price index
D.Consumer_price_index
Years


Clemente-Montañés-Reyes double AO test for unit root
Test on Gdp per capita: breaks at 1999,2008
Gdp_per_capita
Years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D.Gdp_per_capita
Years

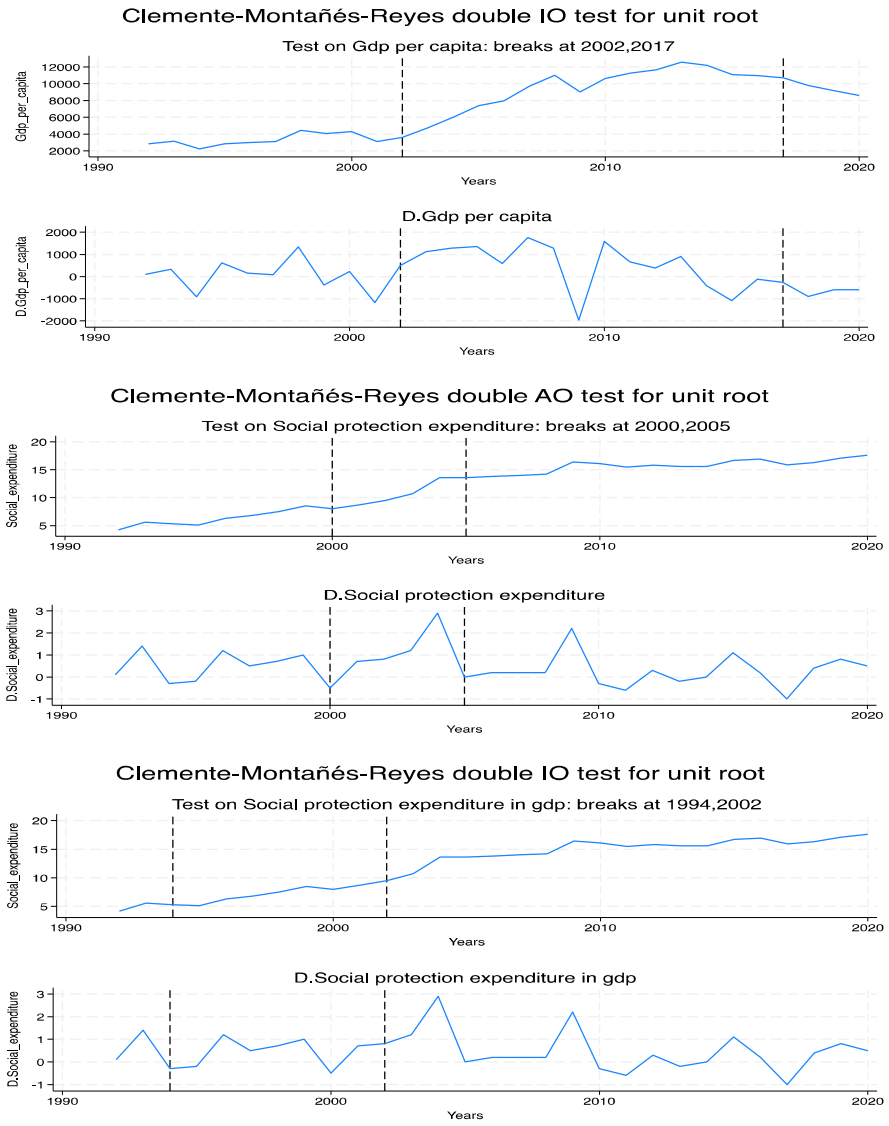

Figure 2. Unit Root Test with Innovative and Additive Outliers
(**Source:** Author's own calculations using Stata version 18.)

Using the Clemente-Montañés-Reyes unit root test, the analysis of fertility rates has revealed significant structural breaks in 1999 and 2018 as well as in 2000 and 2017. These breakpoints correspond to periods of substantial changes in fertility rates, suggesting shifts in demographic trends during these years.

The analysis also identifies clear structural breaks in the Consumer Price Index (CPI) between 1997 and 2001, and again between 1998 and 2004. Both tests confirm that the series is stationary at these breakpoints, indicating that fluctuations in consumer prices were driven more by specific events during these periods than by long-term trends. This information is crucial for directing economic policies and refining inflation targeting more effectively.

Further analysis using the Clemente-Montañés-Reyes unit root tests on GDP per capita has detected two breakpoints each between 1999 and 2008, and between 1999 and 2013. These findings highlight the structural changes and potential economic transformation points within these periods, marking significant shifts in economic growth patterns.

Additionally, the analysis of social protection expenditures has identified structural breaks between 1994 and 2002, and between 2002 and 2007. These periods indicate an

increase in social protection spending from 1994 to 2002, followed by a stabilization in expenditure between 2002 and 2007. This suggests a significant recalibration of welfare policies over these years, reflecting adjustments in government spending in response to social needs.

5.3. Cointegration

In order to test whether the data show stationarity, conventional unit root tests were applied and it was found that there is a unit root at a certain confidence level. The data used have unit roots at their levels, but they become stationary when first differences are taken. In addition, the Bai-Perron and Clemente Montañés Reyes unit root tests with structural breaks were applied. Structural breaks were found to be variable-specific and related to specific economic phenomena. Cointegration tests with structural breaks were applied to determine whether there is a long-run relationship between the variables. Cointegration implies that there is a stable relationship between two or more economic variables in the long run. This means that if one of the variables changes, the other variables will adjust to the change over time. The Hatemi-J cointegration test, which supports 2 structural breaks, and the Maki test, which supports 5 structural breaks, were used in the analysis.

Table 6. Hatemi-J Cointegration Test Results

Test	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
ADF	-8.114	-7.833	-7.352	-7.118
Zt	-8.114	-7.833	-7.352	-7.118
Za	-43.462	-118.577	-104.860	-97.749

Source: Author's own calculations using Gauss version 24.

Table 7. Estimated Break Dates

Estimated break dates	Date	Fraction
First break	1992	0.091
Second break	2015	0.788

Source: Author's own calculations using Gauss version 24.

The results show that there are significant long-term relationships between the variables in the dataset and that these relationships change at certain points in time, possibly due to economic, political or other exogenous changes affecting the data. Structural breaks indicate that significant economic or political changes have affected fertility during the period analysed.

Hatemi-J test results have identified two significant structural breaks in the period from 1990 to 2022. The first break occurred roughly 9.1% into the series, in the year 1992. This break can be associated with the acceleration of migration from rural areas to cities and the resulting demographic pressures. The second break occurred approximately 78.8% into the series, around the year 2015. During this period, the number of women graduating from higher education increased significantly, from 65,610 in 1990 to 2,786,228 in 2015, representing a 4146.65% increase. However, during the same period, the female labor force participation rate decreased from 34.2% to 31.5%, indicating a decline in women's participation in the workforce (TÜİK, 2023). The substantial increase in higher education enrollment has provided an opportunity to better assess changes in fertility rates.

The Maki (2012) test is a test used to test for the presence of cointegration in time series data and allows up to 5 non-breaks. This test aims to obtain more accurate results by taking into account the long-term stable relationships of time series and structural

changes. The Maki test accounts for structural breaks using different models and assesses the impact of these breaks on cointegration relationships.

Maki (2012) introduced the cointegration test with structural breaks to the literature by using four different models. These models are;

Model 0: Trendless model where a break in the constant term is allowed,
Model 1: Trend-free model with breaks allowed in the constant term and slope,
Model 2: Trended model with allowed breaks in the constant term and slope,
Model 3: The model where breaks in the constant term, slope and trend are allowed.

Table 8. Maki Test

Model	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	Estimated break dates
0	-5.361	-5.984	-5.517	-5.272*	2015, 2019
1	-3.964	-6.472	-5.957	-5.682	1998, 2001, 2017
2	-5.706	-7.767	-7.155	-6.868	2001, 2014, 2018
3	-5.137	-8.331	-7.743	-7.449	1994, 2006, 2012

Source: Author's own calculations using Gauss version 24.
*10% significance.

According to the results obtained in Model 0, the test statistic -5.361 exceeds the 10% critical value -5.272. This result means that the cointegration hypothesis is rejected at the 10% level. In other words, it is observed that there is a long-run equilibrium relationship between the data and that this relationship does not remain constant over time, but evolves with structural breaks. The breakpoints in 2015 and 2019 indicate that important economic or political changes in these periods may have an impact on these relationships.

In the other models (Models 1, 2, 3), the test statistics do not exceed the relevant critical values, indicating that there is no cointegration. This suggests that there is no long run stabilising relationship between these series or that the existing structural breaks significantly affect this relationship and that the standard cointegration assumptions do not hold for these models. The fact that cointegration appears only in model 0 and not in models 1, 2 and 3 indicates that these series do not co-move in the long run.

6. Conclusion

In this study, Hatemi-J and Maki cointegration tests were employed to assess the long-term relationships among the analyzed time series. The Hatemi-J test (2008) provided evidence of cointegration by allowing for structural breaks, demonstrating how specific economic events can impact these relationships. On the other hand, the Maki test (2012) found no cointegration relationship in the analyzed data set. This result suggests that the Maki test may be more sensitive to different structural breaks or other features included in the model.

The study's findings indicate that fertility rates in Türkiye are not directly related to economic developments. Although the Hatemi-J test found some evidence of cointegration, the Maki test identified three different structural breaks and found a cointegration relationship only in the model without a trend. No relationship was found in the other models. This strongly suggests the absence of a long-term cointegration and implies that economic variables have a limited or negligible impact on fertility rates. These results highlight how the study deeply develops the literature and distinguishes itself from existing studies.

These findings contradict the widely held belief (Sobotka et al., 2021) that periods of economic growth are often associated with increases in fertility rates. The thesis put forward by Gauthier (2007) and Neyer & Andersson (2008), which suggests that generous family policies can encourage fertility by reducing the cost of raising children, may be

more complex in light of the evidence, suggesting that the impact of social protection spending on fertility is not straightforward and may depend on how such spending is targeted and perceived by potential parents. This complexity calls for more research on the specific aspects of social protection that may influence fertility decisions, expanding the discourse initiated by Thévenon (2011), who notes that the effectiveness of social policies in promoting fertility depends on their design and implementation.

In 2024, the Turkish government established the Family and Population Policies Department to develop new policies aimed at increasing the birth rate. This department is preparing an incentive package to address the decline in fertility rates. The package includes raising the age limit for state-supported IVF treatment from 40 to 45, expanding "mother-friendly hospital" practices, granting mothers the right to part-time work until their children start school, and providing minimum wage-level support for families with three or more children. Additionally, the package plans to offer diaper and formula assistance, tax reductions on vehicle and housing purchases, an expanded Family and Youth Fund, and updated birth allowances (Ministry of Family and Social Services, 2024).

However, consistent with this study's findings, economic incentives in many developed countries have shown limited impact on fertility. Hungary, for example, has allocated about 5% of its GDP to family incentives and implemented aggressive pro-natalist policies, including tax cuts, subsidies for large families, and housing incentives. Despite this, the impact on birth rates has not been as significant as expected, and these policies have incurred substantial costs (Berde & Drabancz, 2022). Similarly, South Korea, with one of the world's lowest fertility rates, has spent approximately $200 billion over the past few decades on pro-natal policies. Despite these efforts, birth rates have not significantly increased. Cultural pressures related to education, intense competition, and economic stress, particularly related to housing costs and job security, make it difficult for families to have more children, even with government support (Kim et al., 2022).

On another note, despite the average annual decline in fertility rates in Türkiye being around 5%, the sharp 32% decline observed between 2022 and 2023 is striking. Possible reasons for this decline include pandemics and natural disasters, particularly earthquakes. The crude death rate increased from 6.1% in 2020 to 6.7% in 2021 and then decreased to 5.9% in 2022 (TÜİK, 2023). An analysis of the age at death shows no significant difference between 2019 and 2022 in the 18-50 age group, during which women are fertile. This suggests that, contrary to Lin & Kong's (2023) findings, the pandemic had a limited impact on fertility rates in Türkiye. However, as data on the crude death rate for 2023 is not yet available, the impact of the 2023 Kahramanmaraş earthquake on fertility rates cannot be determined with certainty. However, the cities affected by the earthquakes have the highest fertility rates in Türkiye.

As a different example, Georgia experienced a significant increase in birth rates after the 2000s, achieved without substantial government spending. This increase was largely attributed to the announcement by the Patriarch of the Georgian Orthodox Church that he would personally baptize third and subsequent children and become their godfather (Meladze, 2023). This suggests that religious and cultural factors can sometimes influence fertility rates more strongly than economic incentives.

To develop an effective policy to increase fertility in Türkiye, a comprehensive understanding of fertility dynamics, including in-depth examination of sociological and psychological dimensions, is necessary. İlkkaracan (2012) documents the impact of women's labor force participation and gender equality policies on fertility rates in Türkiye. Another study found that in 22 OECD countries that had completed the urbanization process, policies increasing female employment also increased fertility rates. For example, spending on preschool education was found to increase fertility (Doepke et al., 2022). However, some research suggests that in countries with long working hours, women's participation in the workforce triggers work-family conflict and fertility anxiety, leading to emotional burnout (Zhang & Hao, 2024; Jiang et al., 2022; Han & Lee, 2015). Emotional burnout reduces job commitment, negatively affects women's career success,

and leads to wage declines. In the long run, this process may lead couples to postpone or abandon having children (Kaya & Karatepe, 2020). In this context, more research is needed to better understand the factors influencing fertility decisions. These studies can provide a broader perspective on how social policies can promote fertility and help policymakers make more informed decisions in this area.

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