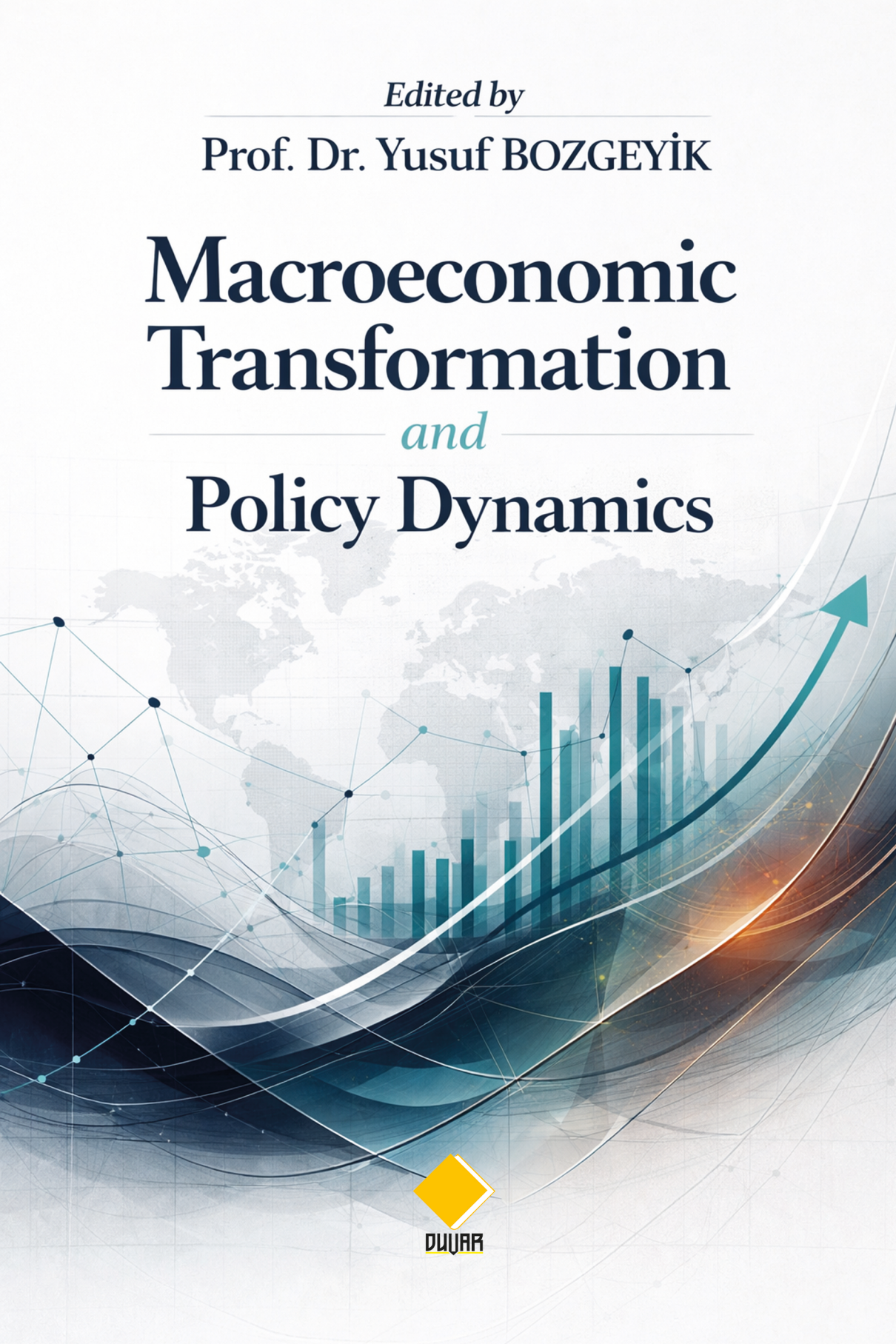
Edited by

Prof. Dr. Yusuf BOZGEYİK

Macroeconomic Transformation *and* Policy Dynamics



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MACROECONOMIC TRANSFORMATION AND POLICY DYNAMICS

Edited by

Prof. Dr. Yusuf BOZGEYİK*

* Gaziantep Üniversitesi, İktisadi Ve İdari Bilimler Fakültesi, ybozgeyik@gantep.edu.tr, 0000-0003-2613-2792

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Prof. Dr. Yusuf BOZGEYİK

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853 Sokak No:13 P.10 Kemeraltı-Konak/İzmir
Tel: 0 232 484 88 68
www.duvaryayinlari.com
duvarkitabevi@gmail.com

FOREWORD

Contemporary macroeconomic analysis increasingly requires a multidimensional framework that goes beyond traditional growth models and incorporates institutional structures, policy mechanisms, and structural transformations. In this context, labour market dynamics—particularly female labour force participation—emerge as a fundamental component of macroeconomic performance. The relationship between public child care provision and maternal labour supply exemplifies how social policy instruments function not merely as welfare tools, but as macroeconomic levers that shape labour allocation, productivity, and long-term growth trajectories .

Building on this perspective, the volume advances the argument that macroeconomic outcomes are inherently embedded within institutional and policy-driven structures. Economic growth is not solely the result of capital accumulation or technological progress, but rather the outcome of coordinated interactions between fiscal capacity, public expenditure, and external integration. The analysis of emerging economies, particularly within the BRICS framework, reinforces this view by demonstrating that growth dynamics are contingent upon the strategic configuration of macroeconomic policies and structural conditions.

At the core of these interactions lies the financial system and the evolving role of monetary policy. The shift toward unconventional monetary policy frameworks reflects the transformation of macroeconomic governance in the post-crisis era. These developments highlight the increasing importance of financial intermediation, expectations, and portfolio behavior in shaping macroeconomic equilibria, thereby redefining the traditional transmission mechanisms of monetary policy .

Simultaneously, the transition toward a carbon-neutral economy introduces a new dimension to macroeconomic analysis by linking energy systems, production structures, and state intervention. The transformation of energy intensity through policy-driven mechanisms underscores the role of the state as a strategic actor in directing structural change, rather than a passive regulator. This perspective situates environmental sustainability within the broader framework of macroeconomic restructuring.

Taken together, the contributions in this volume converge on a central proposition: macroeconomic dynamics are increasingly shaped by the interaction of social policies, financial structures, and state-led transformations. By integrating labour markets, monetary policy, growth theory, and energy transition within a unified analytical framework, this book offers a theoretically grounded and policy-relevant perspective on the evolving architecture of modern macroeconomics.

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Prof. Dr. Yusuf BOZGEYİK

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Chapter 1

The Relationship Between Public Child Care Service Availability, Maternal Labour Force Participation and Covid-19: Estimation With Vecm Approach For Türkiye

Demet ÖZOCAKLI[1]

1.Introduction

One of the most substantial dynamics of economic development and economic growth is high labour force participation. Labour force participation is always lower for females in countries. The high level and sustained labour force participation of females who make up half of the population in a country will lead to economic dynamism, the emergence of a more productive society and the acceleration of economic growth. Moreover, growth female labour force participation will lead to a rise in household income, improvements in income distribution, and ultimately increasing social welfare.

According to the OECD average is 67.1% for female labour force participation and 81% for male labour force participation in the third quarter of 2024. The same values are 42.2% and 79%, respectively in Türkiye (Organization for Economic Co-operation and Development [OECD], 2024). When these rates are compared, it is evident that there is a significant negative diffence in female labour force participation between average of OECD and Türkiye. It is known that the burden of child care is the most important obstacle for female with children to enter and sustain in the labour market (Hüseyinli & Hüseyinli, 2016; Türkiye Ekonomik ve Sosyal Etüdler Vakfı [TESEV], 2017). Studies have shown that female with children are less likely to find work, on the contrary, female without children appear to be more likely to have full-time jobs (İlkkaracan, 1998). In addition, the extremely limited coverage of child care services, especially by the public, and the absence of comprehensive sustainable of child care services in Türkiye further reduce female labour force participation (Kakıcı, et al., 2007).

Compared to developed countries, the lack of widespread and free public child care services in Türkiye further restricts the employment of females with low income in particular (Sosyal Politika Forumu, 2009). In this context, although the

[1] Gaziantep University, Assist. Prof., dozocakli@gantep.edu.tr, 0000-0003-3766-7012.

rate of uneducated or low-educated females in Türkiye returning to the labour force after becoming mothers is very low, the rate of bachelors-graduated females returning to the labour force is very high (Development Analytics, 2015). Moreover, it is known that labour force participation for female in Türkiye is well below the female labour force experience. The reason for this is that even though half of the females with a high school education or below enter the labour market, they have to leave the labour market due to marriage, pregnancy, childbirth and child care. However, ensuring the quality and social care services availability and their expansion is a public finance, fiscal policy, and macro policy issue (İlkkaracan, 2017). Increasing the public child care availability or expanding this service is a social right not only for female employment but also for all individuals who have children to care for (Sosyal Politika Forumu, 2009).

Within the scope of child care policies around the World, service-based policy tools, employment-based policy tools, and financial-based tools are used. Care services such as nurseries, breastfeeding rooms and kindergartens are service-based policy tools. Practices such as paid or unpaid maternity and parental leave, reduction of working hours, flexible working or working from home are employment-based policy tools. Financial policy tools include cash transfers and tax breaks to subsidize child care costs, capital grants to institutions providing child care services, and tax deductions for child care services and capital investments (OECD, 2006). Since 2013, every child in Germany, from the age of 1 until they start school, has the right to access early childhood care and education (Groß, 2017). Employers are required to contribute one-third of the child benefits provided to working parents by income test in the Netherlands (OECD, 2007). In Finland, day child care is provided by municipalities as a right to all pre-school children after the age of 1 immediately after parental leave, regardless of income or employment status. In Sweden, if the parent is working or studying, full-time and paid child care is available. Most of these services are provided by public funds. Child care services are provided nearly 85% in Finland and, nearly 90% in Sweden by the public (Sosyal Politika Forumu, 2009).

In Türkiye, a demand-side government services subsidy for pre-school child care will not fully meet the need of female since these subsidies will become an aid that will benefit females who become active in the labour market. A cash transfer that is solely demand-driven will increase female labour force participation at a low rate and at a high cost. However, the main purpose is to make investments in child care that will provide access to the children of low-income females. Increasing supply-side service provision will increase pre-school child care availability, thus meet the needs of low-income female, and have a greater impact on female's employment (Development Analytics, 2015).

With a system where pre-school child care services are provided in every neighborhood and are spread to the base, females will have the opportunity to be included in the labour market. In this direction, whether female will include more in the labour force with optimized public child care services becomes an important policy issue. In this study, the relationship between the public child care service availability and maternal labour force participation by including COVID-19 as an exogenous shock was examined for Türkiye in the 2007-2023 school.

2.Sıtuatıon Assessment of Chıld Care Servıce in Türkiye

It is reported that child care service is an obligation undertaken by females rather than a public responsibility. While public child care services in Türkiye are inadequate and far from institutionalisation, they are unequally distributed among geographical regions (Sosyal Politika Forumu, 2009). Moreover, access to public child care services varies greatly according to age range. The relevant regulation states the age range accepted for public school enrollment. According to Article 11, 5(a) of the Pre-School Education Regulation[2] children under 36 months of age cannot receive public child care services. According to the Household Data Set of the Türkiye Child Care Services Survey, while public child care services are not common in the 0-4 age group, it is seen that public pre-school child care services generally provide services for children over the age of 5 in the sample. While private child care services outside of public are generally provided for 3-6 years old, child care services for 0-3 years old are limited within the sample (Development Analytics, 2015). Table 1 shows the types of child care services offered in Türkiye.

[2] Children aged 57-68 months are registered for pre-school, kindergarten and practice classes by the end of September of the year in which registration is made. After the registration of children who reside in the school's registration area and will start primary school in the next academic year, children aged 36-56 months can be registered for pre-school and practice classes with sufficient physical facilities, and children aged 45-56 months can be registered for pre-school classes.

Table 1: Types of child care services in Türkiye

Child Care Services in Türkiye
Institutions related to the Ministry of National Education (MoNE)
1-Institutions affiliated to the general directorate of pre-school education of the MoNE
Private or public kindergartens: for children aged 3-6.
Private or public nursery class: for children aged 5-6. Generally, it is in public pre-education school also there is in private pre-education school.
2-Institutions affiliated with the girls' technical and education directorate of the MoNE
Application kindergartens and nursery classes: for children aged 3-6. Mostly these are practice units for Girls' Vocational High School Students.
3- Projects to provide care and early childhood education in institutions affiliated with the general directorate of pre-school education of the MoNE
Mobile kindergarten project: For children between the aged 36-72 months whose families have insufficient financial means and who cannot attend pre-school education institutions.
Summer school: As of June 2004, education is provided in kindergartens in the summer months.
Institutions related to the Ministry of Family and Social Services (MoFSS)
Cheches and Day Care Center: Cheches services for children aged 0-3. Day care center services for children aged 3-6.
For children in need of protection between children 0-12, Also boarding care services for girls over aged 12.
Other Type of Child Care Services
Institutions started to serve in accordance with Law Number 657 Article 191: Early childhood care and education institutions started to serve by employers in workplaces employing 150 or more female.
Creches started to serve in enterprices in accordance with the Labour Law: Private workplaces employing more than 150 female workers are obliged to provide creches for their employees' children between aged 0-6.
*with the employment package in 2008, employers were given the option of purchasing this service from the market.
Low-cost of free child care centres started to serve by some municipalities.
Early childhood care and education services of non-governmental organizations.

Source: (MoNE, 2024)

According to the Household Data Set of the Türkiye Child Care Services Survey, the norm accepted by parents for child care service is the age range of 3-5. Namely, the child care service for 0-3 age range do not accept by parents generally. The 0-3 age range is a period when the feeling of trust prevails in parents (Development Analytics, 2015). In parallel to this, as seen in Table 1, public child care services for children 0-3 years old are not available.

In Türkiye, public child care services are generally provided on a part-time basis, while private child care services provide full-time services. The full-time working conditions for mothers working in the private sector limits public child care availability. Private child care can meet the needs of working mothers as

working hours can be more flexible and full-time. However, the cost of private child care services cannot be afforded by every parent. In addition, public child care is not available in all months of the year, while private child care, unlike public child care, is available in all months of the year. However, private child care services generally meet the needs of mothers with higher levels of education and income. Public child care service availability becomes limited due to service duration and hour not enough (Development Analytics, 2015). This access issue negatively affects maternal labour force participation.

In cases where child care is not available, according to Article 82 of the Regulation on Pre-school Education[3], some models are applied in the public sector. In these models, it is observed that the duration of public child care services is insufficient. In this case, mothers who work or want to work have to prefer private child care services. However, the limited number of parents that can afford private school costs negatively affects maternal labour force participation rates.

According to the Household Data Set of the Türkiye Child Care Services Survey, the likelihood of utilizing private child care services increases with the mother's education level. Although the rates of utilization of public child care services by mothers who are in or out of the labour market are close to each other, it is observed that employed females with children are more likely to use private child care services. Among full time working mothers in the sample, 58% of child care services are undertaken by a family member. Only 8% of the full-time employed mothers in the research sample prefer the babysitter option (Development Analytics, 2015).

Although the utilization rate of public child care services in Türkiye is low, a large part of the demand for child-care centres has not yet been met. In research sample, 22% of working mothers use a child care centre, while 50% of working mothers say they would like to use child care centres. While 26% of non-working mothers use child care centres, 31% of non-working mothers would like to use child care centres (Development Analytics, 2015). If access to child care centres is tailored to needs in terms of service duration and hour, it will both positively affect the labour force participation of non-working mothers increase maternal labour force participation rates and reduce the child care costs of working mothers.

[3] To ensure access to pre-school education for children in settlements where branches cannot be opened due to low pre-school age population and in settlements where the age population is dense and physical conditions are inadequate; mobile teacher class, mobile classroom, transportation centre kindergarten class, summer education and similar flexible time and time access models can be applied and mobile teachers can be assigned. In the different access models to be implemented, at least 200 activity hours of training are provided in a year. The training in a day cannot be less than 2 (two) activity hours. Children who have not benefited from pre-school education are enrolled in summer education, with priority given to children who will start primary school in the next academic year.

3.Literature

Theory suggests that increasing the availability of free centres increases parents' likelihood of labour force participation (Blau, 2001; Blau & Currie, 2006a; Blau & Currie, 2006b). It is suggested that increased public child care service availability rises parental labour force participation although the results have variations. These variations in findings likely are due to historical contexts, methodological approaches, datas, culture, and policy. A significant body of evidence in European countries recommends that public child care availability is a substantial force of maternal employment. Early child care availability has an effect substantial parents' employment status, hours, or stability. Early child care service availability have a large effect on parental employment on Western European Countries which has larger public child care services (Morrissey, 2017)**.** Nollenberger & Rodríguez-Planas (2015) found that the supplying full-time public child care availability for 3 years old in Spain have effect of 20 percent on maternal employment. The reform in Spain did not eliminate private child care service, that is, alternative child care service modes did not crowd out. The emerging effect belong to 30 years old and older mothers with two children or more. They imply these reforms are important in the countries. But they state that the reform in Spain was fulfillmented in a duration of low labour demand. Brilli et al. (2016) found that a percent increase of the public child care service availability have an effect of 1.3% on the mothers' working status in Italy. The effect of child care service is stronger if child care service availability is low in city. Del Boca (2002) found that the child care service availability rises the probability of working for married females in Italy. Norway adopted one of the countries a comprehensive public child care service system firstly. Havnes & Mogstad (2011) analyzed expansion of subsidized child care service gradually in Norway. They found that there is small causal impact of subsidized child care service on maternal employment but there is a strong correlation between subsidized child care service and maternal employment. They state that subsidized child care service mostly eliminate informal child care service arrangements.

Fang & Miao (2024) examined the effects of kindergarten availability on female employment in China. They found that kindergarten suitability increased the possibility of rural female with child working and their work times in non-agricultural sectors. These effects are stronger for low-income and, parents and also rural mothers. Also, kindergarten eligibility decreased rural mothers' agricultural work and unpaid domestic work. Moreover, kindergarten eligibility does not affect urban mothers' employment because of the availability of private

child-care service in urban. Also, kindergarten suitability enhances non-agricultural employment of grandmothers living together in rural.

In the U.S., since the mid-1960s, many state governments have introduced subsidies for schools offering kindergartens (Cascio, 2009). It is suggested that enhancing public child care service boosts maternal labour force participation in the U.S. although the results have variations. The results of the researchs in U.S. show that the public kindergarten or pre-school availability has little positive effects on maternal employment (Cannon et al., 2006; Gelbach, 2002), nevertheless results of other some researchs in U.S. show that the availability of public kindergarten or pre-school have smaller effects or no on maternal employment (Fitzpatrick, 2010; Fitzpatrick, 2012). But these variations can be due to heterogeneity in the timing, methods, data, and finding accros studies. Cascio (2009) estimated that the public school enrollments have strong effect (four of ten) on the labour supply among single females with 5 years old child. But other mothers has no significant labour supply responses. Fitzpatrick (2012) found that public school enrollment rised only the employment of single females with 5 years old without other children in U.S.

It is suggested that institutional child care service do not prefer by mothers in Türkiye. Uğur et al. (2023) found that employed mothers are getting support of mother and mother-in-law in 60 percent between 2003 and 2018. Majority of mothers do not prefer institutional child care service according to results. The employed women with 0-5 of ages prefer institutional child care approximately 12 %. But this rate is enhancing in time according to results. Uğur et al. (2023) stated that this change can be explained by the increase in incentive state policy and investment in Türkiye. They stated that the possibility of institutional child care rises with the age of the child, high income level, high work status, and higher education level of the mother on the contrary decreases bigger household number of family. On the contrary Güneş et al. (2017) invented that the cost of child care service did not change in time between 1993 and 2008 in Türkiye. Other results show that there is a significant and positive relationship between mothers with bachelor graduates and more and institutional child care service in Türkiye. (Güneş et al., 2017; Kakıcı et al., 2007) invented that the probability of mothers' child care service increases as the level of education increases. And also these mothers prefer institutional child care service comparing mother and mother-in-law. Moreover, mothers preferred institutional child care service more and more when their child grows older. Hüseyinli & Hüseyinli (2016) stated that increasing mothers' labour force participation is possible with production of the state for child care service in Türkiye. Especially full-time public child care

service is suggested as the most important factor for mothers' labour force participation.

4.Data and Model

It is proposed to examine the relationship between public child-care service availability and maternal labour force participation by including COVID-19 as an exogenous shock for 2007-2023 period in this paper. Maternal employment defines the employment rate for women with at least one child aged 0-14, part-time/full-time. Türkiye had the lowest maternal employment in 2013 (OECD Family Database, 2023). Moreover, Türkiye has the lowest female labour force participation in OECD countries (OECD, 2024). However, it is not available for maternal employment in other years. Therefore the female labour force participation aged 25-34 (married/union/cohabiting) is taken from ILOSTAT in this paper. The female labour force participation aged 25-54 takes into account due to females with these ages usually have the possibility of one or more children aged 0-6. In this paper, it is considered children aged 0-6 due to mothers need child care service this age group needs public child care service availability is represented by pre-school student numbers such as kindergarten, nursery class, and Law Number 657 Article 191 Number of students. Pre-primary education datasets are taken from National Education Statistics. All variables are presented in Table 2.

Table 2: The variables in models

Variables	Var Code	Sample Period[4]	Source
Dependent Variable			
Female labour force participation aged 25-54 (married/union/cohabiting)	flfp	2007 -2023	ILOSTAT
Independent Variables			
Pre-primary education (public)			
1. Institutions related to MoNE (public)			
a.Number of students in kindergartens (public) *Kindergarten summer education is not taken into account	nsk	2007 -2023	National Education Statistics
b.Number of students in nursery class (public) *Nursery class summer education, 3-6 aged playroom course program and child support education course program are not taken into account.	nsn		
2. Institutions not related MoNE (public)			
a.Number of students in institutions started to serve in accordance with Law Number 657 Article 191 (public)	657	2007 -2023	National Education Statistics
b.Number of students in community-based institutions[5] (public) *Students in community-based institutions were also included in institutions started to serve in accordance with Law Number 657 Article 191 in 2015.	rttk		

[4] 4-6 ages group courses dependent to the Presidency of Religious Affairs, the crèches are founded by municipalities and the crèches are founded by associations (MoNE, 2024).

Sample period is between 2007-2023. It is presented Descriptive Statistics in Table 3 for all variables.

Table 3: Descriptive statistics

Variables	Mean	Median	Maximum	Minimum	Std Dev	Obs
logflfp	3.552058	3.595804	3.759827	3.191381	0.175198	17
lognsknsn	13.85349	13.82409	14.23328	13.32790	0.233456	17
log657rttk	10.33051	10.10639	12.00743	8.771835	1.256853	17

Figures 1(a) 1(b) 1(c) present for all series.

Figure 1: Series for models

It is occurred in two models including above-mentioned variables. These models are presented in (1), and (2). t represents time. Logflfp respresents female labour force participation, lognsknsn represents number of students in kindergartens and nursery class in public. Log657rttk represents sum of number of students in institutions started to serve by Law Number 657 Article 191 in public and number of students in community-based institutions in public.

$$logflfp_t = \beta_0 + \beta_1 lognsknsn_t + \beta_2 dummycovid19_t + \varepsilon_t \quad (1)$$

$$logflfp_t = \Omega_0 + \Omega_1 log657rttk_t + \Omega_2 dummyrttk_t + U_t \quad (2)$$

The crises are used extensively as a dummy variable because should not be miss impacts of crises and events. Dabla-Norris & Bal Gündüz (2012) use monetary policy shock as a dummy variable indicating a banking crisis in the last two years. dummycovid19 represents COVID-19 pandemic as an exogenous shock. dummyrttk represents that students in community-based institutions were also included in institutions started to serve in accordance with Law Number 657 Article 191 in 2015 as an exogenous shock. Ankargren & Lyhagen (2018) estimate VECM with exogeneity restrictions both the short-term dynamics and the short-term adjustment

parameters, it is found more efficient results compared to fully or partially ignoring exogeneity models.

5.Methodology

In a Vector Autoregressive (VAR) model, each endogenous variable is represented as its own lagged value. This approach extends the univariate autoregressive model to a multivariate framework, allowing for the modelling of multiple time series variables simultaneously.

Engle & Granger (1987) integrated the concepts of the error correction model and cointegration, to develop what is known as the trace error correction model. When variables exhibit a cointegration relationship, the error correction model can be derived from an autoregressive distributed lag model. Within a VAR framework, each equation follows an autoregressive distributed lag structure. As a result, the Vector Error Correction (VEC) model can be interpreted as a VAR model subject to cointegration constraints. The existence of cointegration within the VEC model implies that, despite significant short-term fluctuations, the model enforces long-term equilibrium relationships among the endogenous variables, guiding them toward their cointegrated state.

Assuming $y_t = (y_{1t}, y_{2t}, y_{3t}, \dots, y_{kt})'$ as dimensional k stochactic time series, t=1,2,…,T and $y_t - I(1)$, each $y_{it} - I(1)$, i=1,2,…,k k is influenced by exogenous time series of dimension d, $x_t = (x_{1t}, x_{2t}, x_{3t}, \dots, x_{dt})'$ Under these conditions, the vector autoregressive (VAR) model takes the following form:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_p y_{t-p} + B x_t + \mu_t, \quad t = 1,2,\dots,T \tag{3}$$

If y_t , that is, endogenous variables are not influenced by an exogenous time series of dimension d, the VAR model simplifies to:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_p y_{t-p} + \mu_t, \quad t = 1,2,\dots,T \tag{4}$$

By applying cointegration conversion of equation (4), it can be rewritten as:

$$\Delta y_t = \prod y_{t-1} + \sum_{i=1}^{p-1} r_i \Delta y_{t-i} + \mu_t \tag{5}$$

where

$$\prod = \sum_{i=1}^{p} A_i - I,$$
$$r_. = \sum_{j=i+1}^{p} A_j \quad (6)$$

If cointegration relationship exists among variables , after that $\prod y_{t-1} - I(0)$, equation (5) can be reformulated as:

$$\Delta y_t = \alpha\beta' y_{t-1} + \sum_{i=1}^{p-1} r_i \Delta y_{t-i} + \mu_t \quad (7)$$

Where $\beta' y_{t-1} = ecm_{t-1}$ is the error correction term, capturing the long-term equilibrium relationships among variables. This leads to final expression:

$$\Delta y_t = \alpha ecm_{t-1} + \sum_{i=1}^{p-1} r_i \Delta y_{t-i} + \mu_t \quad (8)$$

Equation (8) corresponds to the Vector Error Correction Model (VECM), which combines short-term dynamic adjustment with long-term equilibrium constraints.

6.Results

6.1.Stationary Test

In this paper, ADF, PP Test and DF GLS Tests are applied to test whether include unit root in variables. The results of tests are presented in Table 4. The null hypothesis asserts that variable exhibits a unit root. It is rejected the null hypothesis, that is, all variables are in first-order difference stationary.

Table 4: Results of ADF, DF-GLS, PP unit root tests without structural break

Variables	ADF	DF-GLS	PP
	Level		
$logflfp_t$	-2.375544	-1.074236	-2.373086
$lognsknsn_t$	-2.137689	-1.573241	-2.140507
$log657rttk_t$	-0.220505	-0.345618	-0.429831
	First-order difference		
$logflfp_t$	-2.862464*	-2.979177***	-2.873738*
$lognsknsn_t$	-3.939269***	-4.055612***	-3.948153***
$log657rttk$	-3.001969**	-3.005696***	-2.957858*

Note: Intercept was Included in test equation.

Later in this paper, unit root test with break is used to test whether to include unit root and structural break in series. Results of test with break are presented in Table 5. The null hypothesis asserts that the variable exhibits a unit root. It is accepted the null hypothesis at the level, namely, logflfp, lognsknsn, and log657rttk variables are nonstationary at 1% significance level. But all series are stationary at first order difference and also, logflfp, lognsknsn have structural breaks at 2020. As it is known COVID-19 pandemic revealed in 2020 March in Türkiye, that is, result of test is consistent with theory. But log657rttk has structural break at 2015. students in community-based institutions were also included in institutions started to serve in accordance with Law Number 657 Article 191 in 2015. That is, the test results aligns with the theorical expectations.

Table 5: Result of unit root test with break

Variables	Minimum test stat	Break date	lag
	Level		
$logflfp_t$	-3.061586	2020	0
$lognsknsn_t$	-3.848640	2020	0
$log657rttk_t$	-4.064701	2015	0
	First-order difference		
$logflfp_t$	-4.498589**	2020	0
$lognsknsn_t$	-4.889913***	2020	0
$log657rttk$	-5.935462***	2015	0

Note: Break selection is selected minimize Dickey-Fuller t stat, break type is selected innovation outlier. Lag length is selected lag 0 while max lag is selected 1. Lag length method is used Schwarz criterion. Test specification is intercept.

6.2.VAR Model Estimation

The primary challenge in the VAR model is determining the appropriate lag intervals for endogenous variables (Zou, 2018). In this study, lag length criteria and the AR Roots Graph are utilized to identify the optimal lag intervals for endogenous variables. Results are presented for VAR Models in Table 6.

Table 6: Lag intervals with lag length criteria for endogenous

Models	Lag	LogL	LR	FPE	AIC	SC	HQ
Model I	0	24.34887	NA	0.000228	-2.713182	-2.524369	-2.715193
	1	55.81756	46.15408*	5.99e-06	-6.375674	-5.998047	-6.379697
	2	62.32190	7.805213	4.59e-06*	-6.709587*	-6.143147*	-6.715620*
Model II	0	11.43605	NA	0.001276	-0.991473	-0.802660	-0.993485
	1	34.46890	33.78152*	0.000103*	-3.529187*	-3.151560*	-3.533210*
	2	37.87467	4.086923	0.000120	-3.449956	-2.883516	-3.455990

According to test results, For VAR Model II, the optimal lag order is 1, while for VAR Model I, the optimal lag order is 2. The VAR Models are Predicted and are given in Table 7. Dummy variables are added as exegenous shock in VAR Models. Separating the effects of shocks makes the results more accurate.

Table 7: The VAR models estimation results

	Model I			Model II	
Variables	logflfp	lognsknsn	Variables	logflfp	log657rttk
logflfp(-1)	0.343460	-2.433721	logflfp(-1)	0.815419	0.066772
	(0.23986)	(1.01618)		(0.10289)	(0.85109)
	[1.43190]	[-2.39497]		[7.92506]	[0.07845]
logflfp(-2)	0.419378	2.303000	log657rttk(-	-0.009382	0.528703
	(0.17916)	(0.75901)	1)	(0.01386)	(0.11468)
	[2.34080]	[3.03422]		[-0.67674]	[4.61036]
lognsknsn(-1)	0.198460	1.227025	c	0.762943	3.968503
	(0.07419)	(0.31429)		(0.36039)	(2.98108)
	[2.67517]	[3.90414]		[2.11697]	[1.33123]
lognsknsn(-2)	-0.106742	-0.373342	dummyrttk	0.038703	1.321386
	(0.06062)	(0.25682)		(0.04180)	(0.34579)
	[-1.76085]	[-1.45374]		[0.92582]	[3.82130]
c	-0.374591	2.625484			
	(0.78505)	(3.32583)			
	[-0.47716]	[0.78942]			
dummycovid19	-0.122629	-0.309267			
	(0.02172)	(0.09203)			
	[-5.64523]	[-3.36061]			

The log-likelihood functions for the VAR models are relatively large, while the AIC value is low, indicating a strong explanatory power of the models. The stationarity test results for the VAR models are presented in the Figures. Figures 2(a) and 2(b) shows that the mod of the reciprocal of each characteristic root is in the circle for all VAR Models, that is, lag orders for VAR Models are appropriate, and the VAR Models are stable.

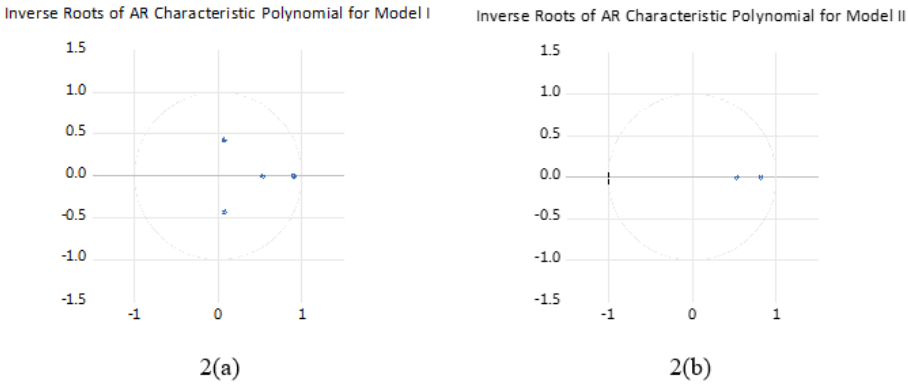


Figure 2: Inverse roots of Autoregressive (AR) Characteristic polynomial

6.3.Cointegration Test

A key challenge is selecting the appropriate cointegration test and determining the optimal lag order (Zou, 2018). In general, the presence of a cointegration relationship among variables in the VAR model is assessed using the Johansen Cointegration Test (Johansen & Juselius, 1990).

Table 8: Results of the cointegration test

Models	Hypothesized No of CE(s)	Eigenvalue	Trace statistic	0.05 Critical value	Prob.**
Model I	None*	0.803817	25.83702	15.49471	0.0010
	At Most 1	0.194905	3.035130	3.841465	0.0815
Model II	None*	0.840339	33.68945	15.49471	0.0000
	At Most 1*	0.337186	6.168912	3.841465	0.0130

Models	Hypothesized No of CE(s)	Eigenvalue	Max-iegenvalue statistic	0.05 Critical value	Prob.**
Model I	None*	0.803817	22.80189	14.26460	0.0018
	At Most 1	0.194905	3.035130	3.841465	0.0815
Model II	None*	0.840339	27.52054	14.26460	0.0002
	At Most 1*	0.337186	6.168912	3.841465	0.0130

Note: The trace test and max-eigenvalue test identify one cointegrating equation at the 5% significance level for Model I. For Model II, both tests indicate the presence of two cointegrating equations at the same significance level. Denotes rejection of the null hypothesis at the 5% significance level for trace and max-eigenvalue statistics.
**MacKinnon-Haug-Michelis (1999) p-values.

The Johansen Cointegration test is conducted to examine the presence of long-term relationships among variables in Model I and Model II. The null hypothesis of the trace test suggests no cointegration, while the null hypothesis of the max-eigenvalue test indicates the presence of a cointegration relationship. In Model I, both the trace test and max-eigenvalue test identify one cointegrating equation at the 5% significance level. For Model II, these tests detect two cointegrating equations at the same significance level. These findings indicate the existence of long-term equilibrium relationships among the variables, as well as their stability. The results are presented in Table 8.

6.4.VECM Estimation and Analysis

It is estimated for Model I, and Model II, with Vector Autoregressive Model (VECM) due to there is a long-term relationship among variables however in the short-term, the variables are in disequilibrium (Zou, 2018). Namely, it can be expressed as VECM in the short-term imbalance and dynamic structure.

When the lag order in the VAR model is 2, the corresponding lag order in the VECM should be 1 (Zou, 2018). Therefore, in this study, since the lag order in the VAR model for Model I is set to 2, the lag order in the VECM is chosen as 1. However, for Model II, where the VAR model has a lag order of 1, the same lag order is maintained in the VECM, as 1 represents the minimum required lag level.Given results of the cointegration equation which signify long-term relationship between the variables in Table 9. For Model I, each percent-point increase in nsknsn (number of student in kindergartens and number of students in nursery class in public) will cause a drop of 0.37 percent points in flfp, and the dummycovid19 as an exogenous shock will cause a drop of 0.09 percent points in flfp.

For Model II, each percent-point increase in 657rttk (sum of number of students in institutions started to serve by Law Number 657 Article 191 in public and number of students in community-based institutions in public) will cause a decrease of 0.16 percent points in flfp, and dummyrttk as an exogenous shock (students in community-based institutions were also included in institutions started to serve in accordance with Law Number 657 Article 191 in 2015) will cause an rising of 0.08 percent points in flfp.

Table 9: Cointegration equation results

Models	Cointegrating Eq:	CointEq1
Model I	logflfp (-1)	1
	lognsknsn (-1)	-0.370756 [-3.02465]
	c	1.585242
	dummycovid19	-0.094004
Model II	logflfp (-1)	1
	log657rttk(-1)	-0.161228 [-6.73601]
	c	-1.960818
	dummyrttk	0.083718

Note: Deterministic trend specifications include only cointegrating constants not including trend. dummycovid19 is used as an exclude variable for Model I, and also dummyrttk is used as an exclude variable for Model II.

The cointegration equations are

$$logflfp_{t-1} = -0.370756 lognsknsn_{t-1} - 0.094004 dummycovid19_{t-1} + 1.585242 \quad (9)$$

$$logflfp_{t-1} = -0.161228\, log657rttk_{t-1} + 0.083718 dummyrttk_{t-1} - 1.960818 \quad (10)$$

The VECM estimation results and tests, which present the short-run coefficients and error correction terms (Cointeq1), are displayed in Table 10. For Model I, deviations from the long-run equilibrium in the previous period are adjusted in the current period at a rate of 23%. This implies that 23% of the prior year's deviation from long-run equilibrium is corrected each period. In the short run, a 1% change in lognsknsn is associated with an average 0.10% increase in logflfp, holding other factors constant. Additionally, COVID-19, considered an exogenous shock, corresponds to an average 0.14% decline in logflfp in the short run, assuming other conditions remain unchanged. The relatively high R-squared values and the low SC and AIC criteria values indicate that the model estimations are well-fitted and reasonable.

For Model II, deviations from the long-run equilibrium in the previous period are adjusted in the current period at a rate of 9%. This means that 9% of the prior year's deviation from long-run equilibrium is corrected each period. In the short run, a 1% change in log657rttk is associated with an average 0.02% increase in logflfp, assuming other factors remain constant. The variable dummyrttk, representing an exogenous shock in 2015 when students in community-based institutions were incorporated into institutions operating under Law Number 657,

Article 191, is linked to an average 0.04% decline in logflfp in the short run, holding other conditions constant. The high R-squared values and the low SC and AIC criteria values indicate that the model estimations are reasonability and well-fitted. The VECM estimation results and related tests are presented in Table 10.

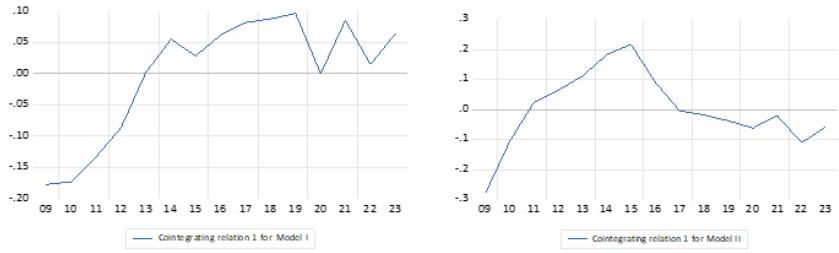
Table 10: VECM estimation results and tests

Models	Error Correction:	D(logflfp)	D(lognsknsn)
Model I	CointEq1	-0.230938[-3.84936]	-0.450691[-1.68841]
	D(logflfp(-1))	-0.414512[-2.59338]	-2.553146[-3.59012]
	D(lognsknsn(-1))	0.108881[2.11104]	0.263393[1.14777]
	c	0.053535[7.34471]	0.150760[4.64863]
	dummycovid19	-0.144038[-7.16456]	-0.367046[-4.10334]
	R-squared	0.875788	0.714002
	Log likelihood	61.39497	
	Akaike information criterion	-6.585997	
	Schwarz criterion	-6.019556	

Models	Error Correction:	D(logflfp)	D(log657rttk)
Model II	CointEq1	-0.097219[-0.85265]	2.305732[2.35362]
	D(logflfp(-1))	-0.147984[-0.31773]	--2.390906[-0.59748]
	D(log657rttk(-1))	0.022514[0.54268]	0.450969[2.69112]
	c	0.066852[1.67271]	0.055384[0.16129]
	dummyrttk	-0.049087[-1.06754]	0.319969[0.80992]
	R-squared	0.186048	0.539773
	Log likelihood	34.79022	
	Akaike information criterion	-2.848777	
	Schwarz criterion	-2.269336	

Note: dummycovid19 is used as an exclude variable for Model I, and also dummyrttk is used as an exclude variable for Model II.

The zero average line demonstrates a stable and long-term equilibrium relationship between variables. Cointegrating relations are shown in Figures 3(a) and 3(b).



3(a) 3(b)

Figure 3: Cointegrating relations for all models

6.5.Granger Causality Test

The cointegration test identifies a long-term equilibrium relationship among variables, whereas the Granger Causality Test is used to examine causal relationships between them. If variable K contributes to predicting L, meaning that adding past values of K to the regression of L, which already includes its own past values, significantly enhances the explanatory power of the model, then K is considered to Granger-cause L. Otherwise, K is regarded as a non-Granger cause of L (Zou, 2018). The null (primary) hypothesis asserts that not existence of Granger cause. The results are given in Table 11.

Table 11: Result of the granger causality test

	Excluded	Chi-sq	df	prob	The primary hypothesis
		Dependent Variable: D(logflfp)			
	D(lognsknsn)	4.456499	1	0.0348	Refuse
Model I					
		Dependent Variable: D(lognsknsn)			
	D(logflfp)	12.88894	1	0.0003	Refuse
		Dependent Variable: D(logflp)			
	D(log657rttk)	0.294499	1	0.5874	Accept
Model II					
		Dependent Variable: D(log657rttk)			
	D(logflfp)	0.356981	1	0.5502	Accept

Note: dummycovid19 is used as exclude variable for Model I, also dummyrttk is used as exclude variable for Model II.

In Model I, logflfp and lognsknsn exhibit a bidirectional Granger causality, indicating that they influence each other over time. The Granger Causality Test confirms the presence of short-term causal relationships between changes in logflfp and lognsknsn, suggesting a reciprocal dynamic between these variables. However, in Model II, log657rttk and logflfp do not demonstrate a Granger causal relationship. The test results do not indicate short-term causality between changes in logflfp and log657rttk**,** implying no reciprocal relationship between these variables.

6.7.VECM Stability Test

For both Model I and Model II, the results of the residual stability test indicate that the root of one residual is equal to 1, while the roots of the other residuals are less than 1. The results are shown in Figures 4(a) and 4(b).

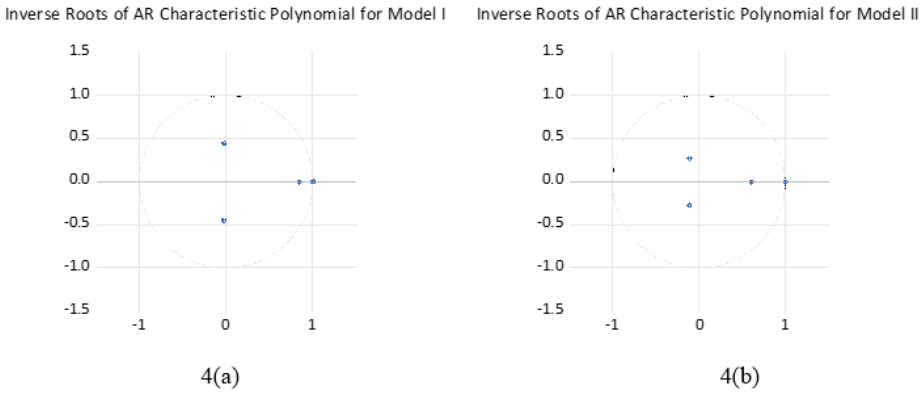


Figure 4: Residual stability test of ECM model.

It is applied to diagnostic tests in all Models. Results are present in Table 12. LM test statistics results indicate that residuals of VEC Model I have no autocorrelation. Jarque-Bera Test Statistic indicates that residuals of VEC Model I distribute normally at 5% significance level. White test statistic indicates that residuals of VEC Model I have no heteroscedasticity.

LM test statistics results indicate that residuals of VEC Model II have no autocorrelation. Jarque-Bera Test Statistic indicates that residuals of VEC Model II distribute normally at 5% significant level. White test statistic indicates that residuals of VEC Model II have no heteroscedasticity.

Table 12: Diagnostisc tests

Models	Tests	stat	prob
Model I	VEC Residual Serial Correlation LM Test	0.451914 (lag 1)	0.7691
		1.504279 (lag 2)	0.2883
	VEC Residual (Dornik Hansen) Normality Tests		
	Skewness (chi-sq)	3.894466	0.1427
	Kurtosis (chi-sq)	1.476851	0.4779
	Jarque-Bera Test	5.371317	0.9199
	VEC Residual Heteroskedasticity White Test (No Cross Term) (chi-sq)	29.75636	0.2513
Model II	VEC Residual Serial Correlation LM Test	5.619915 (lag 1)	0.2314
		2.041355 (lag 2)	0.7293
	VEC Residual (Dornik Hansen) Normality Tests		
	Skewness (chi-sq)	4.959087	0.0838
	Kurtosis (chi-sq)	0.001950	0.9990
	Jarque-Bera Test	4.961037	0.2913
	VEC Residual Heteroskedasticity White Test (No Cross Term) (chi-sq)	16.73365	0.7271

6.8.Impulse Response Function

Additional analyses, including the impulse response function and variance decomposition, assess the dynamic impact of the model in response to specific shocks and the interaction between the two variables. The results over a 10-period horizon are presented in Figures 5(a), 5(b), and 5(c).

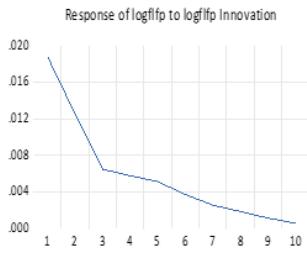


Figure 5(a)

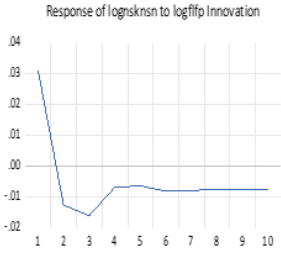


Figure 5(b)

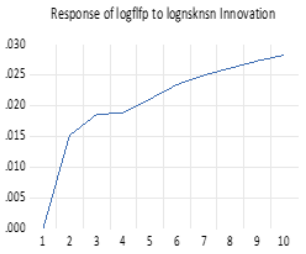


Figure 5(c)

Figure 5: Impulse response function

As shown in Figure (a), logflfp declines rapidly after a shock toward the third period, after that declines slowly toward the tenth period. This recommends that the shock of logflfp has a significant influence on its decline. Figure (b) specifies that lognsknsn changes are induced by logflfp shocks. In the first period, an initial shock causes fluctuations in lognsknsn. It declines rapidly, reaching its lowest point in the third period, then peaks in the fourth period before stabilizing. Figure (c) illustrates that logflfp responds to shocks in lognsknsn, rising sharply in the third period and remaining stable between the third and fourth periods. Additionally, logflfp continues to be influenced by lognsknsn shocks up to the tenth period, particularly after the fifth period.

6.9.Variance Decomposition

The impulse response function illustrates the impact of a shock on an internal variable within a system, while variance decomposition breaks down the mean square error into the contributions of each variable (Zou, 2018). Variance decomposition is utilized to assess how changes in one variable influence another, providing insight into their relative effects. These results are shown in Figures 6(a) and 6(b).

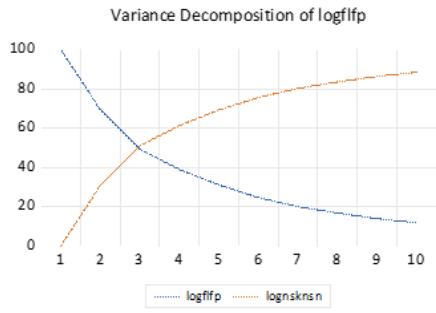


Figure 6(a)

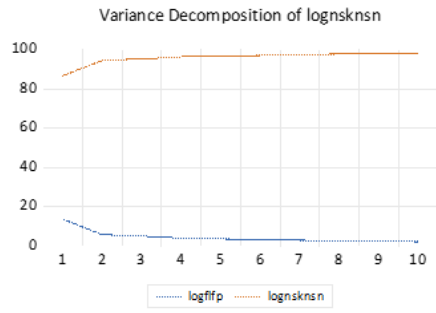


Figure 6(b)

Figure 6: Variance decomposition

According to Figure (a), in the estimated variance of logflfp**,** its own contribution gradually declines from the first period, reaching 12% by the tenth period. Meanwhile, the contribution of lognsknsn starts at 0% in the first period but progressively increases to 88% by the tenth period. According to Figure (b), in the estimated variance of lognsknsn, the contribution of logflfp is 13% in the first period, gradually decreasing to 3% by the fourth period and remaining stable until the tenth period. The contribution of lognsknsn itself is 87% in the first

period, gradually rising to 97% by the sixth period and maintaining stability thereafter until the tenth period.

7.Dıscussion And Conclusion

High and sustainable female labour force participation drives to economic dynamism and accelerating economic growth. In addition, increased female labour force participation drives to increased household income, income distribution improvements, and economic welfare. Female labour force participation is 67.1 in OECD while female labour force participation is %42.2 in Türkiye (OECD, 2024). Lots of research has shown that women with children are less likely to find work, on the contrary, women without children appear to be more likely to have full-time jobs (İlkkaracan, 1998). Namely, it is difficult for mothers to find work. This paper purposes to examine the relationship between public child care service availability and maternal labour force participation by including COVID-19 as an exogenous shock for the 2007-2023 period and using VECM in this paper.

The analysis indicated that an rise in the number of students in kindergartens and the number of students in nursery class in public affected maternal labour force participation negatively in the long run while it had a small effect positively in the short run. This positive effect can be maintained in the long run, suggesting that it depends on the development of services. Service hours in these institutions are part-time and service periods are not every month of the year. While the age range addressed is 3-6 in kindergartens, it is 5-6 in nursery classes. This creates a restriction on the maternal labour force. The analysis also provided evidence that COVID-19 affected maternal labour force participation negatively in the long run while it had a bigger negative effect in the short run. The negative impact of COVID-19 decreased when quarantine measures began to be lifted. This result showed how fragile maternal labour force participation. The third key finding of the current study was that sum of the number of students in institutions started to serve by Law Number 657 Article 191 in public and the number of students in community-based institutions in public affected maternal labour force participation negatively in the long run while it has a very small and positive effect in the short run. The continuation of this positive effect in the long run depends on the services being available full-time and uninterrupted. Child care centres provide full-time and uninterrupted service. Encourage unemployed females to participate in the workforce. The fourth key finding of the current study is that students in community-based institutions were also included in institutions started to serve by Law Number 657 Article 191 in 2015 affected maternal labour force participation positively in the long run, that is, including

community-based institutions has positive an effect on maternal labour force participation in the long run but not the short run. Community-based institutions are 4-6 age group courses dependent to the Presidency of Religious Affairs, the crèches are founded by municipalities and the crèches are founded by associations (MoNE, 2024). The effect is limited due to these institutions include 4-6 age group courses. The impact may be increased if services are provided for younger age groups such as 2-4 age group. Lastly, the analysis also provided evidence that there are Granger causalities between changes in maternal labour force participation and the number of students in kindergartens and the number of students in nursery classes in public in the short run, and there is a certain reciprocity between these two variables. This result shows that there is a bidirectional relationship between child care service availability and maternal labour force participation in the short run.

The sum of the number of students in institutions started to serve by Law Number 657 Article 191 in public and the number of students in community-based institutions in public and also the number of students in kindergartens and the number of students in nursery class in public have a positive effect on maternal labour force participation in the short term. Moreover, the number of students in community-based institutions in public has a positive effect in the long term. The employed women with 0-5 of ages prefer institutional child care service approximately 12 % (Uğur et al., 2023). Also results in the literature from other countries support these findings (Cascio, 2009; Fitzpatrick, 2012; Fang & Miao,2024; Havnes & Mogstad, 2011; Del Boca, 2002; Brilli et al., 2016; Nollenberger et al., 2015). It is found that supplying full-time public child care services for 3 years old in Spain has effect of 20 percent on maternal employment (Nollenberger et al., 2015). It is found that a percent the rise in the public child care service availability have effect 1.3 percent on the mothers' working status in Italy (Brilli, Boca, & Pronzato, 2016). It is found that kindergarten suitability rised probability of rural mothers' working and their work hours in non-agricultural sectors. These effects are stronger for low-income and, nuclear family and also traditional rural mothers in China (Fang & Miao, 2024). It is estimated that public school enrollments have a strong effect (four of ten) on the labour supply between single mothers with 5 years old child in U.S. (Cascio, 2009). The results of the researchs in U.S. show that the availability of public kindergarten or pre-school has small positive effects on maternal employment (Cannon et al., 2006; Gelbach, 2002),

The sum of the number of students in institutions started to serve by Law Number 657 Article 191 in public and the number of students in community-based institutions in public and also the number of students in kindergartens and

the number of students in nursery class in public affect negatively maternal labour force participation in the long term. Also, the number of students in community-based institutions in public has a negative effect in the short term. Employed mothers are getting support from mothers and mothers-in-law in 60 percent between 2003 and 2018 in Türkiye (Uğur et al., 2023). Namely, the majority of mothers do not prefer institutional child care service such as pre-school education. Kindergarten eligibility does not affect urban mothers' employment in China (Fang & Miao, 2024). Some researchers in the U.S. indicate that the availability of public kindergartens or pre-schools has no or smaller effects on maternal employment (Fitzpatrick, 2010; Fitzpatrick, 2012). These findings in the literature support the results in this paper. Another finding in this paper is that COVID-19 hurts maternal labour force participation in both the short term and long term.

The findings should be interpreted considering several limitations. The first limitation is that the maternal labour force participation dataset is not available for Türkiye by year. For this reason, the female age group who is likely to have a child in the pre-school age group was preferred. The second limitation is that datasets are not available for long periods.

According to these findings, it is recommended that the public child care service be provided child for 0-3 years old which has employed mother, public child care services for employed mothers be spread to the base and appeal more to low-income parents, the public child care service should be transformed full-time service, the public child care is available in all months of the year. These politic arrangements especially is seen important for low-income parents, employed mothers and to increase maternal labour force participation.

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Chapter 2

Determinants of Economic Growth in Brics Countries: The Role of Gross Capital Formation, Government Expenditure, and Trade Openness

Ömer YILMAZ[1]

1. Introduction

Economic growth refers to the increase in a country's production of goods and services and is recognized as a fundamental macroeconomic indicator determining a society's well-being, employment opportunities, and living standards (Ülger, 2025). Achieving sustainable growth performance is a core economic policy for both developed and developing countries. Modern literature focuses on how variables such as public expenditures, trade openness, and financial development shape growth dynamics (Karakuş, 2025; Yalçınkaya, 2017).

Public spending is a key fiscal policy tool for sustaining economic activities and enhancing social welfare. The relationship between public spending and growth is examined within the frameworks of Wagner's Law and the Keynesian approach (Duran, 2022). The Keynesian view holds that increasing public expenditures—especially during economic recessions—stimulates growth by boosting aggregate demand. Empirical studies indicate that investment and transfer expenditures have significant, positive effects on long-term growth (Duran, 2022; Uslu, 2023). Expenditures on education, health, and infrastructure support the accumulation of human and physical capital, enhancing growth potential (Uslu, 2023).

Trade openness, which has become one of the most critical dynamics of economic growth alongside globalization, reflects a country's level of integration with global markets (Yenipazarlı et al., 2022). Trade openness facilitates increases in total factor productivity through channels such as technology transfer, knowledge diffusion, specialization, and the utilization of economies of scale (Ülger, 2025; Alagöz et al., 2023). Analyses of country groups such as the G-20 and BRICS indicate that an increase in foreign trade volume generally has a positive impact on economic performance (Yalçınkaya, 2017; Yenipazarlı et

[1] Gaziantep University, Assist Prof., omeryilmaz@gantep.edu.tr, 0000-0002-2325-6135.

al., 2022). In the case of Turkey, while trade openness is observed to positively affect long-term growth, the sustainability of this relationship depends on the structure of foreign trade (Yapraklı, 2007; Karataş and Ergül, 2023).

Financial development, meanwhile, contributes to the growth process as a critical factor in transforming savings into productive investments. The deepening of the financial system promotes capital accumulation and technological innovation by reducing transaction costs and information asymmetry (Karakuş, 2025). Although the relationship between financial development and growth has been debated within the context of "supply-led" or "demand-led" hypotheses, the general trend suggests that an efficiently functioning financial system supports economic growth (Yalçınkaya, 2017). However, some studies have also emphasized that the impact of financial development on growth may vary across countries depending on their institutional structures and economic stability (Karataş and Ergül, 2023).

This study distinguishes itself by systematically analyzing how the fiscal multiplier effect of public expenditures, the competitive advantages of trade openness, and the linkage between the liquidity opportunities provided by the financial sector and the growth process uniquely interact within the context of BRICS-T countries. These interactions are evaluated in light of the literature, offering a comprehensive perspective on the interconnectedness of these dynamics within this country group.

The primary objective of this study is to provide a focused examination of the determinants of economic growth in BRICS-T countries, with an emphasis on the interplay among gross capital formation, public expenditures, and trade openness. Unlike prior studies, this research applies AMG (Augmented Mean Group) and CCE (Common Correlated Effects) estimators—accounting for cross-sectional dependence and heterogeneity—to data from 2000 to 2024, which enables both the identification of long-term relationships and the uncovering of country-specific differences. By using this methodological framework, the study aims to deliver fresh empirical insights and make a distinct contribution to the literature.

2. Literature

This study examines the literature on the determinants of economic growth: public expenditures, financial development, and trade openness. Both domestic and international studies are evaluated, and findings are presented chronologically.

The relationship between public spending and economic growth has long been debated in the literature. Yapraklı (2007) demonstrated a significant relationship

between public spending and economic growth in Turkey. Subsequent studies have examined the direction and scope of this relationship in greater detail.

In his analysis of the Turkish economy, Yurtkuran (2022) found that public spending positively affects long-term economic growth, supporting the Keynesian approach. Similarly, Duran (2022) and Özen and Köse (2022), by focusing on the components of public spending, demonstrate that investment and transfer expenditures support growth, whereas current expenditures can have a negative impact.

Uslu (2023), however, emphasized that the quality of public spending is more important than its quantity, arguing that infrastructure- and production-oriented spending supports growth more strongly. Similar findings are also present in the international literature. Emeru (2023) and Poku et al. (2022) have demonstrated that, particularly in developing countries, expenditures on education and health boost growth.

Recent studies show that the impact of public spending varies between countries and types of expenditure. Sosvilla-Rivero et al. (2025) observed that education, health, and infrastructure spending increase growth in the European Union. However, social protection spending can suppress growth. Griggi and Maciel (2025), studying Brazil, found that productive expenditures support growth, while unproductive expenditures have negative effects. Cooray and Nam (2025) noted that effective public administration strengthens the impact of public expenditures on growth.

The relationship between financial development and economic growth is covered in several theories. Önder (2022) and Uslu (2022) supported the supply-led hypothesis and found that financial development boosts economic growth. Taşseven and Yılmaz (2022) found a one-way causal relationship from growth to financial development in Turkey, confirming the demand-led hypothesis. Karataş and Ergül (2023) noted that financial development may slow short-term growth and that financial openness can lead to negative long-term outcomes. Çınar, Fidan Cebecioğlu,Yalçınkaya and Taş (2024) found bidirectional causality between financial development and growth in a wide country sample.

International studies usually find that financial development supports growth. Abdullahi et al. (2024) showed that financial development and trade openness together increase growth. Azmeh and Al-Raeei (2025) found a strong positive link between financial development and growth in MENA countries. Seti et al. (2025) emphasized that only strong macroeconomic and institutional settings allow financial development to sustain growth.

African studies give mixed results. Bunje et al. (2022) found that exports support growth, but imports may hurt it. Oppong-Baah et al. (2022) concluded

that trade openness has a positive and significant effect on growth in Ghana and Nigeria.

In a recent study on Turkey, Çetin, Can, and Kapçak (2023) found that the relationship between trade openness and growth is asymmetric, with positive shocks boosting growth. Karataş and Ergül (2023) also concluded that there is a positive long-term relationship between growth and trade openness.

Internationally, Nam and Ryu (2024) reported that trade liberalization generally helps growth, but rapid liberalization can be harmful. Dinçer (2025) and Seti et al. (2025) showed that institutional quality affects the trade-growth link. Ülger (2025) found no significant effect of trade openness on growth in some country groups. Overall, reviews indicate that public spending, financial development, and trade openness typically support growth. Yet, their effects differ across countries, time periods, and structural conditions. Recent studies show these effects are closely tied to institutional quality, macroeconomic stability, and the policy mix. This finding means that the drivers of growth must be assessed with a country-specific, comprehensive approach.

The relationship between trade openness and economic growth is also extensively discussed in the literature. Kar, Kılıç, and Pazarcı (2022) and Yenipazarlı et al. (2022) have demonstrated that trade openness boosts growth across different country groups. However, Sugözü and Omer (2022) have highlighted divergent views in the literature by noting that trade openness may have a negative impact on Eurasian countries.

Studies on African countries have also yielded mixed results. Bunje et al. (2022) found that exports support growth, but imports may have negative effects. Oppong-Baah et al. (2022), however, concluded that trade openness has a positive and significant effect on growth in Ghana and Nigeria.

When examining recent studies on Turkey, Çetin, Can, and Kapçak (2023) found that the relationship between trade openness and growth is asymmetric, with positive shocks increasing growth. Karataş and Ergül (2023) also concluded that there is a positive relationship between growth and trade openness in the long term.

In the international literature, Nam and Ryu (2024) noted that trade liberalization supports growth but that a rapid liberalization process may have negative effects on growth. Dinçer (2025) and Seti et al. (2025) emphasized that the effect of trade openness on growth depends on institutional quality. On the other hand, Ülger (2025) found that trade openness had no significant effect on growth in certain country groups.

When literature reviews are evaluated overall, they indicate that the effects of public spending, financial development, and trade openness on economic growth

are generally positive, but exhibit a structure that varies depending on the country, period, and structural conditions. In particular, studies conducted in recent years have revealed that the effects of these variables are closely related to institutional quality, macroeconomic stability, and the policy mix. This situation indicates that economic growth determinants must be evaluated through a country-specific and comprehensive approach.

3. Data, Methodology, and Findings

This section explains the data used in the study, what each variable means, the methods used to analyze the data, and the main results. The study uses new analytical methods that address connections and differences across countries, which are increasingly common in panel-data studies.

3.1. Data Set and Model Specification

The study utilizes annual data for the BRICS-T countries (Brazil, Russia, India, China, South Africa, and Turkey) covering the period 2000–2024. In the econometric model, real per capita income (LNGDP) is used as the dependent variable to represent economic growth. The independent variables, consistent with the literature, were identified as gross capital formation (LNBRUT), government expenditures (LNKH), and trade openness (LNTRADE). The data for these variables were obtained from the World Bank database. Additionally, the natural logarithms of all variables were taken, and the model was defined as follows:

$$LNGDP_{it} = \beta_0 + \beta_1 LNBRUT_{it} + \beta_2 LNKH_{it} + \beta_3 LNTRADE_{it} + \varepsilon_{it} \qquad (1)$$

3.2. Descriptive Statistics and Preliminary Analyses

Upon examining the descriptive statistics, it is observed that the mean and standard deviation values of the variables are close to one another, and the logarithmic transformation significantly reduces scale differences in the dataset. This is considered a positive indicator of the model's reliability.

The issue of multicollinearity in the model was examined using the VIF test. According to the results, the VIF values for all variables were well below 5, with an average VIF also low. This finding indicates that there is no serious multicollinearity problem in the model and that the estimated coefficients are unbiased and consistent. Table 1 below provides descriptive statistical information for all variables used in the study.

Table 1. Descriptive Statistics for Variables

Variable	Number of Observations	Mean	Standard Deviation	Min	Max
LNGDP	144	27.917	1.049	26.125	30.500
LNBRUT	144	26.452	1.351	23.89	29.681
LNKH	144	3.438	0.222	2.789	3.833
LNTRADE	144	3.789	0.285	3.096	4.381

Descriptive statistics for the variables are presented in Table 1. There are 144 observations per variable, and the logarithm of each variable has been taken. The mean of LNGDP is 27.917, the standard deviation is 1.049, and the minimum and maximum values range from 26.125 to 30.500. The mean of LNBRUT is 26.452, the standard deviation is 1.351, and the minimum and maximum values fall within the range of 23.689–29.681. The LNKH variable exhibits a distribution ranging from 2.789 to 3.833, with a mean of 3.438 and a standard deviation of 0.222. The LNTRADE variable, meanwhile, has a mean of 3.789, a standard deviation of 0.285, and a range of 3.096–4.381.

Table 2: VIF Test Results

Variable	VIF	1/VIF
LNBRUT	1.06	0.943
LNKH	1.26	0.793
LNTRADE	1.30	0.769
Average VIF	**1.21**	—

VIF values range from 1.06 to 1.30, and the absence of any variable exceeding 5 indicates low multicollinearity. The average VIF value of 1.21 confirms that there is no significant linear relationship among the independent variables in the model. These results indicate that the coefficients in the analysis are reliable and the estimates are stable.

Testing for cross-sectional dependence among countries in panel data analyses is of critical importance for selecting the appropriate estimation method. In Table 3, the Pesaran (2004) CD test was primarily used to examine the cross-sectional dependence of the variables.

3.3. Cross-Section Dependence and Homogeneity Analysis

Failure to account for cross-country interactions in panel data analyses can lead to misleading results. Therefore, the study first tested for cross-sectional

dependence using the Pesaran (2004) CD test. The test results indicate strong cross-sectional dependence among the model's variables. This suggests that BRICS-T countries influence one another through global economic shocks and shared macroeconomic dynamics.

Homogeneity of the slope coefficients was analyzed using the Pesaran and Yamagata (2008) homogeneity test. The findings indicate that the homogeneity hypothesis is rejected and that the panel is heterogeneous. This result clearly demonstrates that structural differences exist among the countries and that analysis using a single common coefficient is inappropriate.

Table 3: Cross-Section Dependency Test by Model

Test Type	CD Test	P-Value
Pesaran CD Test (abs)	8.638	0.000***

(***1%, **5%, *10%) indicate significance levels

According to the Pesaran CD test results, cross-sectional dependence was found to be statistically significant at the model level, indicating that the variables for the BRICS-T countries are jointly determined. This finding highlights the need to use second-generation analytical methods that account for cross-sectional dependence in analyses.

Table 4. Pesaran and Yamagata (2008) Homogeneity Test

	t-statistic	p-value
Delta	13.391	0.000***
Adjusted Delta	15.050	0.000***

(***1%, **5%, *10%) indicate significance levels

Regarding the results of the homogeneity test presented in Table 4, the statistically significant probability values strongly reject the null hypothesis that the slope coefficients are homogeneous, thereby clearly and unequivocally demonstrating that the panel has a heterogeneous structure.

3.4. Unit Root and Stationarity Analysis

The stationarity of the series was examined using the CADF (Cross-sectionally Augmented Dickey-Fuller) test, a second-generation unit root test that accounts for cross-sectional dependence. According to the results, none of the variables are stationary at the level, but they become statistically significant when first differences are taken. This indicates that all variables are integrated at the

I(1) level. Considering these results, the estimation methods used in the analysis must account for both the level of stationarity and heterogeneity.
Table 5 presents the results of the CADF (Cross-sectionally Augmented Dickey-Fuller) unit root test, a second-generation unit root analysis that accounts for cross-sectional dependence among the variables.

Table 5: CADF unit root test results

Variable	t-bar	Z[t-bar]	P-value	Stationarity
LNGDP	-1.887	-0.320	0.375	Not stationary
LNBRUT	-1.860	-0.252	0.401	Not stationary
LNKH	-2.093	-0.841	0.200	Not stationary
LNTRADE	-1.134	1.581	0.943	Not stationary
D.LNGDP	-2,836***	-2,716	0.003***	Stationary
D.LNBRUT	-3.179***	-3.583	0.000***	Stationary
D.LNKH	-2.975***	-3.068	0.001***	Stationary
D.LNTRADE	-2.843***	-2.735	0.003***	Stationary

Note: The critical values are -2.210 at the 10% level, -2.330 at the 5% level, and -2.570 at the 1% level. (***1%, **5%, *10%) indicates the significance levels

According to the CADF panel unit root test results presented in Table 5, all variables exhibit a unit root in their level series and are therefore non-stationary. When the first differences of the series were taken, it was observed that the test statistics for all variables were significant at the 1% level, and that all variables became stationary; they were determined to be I(1) stationary. In the subsequent analysis, estimation methods that account for cross-sectional dependence and heteroskedasticity were used.

3.5. Long-Run Coefficient Estimates: AMG and CCE Approaches

In this study, the AMG (Augmented Mean Group) and CCE (Common Correlated Effects) estimators, which account for cross-sectional dependence and heterogeneity, were used to estimate the long-run relationships among the variables. These methods provide more reliable results compared to traditional panel data estimators.

Table 6: Comparison of AMG and CCE estimation results

LNGDP	AMG	CCE
LNBRUT	0.166*** (0.015)	0.135*** (0.033)
LNKH	0.066*** (0.020)	0.097** (0.039)
LNTRADE	0.124*** (0.034)	0.125* (0.066)

Note: Values in parentheses indicate standard errors. *** denotes a 1% significance level, ** denotes a 5% significance level, and * denotes a 10% significance level.

The AMG (Augmented Mean Group) and CCE (Common Correlated Effects) estimation results presented in Table 6 provide a comparative view of the effects of the dependent and independent variables. According to the AMG estimator, the coefficient for the LNBRUT variable is 0.166 and is statistically significant at the 1% significance level. This finding indicates that a 1% increase in the LNBRUT variable increases national income by approximately 0.166%. Similarly, a 1% increase in the LNKH variable increases national income by 0.066. Finally, a 1% increase in the LNTRADE variable increases the dependent variable, national income, by 0.124. The CCE estimation results from the robustness test following the AMG analysis were generally similar to the AMG findings and supported them. The fact that the coefficients are positive and statistically significant in both estimation methods clearly demonstrates that the relevant variables have a positive, economically meaningful effect on the dependent variable.

3.6. Evaluation of Country-Specific AMG Findings

The country-specific results from the AMG estimator clearly reveal the panel's heterogeneous structure.

The gross capital formation variable was found to be positive and highly significant across all countries. In particular, the high coefficient obtained for China underscores the decisive role of capital accumulation in driving growth in that country.

The effect of the public expenditure variable, however, varies across countries. While a positive and significant relationship is observed in Brazil, a negative and significant effect is observed in China. In other countries, statistically significant results could not be obtained. This indicates that the

effectiveness of public expenditures is closely linked to country-specific institutional structures, expenditure patterns, and levels of efficiency.

The trade openness variable is positive and significant, particularly for Turkey, South Africa, and India. The high coefficient obtained for Turkey highlights the strong impact of foreign trade on growth. Conversely, the insignificance of coefficients in some countries suggests that the effect of trade openness may vary across countries.

Table 7: Country-level panel AMG estimation results for BRICS-T countries

LNGDP	Brazil	Russia	India	China	South Africa	Turkey
LNBRUT	0.183***	0.208***	0.122***	0.394***	0.156***	0.162***
	(0.008)	(0.018)	(0.042)	(0.035)	(0.012)	(0.016)
LNKH	0.242***	0.031	0.064	-0.196*	0.093	0.057
	(0.064)	(0.105)	(0.048)	(0.116)	(0.090)	(0.064)
LNTRADE	0.060**	0.175	0.117*	0.081	0.124***	0.352***
	(0.027)	(0.138)	(0.063)	(0.054)	(0.042)	(0.055)
CONSTANT	22.098***	21.456	23.665***	18.374***	21,650***	21,140***
	(0.428)	(1.200)	(0.838)	(0.495)	(0.288)	(0.657)

Note: Values in parentheses indicate standard errors. (***1%, **5%, *10%) denote significance levels

It was found that the coefficient of the LNBRUT variable is positive in all countries and statistically significant at the 1% level. China (0.394) has the highest coefficient value. China is followed by Russia (0.208) and Brazil (0.183). Turkey (0.162), South Africa (0.156), and India (0.122) also have positive and significant coefficients. This result indicates that the long-term effect of the variable on economic growth is positive and significant across all countries. The fact that the effect is relatively higher in China, in particular, indicates that this variable's impact on growth is stronger compared to other countries.

The effect of the LNKH variable varies across countries: For Brazil (0.242), the coefficient is positive and statistically significant at the 1% level. For China (-0.196), the coefficient is negative and statistically significant. Upon examining the coefficients for other countries, it was found that Russia (0.031), India (0.064), South Africa (0.093), and Turkey (0.057) had coefficients, but these were not statistically significant. This finding indicates that the effect of the LNKH variable on economic growth varies across countries. The fact that the LNKH variable is negative in China indicates a negative long-term effect on growth.

The LNTRADE variable is positive and statistically significant for most countries. Turkey (0.352) has the highest coefficient and is significant at the 1%

level. The coefficients for South Africa (0.124), India (0.117), and Brazil (0.060) are positive and significant. Although the coefficients for Russia (0.175) and China (0.081) are positive, they are statistically insignificant. These results clearly indicate that trade openness strongly supports economic growth, particularly in Turkey. The high coefficient of the LNTRADE variable in Turkey indicates that foreign trade integration plays a significant role in growth dynamics.

4. Conclusion and Evaluation

In this study, the determinants of economic growth in BRICS-T countries were examined using panel data analysis for the 2000–2024 period, focusing on gross capital formation, government spending, and trade openness. During the analysis, accounting for cross-sectional dependence and heterogeneity, second-generation unit root tests were conducted using the AMG and CCE estimators, and the findings were evaluated at both the panel and country levels.

The empirical results reveal that gross capital formation has a strong, positive, and statistically significant effect on economic growth across all countries. This finding is consistent with neoclassical growth theory, which emphasizes that capital accumulation is a fundamental driver of growth; this effect was particularly pronounced in countries such as China and Russia. Consequently, it is concluded that policies promoting investment and capital accumulation are of critical importance for sustainable growth.

Findings regarding public expenditures, however, exhibit a more heterogeneous pattern. While public expenditures have a positive effect on growth across the panel as a whole, the direction and significance of this effect vary across countries. In particular, positive, statistically significant results were obtained in Brazil, whereas negative, statistically significant results were found in China. In other countries, no statistically significant relationship was found. This indicates that the impact of public spending on growth depends not only on its magnitude but also on its composition, efficiency, and institutional quality.

The trade openness variable, on the other hand, generally emerges as a factor supporting economic growth. Panel results and country-specific findings indicate that trade openness has a positive, statistically significant effect on growth, particularly in Turkey, South Africa, and India. The high coefficient obtained for Turkey clearly highlights the critical role of foreign trade in economic growth. However, the fact that coefficients are statistically insignificant in some countries suggests that the effect of trade openness may vary across countries, depending on their structural characteristics.

The findings from this study generally align closely with the prevailing views in the literature. The positive effect of gross capital formation on growth is

consistent with both theoretical and empirical studies. In particular, studies on BRICS countries (Dhingra, 2023; Erkişi, 2018) conclude that investment and capital accumulation are among the key determinants of growth. The findings of this study also strongly support this body of literature.

The heterogeneous findings regarding public expenditures are consistent with the mixed results in the literature. Indeed, while studies such as those by Duran (2022) and Uslu (2023) indicate that public expenditures positively affect growth, Sosvilla-Rivero et al. (2025) and Griggi and Maciel (2025) emphasize that the effect of public expenditures varies depending on the type and efficiency of spending. The negative coefficient for China in this study is consistent with studies suggesting that unproductive public expenditures may dampen growth.

The findings regarding the trade openness variable are also largely consistent with the literature. While studies such as those by Karataş and Ergül (2023), Yenipazarlı et al. (2022), and Oppong-Baah et al. (2022) demonstrate that trade openness supports economic growth, some studies, such as those by Sugözü and Omer (2022), indicate that this relationship may vary from country to country. The fact that trade openness is found to be strong and significant in some countries but insignificant in others in this study also confirms these differences.

Overall, this study demonstrates that economic growth is not one-dimensional but is shaped by multidimensional and country-specific dynamics. The findings provide important implications for policymakers. In particular:

- Policies that promote capital accumulation (investment incentives, increased access to finance) are crucial for the sustainability of growth.
- The quality and effectiveness of public spending should be prioritized over its quantity, and it should be directed toward productive sectors.
- Trade openness policies should be designed in alignment with the country's competitive strength and production structure.

In conclusion, while the determinants of economic growth vary across BRICS-T nations, when capital accumulation, effective public policies, and balanced openness strategies are considered together, they emerge as a fundamental requirement for sustainable growth.

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Chapter 3

The Effects of Unconventional Monetary Policies on Deposit Behavior: The Case of Türkiye

Erhan AKARDENİZ[1]

1. Introduction

In the aftermath of the global financial crisis, central banks have been observed to move beyond traditional policy tools and adopt various unconventional monetary policy measures in order to ensure price stability and support the financial system. Particularly in a low-interest-rate environment where the effectiveness of short-term policy interest rates has become limited, quantitative easing, incentives for credit expansion, reserve requirement regulations, and liquidity management tools have become key components of monetary policy (Bernanke, 2020; Borio & Disyatat, 2010). This process has also transformed the structure of the monetary policy transmission mechanism, leading to the credit channel, balance sheet channel, and expectations channel becoming more prominent alongside the traditional interest rate channel (Mishkin, 1996; Gertler & Karadi, 2013). The scope of non-traditional monetary policies has expanded, particularly in advanced economies, in conjunction with the zero lower bound (ZLB) problem; however, over time, the use of these tools has also become widespread in emerging economies with the aim of ensuring macro-financial stability (International Monetary Fund, 2013; Joyce et al., 2012). The Central Bank of the Republic of Turkey (CBRT) also adopted a new policy mix in the post-2010 period that prioritized both price stability and financial stability, actively utilizing the interest rate corridor, reserve requirements, and liquidity management tools (Kara, 2012). This transformation in monetary policy, transmitted through the banking sector, has significantly reshaped the monetary transmission mechanism and strengthened the role of financial intermediaries in influencing economic activity.

The banking sector plays a central role in shaping the effects of monetary policy on the real economy. Deposits, which form the foundation of banks' funding structure, play a critical role in both determining credit supply and maintaining financial stability. In this context, depositors' reactions to interest rates, risk perceptions, and macroeconomic expectations are decisive for the

[1] Gaziantep University, Assist. Prof., erhanakardeniz@gantep.edu.tr, 0000-0003-2269-8182.

effectiveness of monetary policy (Drechsler et al., 2017). Particularly in economies where foreign currency deposits are prevalent, the effects of monetary policy decisions on the composition of deposits are also significant in terms of exchange rate volatility and financial fragility (Reinhart & Reinhart, 2008).

The effects of unconventional monetary policy tools on deposit behavior have become an increasingly prominent area of research in the literature. Studies in this context have shown that central bank policies are effective not only through the credit channel but also through savings preferences and portfolio allocation (Andrade et al., 2016; Rodnyansky & Darmouni, 2017). However, it is observed that in the existing literature, particularly in the context of developing countries, there is a limited number of studies that address the effects of unconventional monetary policies on deposit types and composition within a comprehensive framework.

The purpose of this study is to examine the effects of non-traditional monetary policy instruments implemented in Turkey on deposit behavior within a theoretical and conceptual framework. The study aims to contribute to the literature by examining the relationship between monetary policy transmission mechanisms and deposit behavior from the perspective of the banking sector. To this end, a comprehensive evaluation will be conducted, taking into account both the international literature and Turkish practices. The study consists of four sections. Following the introduction, the second section will present theoretical explanations and a review of the literature. Subsequently, evaluations based on data related to Turkey will be presented, and the final section will discuss the findings and policy recommendations.

2. Theoretical Framework and Literature Review

The effects of monetary policy on the real economy depend largely on the functioning of transmission mechanisms. In the traditional approach, monetary policy steers economic activity by influencing aggregate demand, investment, and consumption decisions through short-term interest rates. Within this framework, the interest rate channel is considered the most fundamental transmission mechanism of monetary policy (Mishkin, 1996). However, the deepening of financial markets and the increasing role of the banking sector have led to the growing importance of alternative transmission channels.

In this context, the credit channel and the bank balance sheet channel play a critical role in the transmission of monetary policy to the economy through the banking sector. While the credit channel emphasizes the impact of monetary policy on banks' credit supply, the balance sheet channel explains how changes

in the net worth of firms and households affect their borrowing capacity (Bernanke & Gertler, 1995). Deposits, a fundamental component of banks' funding structure, lie at the center of these mechanisms. Monetary policy shocks affect deposit interest rates—and consequently the behavior of savers—by altering banks' funding costs and liquidity conditions.

Non-traditional monetary policies encompass tools that are deployed, particularly when policy interest rates approach their lower bound, and aim to influence the economy through the size and composition of central banks' balance sheets. These tools include quantitative easing policies, forward guidance, negative interest rate policies, reserve requirement ratios, and liquidity management measures (Borio & Disyatat, 2010). These tools affect economic agents not only through interest rates but also through expectations, risk perceptions, and portfolio preferences.

At this point, deposit behavior emerges as a key factor determining the effectiveness of monetary policy. Depositors' savings preferences are shaped by factors such as interest rates, inflation expectations, exchange rate volatility, and perceptions of financial stability. Particularly in emerging economies, the prevalence of foreign currency deposit accounts can act as a constraint on the effectiveness of monetary policy. This situation necessitates analyzing monetary policy not only through the interest rate channel but also through portfolio choice and substitution behavior (Reinhart & Reinhart, 2008).

Furthermore, the effects of unconventional monetary policies on the banking sector are also transforming the relationship between deposit rates and market interest rates. Banks adjust deposit rates based on the terms of access to central bank liquidity, and this leads to changes in savers' deposit preferences. In this context, the effects of monetary policy on the composition of deposits (TL and foreign currency deposits, maturity structure, etc.) have significant implications for financial stability (Drechsler et al., 2017).

The effects of unconventional monetary policies on economic variables have been extensively examined in the literature, particularly in the wake of the global financial crisis. A significant portion of these studies focuses on the effects of such policies on financial markets, credit expansion, and economic growth. For example, Joyce et al. (2012) analyzed the effects of quantitative easing policies on financial asset prices and long-term interest rates, demonstrating that these policies exert strong effects through market expectations. Similarly, Andrade et al. (2016), by examining the effects of expansionary monetary policies on financial intermediaries and portfolio preferences, demonstrated that central bank policies can increase risk-taking behavior.

From the perspective of the banking sector, the effects of unconventional monetary policies on credit supply and bank behavior come to the forefront. Gertler and Karadi (2013) examined the effects of central bank interventions on the real economy through financial intermediaries both theoretically and empirically, highlighting the importance of the credit channel. Rodnyansky and Darmouni (2017), on the other hand, analyzed the effects of quantitative easing policies on bank balance sheets and credit expansion, demonstrating that these policies directly influence bank behavior. Studies specifically on deposit behavior are more limited, but they have been increasing in recent years. Drechsler et al. (2017) have shown that banks possess market power in the deposit market and that changes in monetary policy affect banks' profit margins through deposit interest rates. This finding reveals that deposit behavior plays an important role in the monetary policy transmission mechanism. Studies conducted in the context of developing countries focus on the effects of monetary policy implementations on exchange rates, capital movements, and financial stability. Reinhart and Reinhart (2008) examined the effects of policies implemented during financial crises on capital flows and reserve dynamics, emphasizing that financial vulnerabilities are more pronounced in developing economies. In the case of Turkey, it is stated that the policy mix implemented by the Central Bank of the Republic of Turkey (CBRT) in the post-2010 period was aimed at supporting financial stability, and in this context, unconventional tools were actively used (Kara, 2012). Studies on developing economies focus on the effects of monetary policy on deposit dollarization and financial vulnerabilities. Especially in economies where foreign currency deposits are prevalent, the effectiveness of monetary policy can be limited, and exchange rate expectations become an important factor determining deposit preferences. Levy Yeyati (2006) has shown that dollarization reduces the effectiveness of monetary policy and increases the fragility of the financial system. However, when the current literature is examined, it is observed that there are limited studies directly addressing the effects of unconventional monetary policies on deposit behavior. It is particularly noteworthy that there is a lack of studies that comprehensively evaluate the relationship between elements such as deposit composition, maturity structure, and currency preference with monetary policy. This situation necessitates a more comprehensive examination of the relationship at a theoretical and conceptual level.

The effects of unconventional monetary policies on macroeconomic variables have been extensively addressed in the academic literature, especially following the 2008 global financial crisis. In this context, studies examine the effects of central banks' balance sheet size, asset purchase programs, and

liquidity provision mechanisms on financial markets and the real economy. However, over time, the literature has not been limited to macro variables but has also focused on banking behaviors and financial intermediation mechanisms.

One of the early studies on the effects of quantitative easing policies on financial markets, Krishnamurthy and Vissing-Jorgensen (2011), revealed that central bank asset purchases have significant impacts on the yield curve, particularly by lowering long-term interest rates. Similarly, Neely (2015) analyzed the effects of such policies on exchange rates and international portfolio flows, demonstrating that central bank interventions affect not only local but also global financial markets.

When evaluated from the perspective of the banking sector, the effects of unconventional monetary policies on bank balance sheets have formed an important area of research in the literature. Jiménez et al. (2012) demonstrated that the expansionary monetary policies implemented in Europe increased banks' lending behavior and that banks with strong capital structures benefited more from these policies. Similarly, Gambacorta and Shin (2018) noted that monetary policy affects banks' risk-taking behavior and that a low-interest-rate environment can increase financial risks.

The literature on deposit behavior, while a more specific area, has been expanding in recent years. Stein (2012) analyzed the pass-through of monetary policy to banks' deposit rates, showing that deposit rates respond more slowly to market rates, creating a profit margin for banks. This finding indicates that the deposit market is not fully competitive and that banks have pricing power. Additionally, Drechsler et al. (2021) have shown that monetary policy changes are decisive in the deposit market, affecting deposit demand and the bank funding structure by addressing the effects of monetary policy in a broader context. According to this study, changes in interest rates affect depositors' portfolio preferences, altering the liquidity structure of the banking system.

When examining studies conducted in the context of Turkey, there are various empirical and theoretical works that address the effects of monetary policy on the banking sector and financial variables. Especially with the implementation of unconventional monetary policy tools, the effects of these policies on banks' liquidity management, credit supply, and deposit composition have become subjects of research. Disyatat (2011) stated that the framework of monetary policy implemented in Turkey has a structure that considers financial stability and that this situation affects banking behavior. However, it is observed that a significant portion of the existing studies in the literature focuses on the credit channel and macro variables, while studies directly addressing deposit

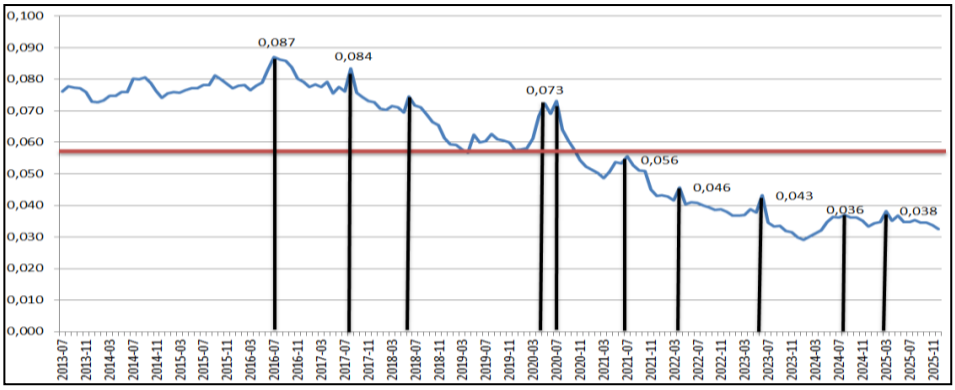
behavior are limited. The scarcity of studies that jointly evaluate the relationship between elements such as the maturity structure of deposits, currency preference, and their distribution within the total with monetary policy indicates a significant research gap in this area. Especially in economies like Turkey, where financial dollarization is relatively high, a more detailed analysis of the effects of monetary policy on deposit behavior is necessary. In conclusion, while the literature generally reveals the effects of unconventional monetary policies on financial markets, the banking sector, and the credit mechanism, it indicates a need for more in-depth analyzes specifically on deposit behavior. This study aims to address the identified gap within a theoretical framework, evaluating the relationship between monetary policy and deposit behavior from the perspective of the banking sector.

3. Unconventional Monetary Policies and Deposit Behavior in Turkey

In the wake of the global financial crisis, Turkey, like many other developing countries, embarked on a significant transformation in its monetary policy practices. During this period, the Central Bank of the Republic of Turkey (CBRT) adopted a multi-objective policy framework that prioritized both price stability and financial stability, implementing various policy tools that went beyond traditional instruments (Kara, 2012). This new policy approach diversified the transmission mechanisms of monetary policy and increased the importance of channels operating primarily through the banking sector.

The policy mix implemented by the CBRT in the post-2010 period was primarily built on the interest rate corridor system, reserve requirements, and active liquidity management. While the interest rate corridor aimed to steer short-term market interest rates, reserve requirement ratios influenced the banking system's lending capacity and liquidity conditions. Additionally, innovative tools such as the reserve option mechanism were used to provide flexibility between banks' foreign exchange and Turkish lira liquidity. These tools have influenced economic agents not only through interest rates but also through expectations and portfolio preferences. One of the most significant implications of these policy tools has been observed in the funding structure of the banking sector. Deposits, the primary funding source of the banking system in Turkey, exhibit a structure sensitive to monetary policy measures. In particular, changes in reserve requirement ratios and fluctuations in liquidity conditions lead banks to adjust their deposit interest rates, which in turn affects savers' deposit preferences. In this context, the effects of monetary policy measures on the composition of deposits have become as significant as their impact on deposit volume.

Figure 1: Money Supply and Liquidity Indicators



Note: The data were obtained from the Central Bank of the Republic of Türkiye (CBRT) Electronic Data Delivery System (EVDS) and calculated by the author.

During the period under review, the share of currency in circulation within the broad money supply (M2) showed significant fluctuations but generally followed a downward trend. Reaching its peak of approximately 0.087 in 2016, the ratio remained at 0.084 in 2017 and declined to 0.073 in 2020, signaling a downward break. Since then, the downward trend has accelerated, with the ratio falling to 0.056 in 2021, 0.046 in 2022, 0.043 in 2023, and 0.036 in 2024. As of 2025, a limited recovery has been observed, with the ratio reaching approximately 0.038. These developments indicate that, particularly in the period following 2018, economic units have moved away from a tendency to hold cash and shifted toward deposits and other financial instruments.

One of the structural features of the Turkish economy, the high level of foreign currency deposit accounts, stands out as a factor that directly affects the effectiveness of monetary policy. Exchange rate volatility, inflation expectations, and macroeconomic uncertainties can increase the tendency of individuals and firms to hold their savings in foreign currency. This situation makes it difficult to conduct monetary policy through instruments denominated in Turkish lira and can limit the effectiveness of the policy transmission mechanism. It is observed that the Central Bank of the Republic of Turkey (CBRT) is trying to manage this trend with tools such as the reserve option mechanism. On the other hand, the effects of unconventional monetary policies implemented in Turkey on the maturity structure of deposits are also noteworthy. It is observed that during periods of low interest rates and liquidity abundance, the weight of short-term deposits increases, while during periods of uncertainty, there is a stronger inclination toward more liquid and flexible financial instruments. This situation makes it difficult to manage the banking sector's assets and liabilities and can create risks in terms of financial stability.

In conclusion, unconventional monetary policies in Turkey create significant impacts not only through credit and interest channels but also through deposit behavior and savings preferences. In this context, it is necessary to consider elements such as deposit composition, currency preference, and maturity structure together when evaluating the effectiveness of monetary policy. The Turkish example offers an important area of analysis in terms of revealing the multidimensional structure of the relationship between monetary policy and financial behaviors in developing economies.

Table 1: Money Supply and Money in Circulation (Million TL)

Date	M2(A)	Change %	Circulating Money (B)	Change %	A/B
2013-12	908	3,3	66	-0,8	0,073
2014-05	924	-0,3	70	1,3	0,076
2014-12	1.016	2,9	75	0,1	0,074
2015-05	1.109	0,9	86	1,8	0,077
2015-12	1.189	0,9	92	-0,9	0,077
2016-05	1.250	2,1	99	3,3	0,079
2016-06	1.262	0,9	105	**6,3**	0,083
2016-07	1.283	1,7	112	**6,6**	0,087
2016-08	1.284	0,1	111	-1,0	0,086
2016-09	1.302	1,4	112	1,0	0,086
2016-10	1.322	1,5	111	-1,0	0,084
2016-11	1.367	3,5	110	-0,9	0,080
2016-12	1.407	2,9	111	1,5	0,079
2017-05	1.492	1,1	113	-3,5	0,076
2017-08	1.545	1,5	129	**11,3**	0,084
2017-09	1.563	1,2	118	-8,2	0,076
2017-12	1.628	0,0	118	-0,5	0,073
2018-05	1.787	4,4	124	2,1	0,070
2018-08	2.099	12,2	149	**11,3**	0,071
2018-12	1.939	2,1	119	-4,2	0,061
2019-05	2.166	0,7	135	**10,7**	0,062
2019-06	2.160	-0,3	130	-4,1	0,060
2019-07	2.153	-0,3	130	0,3	0,060
2019-08	2.255	4,7	141	**8,7**	0,063
2019-12	2.445	4,3	141	-0,1	0,058
2020-01	2.469	1,0	143	1,5	0,058

2020-02	2.557	3,6	149	4,1	0,058
2020-03	2.681	4,9	164	**10,3**	0,061
2020-04	2.911	8,5	198	**21,0**	0,068
2020-05	2.919	0,3	211	6,3	0,072
2020-06	3.001	2,8	208	-1,6	0,069
2020-07	3.142	4,7	230	**10,6**	0,073
2020-08	3.197	1,8	205	-10,9	0,064
2020-12	3.327	0,4	174	-3,7	0,052
2021-05	3.677	2,8	197	**8,7**	0,054
2021-12	5.108	1,7	220	-2,8	0,043
2022-04	5.896	3,4	270	**13,4**	0,046
2022-05	6.277	6,5	253	-6,1	0,040
2022-12	8.209	4,3	312	2,0	0,038
2023-04	9.538	5,1	370	**10,4**	0,039
2023-05	9.508	-0,3	359	-3,1	0,038
2023-06	10.875	14,4	470	**31,0**	0,043
2023-07	11.510	5,8	399	-15,1	0,035
2023-12	13.665	4,7	408	-0,9	0,030
2024-05	14.838	2,2	515	**10,0**	0,035
2024-12	17.589	3,5	587	-2,0	0,033
2025-05	20.703	2,6	763	7,6	0,037
2025-09	22.861	3,0	792	0,8	0,035
2025-12	24.739	4,7	804	0,8	0,032

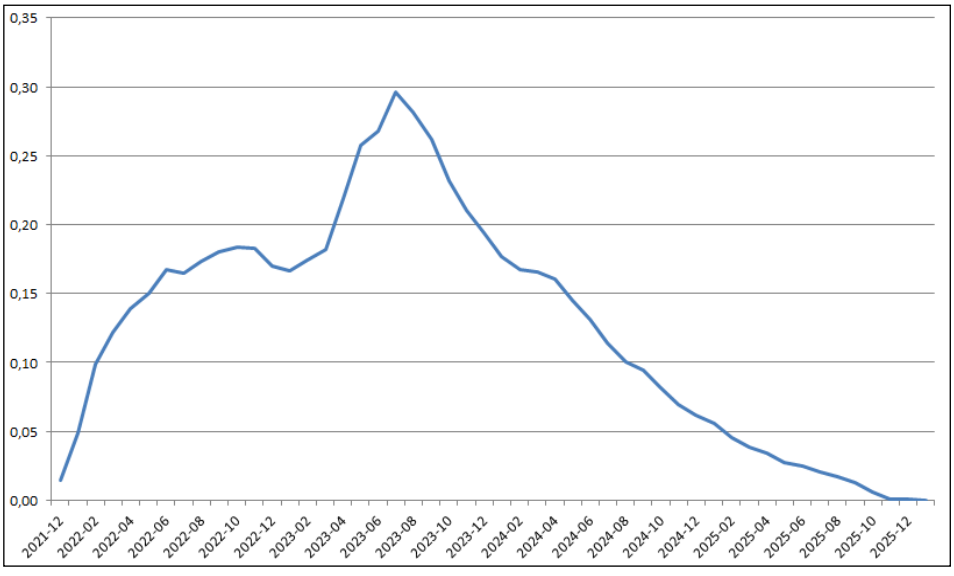
Note. The data were obtained from the Central Bank of the Republic of Türkiye (CBRT) Electronic Data Delivery System (EVDS) and calculated by the author.

Additionally, the more pronounced decline observed in the post-2021 period indicates that, along with monetary policy implementations, the financial system has absorbed more liquidity and the relative importance of money in circulation has diminished. When examining the monthly change rates of money data outside of banks, it is observed that the money in circulation shows strong increases, especially during certain periods. It is noteworthy that these increases are largely concentrated during periods such as Ramadan and Eid al-Adha, reaching rates between 8% and 30%. For example, the increases of 21.0% in April 2020 and 31.0% in June 2023 indicate that both seasonal and economic factors were simultaneously effective. In addition, during periods of uncertainty such as the July 2016 coup attempt, the 2018 currency crisis, and the 2020 COVID-19 pandemic, significant increases in the demand for

circulating money have also been observed. Additionally, similar increases in cash demand are observed during the months coinciding with election periods. These findings indicate that the demand for money in circulation is largely influenced by seasonal, behavioral, and uncertainty-related factors.

The Currency Protected Deposit (KKM) system, implemented in December 2021 in Turkey to maintain financial stability, has constituted a mechanism managed in coordination by the Banking Regulation and Supervision Agency (BRSA) and the Central Bank of the Republic of Turkey (CRBT). The system aimed to break the trend of dollarization by offering savers a currency difference guaranty in addition to the TL deposit return (Eğilmez, 2022). Yeldan and Ünüvar (2025) emphasize the transfer mechanism this system creates on public finance and its long-term macroeconomic costs. The bulletins published by the Banking Regulation and Supervision Agency (BRSA) have been the primary data source for monitoring the share of the KKM volume within the total deposits of the banking sector (BRSA, 2024). With the transition to rational policies initiated by the economic management from mid-2023, the system was gradually phased out and officially ended in January 2026 (Official Gazette, 2026). This transition process is considered part of Turkey's strategy to return to traditional monetary policy tools and to increase the attractiveness of TL assets through a direct interest rate mechanism.

Graph 2: The Ratio of Currency-Protected Deposits to Total Depo**sits**



Note. The data were obtained from the Central Bank of the Republic of Türkiye (CBRT) Electronic Data Delivery System (EVDS) and calculated by the author.

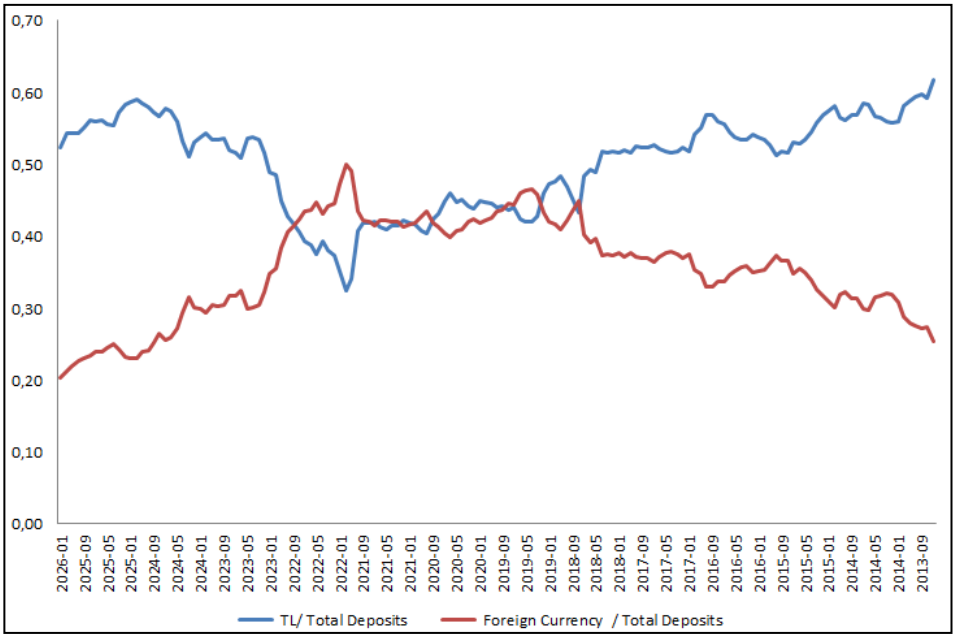
When examining the Currency Protected Deposit (KKM) and TL KKM applications in Turkey during the period from December 2021 to January 2026, it is observed that the total volume of these instruments expanded rapidly throughout 2022–2023, followed by a gradual but decisive unwinding process starting from mid-2023. This trajectory reflects the cyclical nature of unconventional monetary policy tools, particularly those designed to stabilize exchange rate expectations under conditions of high currency substitution. The sharp increase in the USD/TRY exchange rate played a dual role by both inflating the Turkish lira equivalent of FX-indexed deposits (DDKKM) and reinforcing the attractiveness of KKM instruments as a hedge against exchange rate risk. Consequently, the share of KKM in total deposits rose significantly—from around 5–10% at the end of 2022 to nearly 30% in 2023—indicating a substantial portfolio reallocation toward quasi-FX-protected TL assets. This shift suggests that KKM functioned as an intermediate instrument between pure TL deposits and foreign currency holdings, effectively reducing immediate dollarization pressures without fully eliminating exchange rate pass-through expectations. However, the rapid decline in KKM's share to the 1–6% range in 2024–2025 points to a policy normalization phase, in which macroeconomic authorities aimed to restore conventional monetary transmission mechanisms. This decline can be interpreted as the combined result of tighter monetary policy, reduced exchange rate volatility, and regulatory measures discouraging reliance on KKM. From a banking sector perspective, this unwinding likely alleviated balance sheet distortions and contingent fiscal risks associated with exchange rate guarantees, while simultaneously reactivating traditional deposit competition based on interest rates. Overall, KKM functioned as a temporary stabilization tool that reduced short-term exchange rate pressures but required a careful exit to prevent long-term distortions in deposits and monetary policy.

Table 2: Currency-Protected Deposit and Total Deposit

Date	TCMB USD Buying Rate (Monthly)	DDKKM - Total (billion USD)	DDKKM - Total (billion TL)	KKM - Total (billion TL)	KKM + DDKKM (billion TL)	Total Deposits (billion TL)	KKM + DDKKM / Total Deposits
2021-12	13,53	0,70	9,47	68,20	78,37	5.302,77	0,01
2022-01	13,52	7,60	102,75	153,70	264,05	5.380,49	0,05
2022-02	13,62	22,50	306,48	217,20	546,18	5.538,39	0,10
2022-03	14,57	26,30	383,08	320,40	729,78	5.971,75	0,12
2022-04	14,68	28,30	415,54	408,40	852,24	6.130,88	0,14
2022-05	15,62	30,80	481,22	476,40	988,42	6.580,38	0,15
2022-06	16,96	33,30	564,93	540,90	1.139,13	6.795,48	0,17
2022-07	17,39	34,60	601,60	591,10	1.227,30	7.456,95	0,16
2022-08	17,99	36,20	651,42	651,20	1.338,82	7.738,54	0,17
2022-09	18,28	39,60	723,95	688,30	1.451,85	8.051,77	0,18
2022-10	18,56	42,90	796,42	693,80	1.533,12	8.346,79	0,18
2022-11	18,59	47,60	884,93	618,60	1.551,13	8.505,95	0,18
2022-12	18,64	51,80	965,39	487,30	1.504,49	8.861,14	0,17
2023-01	18,76	58,70	1.101,07	364,50	1.524,27	9.146,43	0,17
2023-02	18,82	66,40	1.249,87	329,10	1.645,37	9.437,21	0,17
2023-03	18,97	74,80	1.418,90	318,30	1.812,00	9.955,55	0,18
2023-04	19,30	85,70	1.654,20	521,20	2.261,10	10.349,30	0,22
2023-05	19,68	92,60	1.822,74	750,70	2.666,04	10.355,00	0,26
2023-06	23,06	94,20	2.172,67	853,90	3.120,77	11.650,52	0,27
2023-07	26,42	97,20	2.568,29	1.020,90	3.686,39	12.455,16	0,30
2023-08	26,95	92,40	2.490,23	1.061,20	3.643,83	12.930,66	0,28
2023-09	26,94	90,70	2.443,54	953,50	3.487,74	13.305,54	0,26
2023-10	27,80	90,10	2.504,42	609,70	3.204,22	13.847,23	0,23
2023-11	28,59	88,80	2.538,40	341,90	2.969,10	14.130,04	0,21
2023-12	29,02	86,60	2.513,35	282,50	2.882,45	14.851,05	0,19
2024-01	30,00	79,00	2.369,98	196,60	2.645,58	14.946,62	0,18
2024-02	30,70	75,70	2.324,30	131,50	2.531,50	15.138,87	0,17
2024-03	31,93	74,80	2.388,31	98,80	2.561,91	15.470,82	0,17
2024-04	32,27	73,30	2.365,49	65,10	2.503,89	15.641,43	0,16
2024-05	32,19	68,30	2.198,57	37,10	2.303,97	15.919,83	0,14
2024-06	32,46	64,00	2.077,62	25,10	2.166,72	16.464,57	0,13
2024-07	32,84	56,80	1.865,05	7,90	1.929,75	16.940,72	0,11
2024-08	33,56	50,70	1.701,53	3,90	1.756,13	17.457,81	0,10
2024-09	33,97	48,00	1.630,53	2,80	1.681,33	17.832,50	0,09
2024-10	34,17	42,00	1.435,18	1,30	1.478,48	18.102,89	0,08
2024-11	34,36	35,70	1.226,82	0,40	1.262,92	18.173,61	0,07
2024-12	34,90	32,50	1.134,37	0,00	1.166,87	18.902,30	0,06
2025-01	35,46	28,90	1.024,68	0,00	1.053,58	19.045,70	0,06
2025-02	36,09	24,10	869,87	0,00	893,97	19.799,06	0,05
2025-03	36,97	21,50	794,87	0,00	816,37	21.144,01	0,04
2025-04	38,02	18,70	711,01	0,00	729,71	21.524,93	0,03
2025-05	38,69	15,20	588,02	0,00	603,22	22.098,51	0,03
2025-06	39,34	14,00	550,75	0,00	564,75	22.912,48	0,02
2025-07	40,11	11,90	477,26	0,00	489,16	23.487,87	0,02
2025-08	40,73	9,80	399,14	0,00	408,94	23.999,46	0,02
2025-09	41,22	7,40	305,02	0,00	312,42	24.846,18	0,01
2025-10	41,73	3,50	146,06	0,00	149,56	25.363,90	0,01
2025-11	42,18	0,50	21,09	0,00	21,59	26.066,99	0,00
2025-12	42,59	0,20	8,52	0,00	8,72	27.223,19	0,00
2026-01	43,11	0,10	4,31	0,00	4,41	27.826,25	0,00

Note: The data were obtained from the Central Bank of the Republic of Türkiye (CBRT) Electronic Data Delivery System (EVDS) and the Banking Regulation and Supervision Agency (BRSA), and were calculated by the author.

Graph 3: Distribution of Savings in Turkey by Turkish Lira and Foreign Currency



Note:The data were obtained from the Central Bank of the Republic of Türkiye (CBRT) Electronic Data Delivery System (EVDS) and the Banking Regulation and Supervision Agency (BRSA), and were calculated by the author.

The graph clearly illustrates the change in the currency composition of deposits in Turkey from a macroeconomic perspective. During the period from 2013 to 2026, an inverse relationship over time is observed between the share of TL deposits in total deposits and the share of foreign currency deposits. Especially during the 2013–2021 period, while the share of TL deposits relatively declined, there was a noticeable upward trend in the share of foreign currency deposits. This situation reflects the increasing macroeconomic uncertainties, exchange rate volatility, and expectation management during the relevant period, leading economic units to prefer foreign currency in their portfolio choices. After 2021, a significant recovery in the share of TL deposits was observed, while the share of foreign currency deposits in the total decreased. This transformation can be explained by the impact of unconventional tools applied in monetary policy, changes made in the regulatory framework, and practices such as Currency Protected Deposits (KKM). These developments have limited the demand for foreign currency by economic units while encouraging a shift toward TL assets.

As a result, the graph shows that the deposit structure in Turkey has significantly changed over time and that monetary policy has been effective in influencing financial dollarization. This transformation in the deposit composition also offers significant insights in terms of financial stability and the transmission mechanism of monetary policy.

When the table is examined, it is observed that the shares of Turkish lira (TL) and foreign currency (YP) deposits within total deposits in Turkey have shown significant changes over time. During the 2013–2017 period, the share of TL deposits within total deposits followed a relatively high and stable trend, occurring in the range of approximately 52%–58%, while the share of foreign currency deposits remained in the range of 29%–37%.

Table 3: Distribution of Deposits

Date	TL Deposits	Foreign Currency Deposit Accounts	Total Deposits	TL/ Total Deposits	Foreign Currency / Total Deposits
2026-01	14.547.063.058	5.648.376.829	27.826.249.205	0,52	0,20
2025-12	14.790.581.798	5.790.892.249	27.223.189.679	0,54	0,21
2025-06	12.840.617.692	5.488.681.245	22.912.475.336	0,56	0,24
2025-01	11.181.649.596	4.366.571.929	19.045.703.524	0,59	0,23
2024-12	11.168.065.761	4.338.152.317	18.902.302.591	0,59	0,23
2024-06	9.454.011.787	4.277.567.732	16.464.568.909	0,57	0,26
2024-01	8.047.195.899	4.463.982.550	14.946.620.489	0,54	0,30
2023-12	8.062.133.021	4.345.690.427	14.851.047.896	0,54	0,29
2023-06	5.935.001.056	3.775.441.147	11.650.518.130	0,51	0,32
2023-01	4.465.772.166	3.173.148.002	9.146.428.076	0,49	0,35
2022-12	4.295.278.857	3.143.106.106	8.861.140.842	0,48	0,35
2022-06	2.630.286.982	2.960.797.615	6.795.476.454	0,39	0,44
2022-01	1.889.981.205	2.542.685.357	5.380.494.220	0,35	0,47
2021-12	1.722.165.510	2.645.172.791	5.302.774.326	0,32	0,50
2021-06	1.595.429.931	1.634.317.622	3.869.447.133	0,41	0,42
2021-01	1.426.868.638	1.423.008.553	3.418.378.974	0,42	0,42
2020-12	1.437.401.908	1.446.142.131	3.455.077.869	0,42	0,42
2020-06	1.406.788.966	1.220.695.041	3.059.747.572	0,46	0,40
2020-01	1.163.134.873	1.083.589.537	2.590.803.646	0,45	0,42
2019-12	1.149.155.330	1.084.400.536	2.566.744.198	0,45	0,42
2019-06	961.825.111	1.043.350.977	2.272.485.163	0,42	0,46
2019-01	966.673.973	861.870.779	2.047.845.951	0,47	0,42
2018-12	970.650.622	847.660.201	2.035.875.951	0,48	0,42
2018-06	934.730.790	742.920.558	1.899.048.589	0,49	0,39
2018-01	883.297.586	645.084.803	1.713.763.973	0,52	0,38
2017-12	890.266.937	635.626.101	1.710.831.368	0,52	0,37
2017-06	822.287.420	586.020.279	1.578.052.012	0,52	0,37
2017-01	776.130.250	560.914.250	1.499.487.799	0,52	0,37
2016-12	787.674.523	512.342.333	1.453.191.950	0,54	0,35
2016-06	714.239.221	452.133.486	1.310.171.379	0,55	0,35
2016-01	671.402.905	439.529.801	1.249.175.771	0,54	0,35
2015-12	665.201.220	439.972.233	1.244.864.993	0,53	0,35
2015-06	616.661.271	413.938.411	1.167.690.152	0,53	0,35
2015-01	609.630.944	328.551.599	1.061.138.527	0,57	0,31
2014-12	612.347.810	316.390.981	1.052.662.445	0,58	0,30
2014-06	569.052.590	290.241.866	975.067.086	0,58	0,30
2014-01	541.010.248	298.003.843	965.700.500	0,56	0,31
2013-12	549.470.438	272.734.839	945.769.965	0,58	0,29

Note. The data were obtained from the Central Bank of the Republic of Türkiye (CBRT) Electronic Data Delivery System (EVDS) and the Banking Regulation and Supervision Agency (BRSA), and were calculated by the author.

However, after 2018, this structure changed significantly, and it was particularly noted that the trend of dollarization strengthened between 2020 and 2022. Indeed, by the end of 2021, the share of TL deposits had decreased to 32%, while the share of foreign currency deposits reached 50%, peaking at that level.This situation indicates that economic units have turned to foreign currency-denominated assets due to the impact of exchange rate shocks, high inflation, and a negative real interest rate environment. However, in the post-2022 period, the situation began to reverse, and especially with policy interventions, an increase in the share of TL deposits was observed. In the years 2023 and 2024, the share of TL deposits in the total again rose to the 49–59% range, while the share of foreign currency deposits decreased from 35% to the 20% range. In the 2025 and 2026 periods, this trend is expected to strengthen further, with the TL deposit ratio stabilizing at levels of 52–56%. These developments indicate that the monetary policy tools applied (especially regulations encouraging the use of the Turkish Lira) have been effective on the deposit composition and that financial dollarization has begun to be partially resolved.

Overall, the findings indicate that deposit behavior in Turkey is highly sensitive to macroeconomic stability, exchange rate expectations, and monetary policy implementations.

4. Conclusion and Evaluation

This study has examined the effects of unconventional monetary policies on deposit behavior within a theoretical and conceptual framework, evaluating how the monetary policy transmission mechanism affects savings. The transformation in central banks' policy tools following the global financial crisis has created a multidimensional structure that affects the behavior of economic units not only through interest rates but also through mechanisms such as liquidity management, reserve requirements, and the expectations channel. The Turkish example serves as an important laboratory for examining the effectiveness of unconventional monetary policies. The policy mix implemented by the Central Bank of the Republic of Turkey in the post-2010 period has been shaped within a framework that considers financial stability and has influenced deposit behaviors through the banking sector. Especially tools such as the interest rate corridor, required reserves, and the reserve option mechanism have been decisive on the composition of deposits by changing banks' funding costs and liquidity conditions. When the literature and conceptual framework are evaluated together, it is observed that the effects of unconventional monetary policies on deposit behavior are not limited to interest rates alone, but are also

shaped by expectations, risk perception, and portfolio preferences. This situation necessitates the consideration of elements such as types of deposits, currency preferences, and maturity structures together in the evaluation of the effectiveness of monetary policy.

When evaluated in terms of policy recommendations, it is important for central banks to continue effectively using tools that support financial stability in the design of monetary policy. Especially in economies with high foreign currency deposit accounts, the interaction between monetary policy and exchange rate stability should be taken into account, and complementary policies aimed at reducing deposit dollarization should be developed. However, regulations that facilitate liquidity management in the banking sector and stabilize the deposit base will strengthen the transmission mechanism of monetary policy.

Finally, to better understand the effects of monetary policy on deposit behavior, future studies could focus on bank-based analyzes at the micro data level and non-linear methods. Such approaches will contribute to more accurate decision-making by policymakers by more clearly revealing the heterogeneous effects of monetary policy.

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Chapter 4

The Impact of Energy Policies on Energy Intensity in the Transition to a Carbon-Neutral Economy: Panel Data Evidence from European Countries and Türkiye

Hayriye TAŞCI[1]

1. Introduction

Since the Industrial Revolution, economic growth has largely been built upon energy systems based on fossil fuels. However, this growth model has significantly lost its sustainability due to increasing greenhouse gas emissions and the environmental and economic costs caused by climate change. Rising global temperatures, extreme weather events, and ecosystem losses have evolved into not only an environmental crisis but also an economic problem with significant implications for production, trade, and welfare (IPCC, 2023; Stern, 2007: 296). These developments have made it necessary to reconsider the carbon-intensive structure of economic growth.

In this context, the concept of a "carbon-neutral economy" has gained a central place in both academic literature and policy agendas in recent years. Carbon neutrality refers to balancing greenhouse gas emissions resulting from economic activities through mitigation policies and carbon sinks. However, the goal of carbon neutrality involves not only a transformation in energy production technologies but also a multidimensional transition requiring the restructuring of production systems, investment preferences, trade relations, and financial systems (Grubb, 2014: 112; Aghion et al., 2016: 987). Therefore, the carbon-neutral transition should be considered not merely as a technical energy shift, but as a structural transformation affecting the entire economic system.

In this transformation process, the role of the state has regained importance. Although the neoclassical economic approach assumes that market mechanisms are efficient in resource allocation, the existence of global externalities such as climate change reveals the limitations of this assumption. The inability to price carbon emissions, the high initial costs of clean energy technologies, and coordination problems arising during the transition process indicate that market

[1] Gaziantep University, Lecturer Dr., htasci@gantep.edu.tr, 0000-0002-6402-3151.

mechanisms alone are insufficient (Stiglitz, 2019: 21; Nordhaus, 2013: 34). In this context, the state emerges not only as a regulatory actor but also as an entity that directs investments, undertakes risks, and coordinates the transformation process (Mazzucato, 2013: 5).

Recent policy implementations at the global level clearly demonstrate the decisive role of the state in this transformation. In particular, the European Green Deal, implemented by the European Union, restructures energy, industry, transportation, and trade policies within a comprehensive framework aligned with carbon neutrality goals. The emissions trading system (ETS), carbon pricing mechanisms, and the Carbon Border Adjustment Mechanism (CBAM) developed within this framework affect not only the internal dynamics of the European economy but also the global trade system (European Commission, 2019; Mehling et al., 2019). In this respect, the Green Deal can be considered not only an environmental policy but also an industrial and competitiveness strategy.

These developments make the carbon-neutral transition an economic necessity rather than an environmental choice for countries like Türkiye, which have strong trade integration with the European Union. The steps taken by Türkiye in line with its 2053 net-zero emission target have made the economic implications of energy policies more apparent. In particular, energy import dependency, the carbon-intensive production structure of the industrial sector, and the dependence of foreign trade on European markets indicate that this transition process presents both risks and opportunities for the Turkish economy (IEA, 2023; World Bank, 2023).

This study examines the transition to a carbon-neutral economy from a political economy perspective and aims to analyze the effects of energy policies on energy intensity. The main argument of the study is that the carbon-neutral transition is not merely a technological process but rather a political-economic transformation shaped by state policy instruments and strategic interventions. In this framework, the study empirically investigates the indirect effects of energy policies on the economic structure through energy intensity.

Accordingly, the analytical framework of the study is expressed through the following functional relationship:

$$\ln EI = f(RE, ETS, \ln GDP)$$

Here, lnEI represents energy intensity, RE denotes the share of renewable energy, ETS captures carbon pricing mechanisms (including emissions trading systems and carbon taxes), and lnGDP represents the level of per capita income. The contribution of this study to the literature is threefold. First, it provides a

more concrete framework by analyzing the carbon-neutral transition through energy intensity, thereby examining the effects of energy policies on the economic structure. Second, it conceptualizes the role of the state not merely as a regulatory actor but as a strategic agent that directs the transformation through carbon policies. Third, it contributes to the literature by analyzing the potential impacts of the European Green Deal on the Turkish economy from a political economy perspective.

2. Literature Review

The transition to a carbon-neutral economy has brought renewed attention to the relationships between energy use, economic growth, environmental sustainability, and public policies. In this context, the literature has generally developed along three main strands: (i) the energy–growth–environment nexus, (ii) low-carbon transition and green growth debates, and (iii) the political economy approach focusing on the role of the state.

2.1 Energy, Growth, and Environment Nexus

The relationship between energy consumption and economic growth has long been one of the central research areas in the economics literature. Studies in this field emphasize that energy use is a fundamental input in the production process and, therefore, a key determinant of economic growth (Stern, 2007: 41; Soytas and Sari, 2003: 34). In particular, strong empirical evidence suggests a bidirectional relationship between energy consumption and economic growth in developing countries.

Over time, this literature has expanded to incorporate environmental dimensions, leading to the examination of the relationship between energy consumption and carbon emissions. In this context, the Environmental Kuznets Curve (EKC) hypothesis suggests that economic growth initially increases environmental degradation, but after a certain income level, environmental improvement begins (Grossman and Krueger, 1995: 353). However, the variation of empirical findings across countries and time periods indicates that the relationship between growth and the environment is neither linear nor universal.

At this point, the concept of energy intensity has emerged as a key indicator in the literature. Energy intensity refers to the amount of energy consumed per unit of economic output and is considered one of the primary indicators of energy efficiency (Ang, 2006: 25). A decrease in energy intensity plays a critical role in both improving economic efficiency and reducing emissions. However, it is emphasized that this relationship is largely shaped by technological progress, structural transformation, and policy choices.

2.2 Low-Carbon Economy and Green Transition Literature

A second strand that has gained prominence in recent years is the literature on low-carbon economy and green growth. These studies revolve around the debate between the "green growth" approach, which argues that economic growth can be made compatible with environmental sustainability, and the "degrowth" approach, which advocates limiting economic growth (Jackson, 2009: 52; Aghion et al., 2016: 989).

The green growth literature suggests that technological innovation and investments in renewable energy can enable simultaneous economic growth and emission reduction. In this context, there is substantial evidence indicating that increasing the share of renewable energy can reduce carbon emissions while supporting economic growth (IEA, 2023; OECD, 2023).

On the other hand, some studies argue that the energy transition involves significant costs and may exert downward pressure on economic growth in the short term (Nordhaus, 2013: 45). In particular, carbon pricing policies may increase production costs and negatively affect competitiveness. These debates highlight that the carbon-neutral transition is not only an environmental process but also one with significant macroeconomic implications.

2.3 The Role of the State: A Political Economy Perspective

Studies focusing on the role of the state in the carbon-neutral transition have gained increasing importance in the literature. This perspective emphasizes that market mechanisms alone are insufficient to internalize environmental externalities and that state intervention is inevitable (Stiglitz, 2019: 24).

In this framework, carbon pricing mechanisms (carbon taxes and emissions trading systems) are among the most important policy instruments of the state. The European Union's Emissions Trading System (ETS) represents one of the most comprehensive examples in this regard. Additionally, the Carbon Border Adjustment Mechanism (CBAM) aims to balance the effects of carbon costs on international trade (Mehling et al., 2019).

However, the role of the state is not limited to regulatory functions. Mazzucato argues that the state should be considered an "entrepreneurial state" that directs innovation and undertakes risks (Mazzucato, 2013: 6). Similarly, Rodrik emphasizes the critical role of industrial policies in the green transition process (Rodrik, 2017: 78). This perspective demonstrates that the carbon-neutral transition is shaped not only by market mechanisms but also by active state policies.

2.4 European Green Deal and Studies on Türkiye

Another emerging area in the literature focuses on the economic impacts of the European Green Deal. The European Green Deal provides a comprehensive policy framework aimed at restructuring energy, industry, and trade policies in line with carbon neutrality goals (European Commission, 2019).

Within this framework, the CBAM mechanism is expected to have significant effects, particularly on countries operating in carbon-intensive sectors. For countries like Türkiye, which have strong trade ties with the European Union, this mechanism is anticipated to have a decisive impact on export structures and competitiveness (World Bank, 2023; IEA, 2023).

Studies on Türkiye generally focus on energy dependency, renewable energy potential, and energy intensity. These studies suggest that while Türkiye has significant potential in the carbon-neutral transition process, there are still notable shortcomings in the existing policy framework.

2.5 Research Gap and Contribution of the Study

A review of the existing literature reveals that studies are largely concentrated around three main areas: the relationship between energy consumption and economic growth, the determinants of carbon emissions, and the sectoral impacts of carbon policies. However, a significant portion of these studies treats the carbon-neutral transition as a technical or sectoral process and does not comprehensively analyze the role of the state within the broader context of macroeconomic transformation.

This study aims to fill this gap. Its main contribution lies in analyzing the carbon-neutral transition from a political economy perspective and providing a comprehensive framework for understanding the effects of energy policies on the economic structure. In this respect, the study positions the state not only as a regulatory actor but also as a strategic agent that actively directs economic transformation.

3. Theoretical Framework

The transition to a carbon-neutral economy represents not only a change in energy production technologies but also a structural transformation in which production structures, cost dynamics, and economic decision-making mechanisms are reshaped. Therefore, in order to analyze this process, it is necessary to move beyond the conventional energy economics approach and adopt a political economy perspective that places the state–market relationship at the center.

Although the neoclassical economic approach assumes that market mechanisms are efficient in resource allocation, the existence of negative externalities such as carbon emissions reveals the limitations of this framework. The failure to fully reflect carbon emissions in production costs leads firms to produce without considering true social costs, thereby increasing environmental degradation (Stiglitz, 2019: 24). In addition, the high initial costs of low-carbon technologies and the uncertainty associated with investment processes hinder the private sector's ability to adapt rapidly to the transition. This situation emerges as one of the main factors preventing the carbon-neutral transition from occurring spontaneously.

Within this framework, the role of the state is not limited to regulatory interventions but also includes directing investments, sharing risks, and coordinating the transformation process. Through carbon pricing mechanisms, emissions trading systems, and incentive policies, the state steers the production structure toward a less carbon-intensive configuration. This perspective indicates that the carbon-neutral transition is shaped not solely by market forces but also by active state policies (Mazzucato, 2013: 6).

To analyze the economic implications of the carbon-neutral transition, an analytical framework is required to capture the impact of energy policies on the production structure. In this study, this relationship is examined through energy intensity. Energy intensity refers to the amount of energy consumed per unit of economic output and serves as a key indicator of both energy efficiency and production structure. In this context, energy intensity provides an appropriate proxy for analyzing the economic reflections of the carbon-neutral transition.

Accordingly, the theoretical framework of the study is based on the assumption that energy intensity is determined by renewable energy use, the level of economic development, and carbon policies:

$$\ln(\mathrm{EI}_{\mathrm{it}}) = \alpha + \beta_1 \mathrm{RE}_{\mathrm{it}} + \beta_2 \ln(\mathrm{GDP}_{\mathrm{it}}) + \beta_3 \mathrm{ETS}_{\mathrm{it}} + \mu_i + \lambda_i + \varepsilon_i$$

In this model, energy intensity (EI) represents the energy efficiency of the production process, while renewable energy use (RE) reflects the extent of the energy transition. An increase in renewable energy use reduces dependence on fossil fuels and, therefore, lowers energy intensity. Per capita income (GDP) represents the level of economic development and plays a decisive role in shaping energy intensity through technological progress and structural transformation.

The ETS variable, which represents carbon policies, reflects the regulatory interventions of the state and influences firms' production decisions through carbon pricing mechanisms. It captures cross-country differences in the intensity

and scope of carbon pricing policies. In this study, the role of the state is incorporated into the model indirectly through the ETS variable rather than through a direct institutional indicator. However, the institutional structure variable (INST), included in the theoretical framework, could not be incorporated into the empirical model due to data limitations. This approach allows for the empirical measurement of the impact of policy instruments on the economic structure.

The country fixed effects (μ_i) in the model control for unobserved structural characteristics specific to each country, while time fixed effects (λ_i) capture global shocks and common trends. This structure indicates that the carbon-neutral transition is shaped by both country-specific differences and global developments.

This theoretical framework suggests that the carbon-neutral transition operates through three main channels. First, the increase in renewable energy use alters the energy supply structure, enabling production processes to operate with lower energy intensity. Second, as the level of economic development increases, technological progress and efficiency gains lead to a decline in energy intensity. Third, carbon policies implemented by the state reshape market mechanisms, transform firms' production choices, and contribute to reducing energy intensity.

In this context, the transition to a carbon-neutral economy should be considered not only as an environmental objective but also as a political-economic transformation in which production structures, energy use, and economic decision-making mechanisms are fundamentally reconfigured. The model developed within this framework is tested in the empirical section of the study, where the effects of energy policies are evaluated through energy intensity.

4. Data and Method

4.1. Data Set and Variables

In this study, the determinants of energy intensity are examined within a multidimensional framework, focusing on the effects of renewable energy use, the level of economic development, and carbon policies. The analysis is conducted for a total of 18 countries consisting of European countries and Türkiye, covering the period 2016–2021 for which consistent and continuous data are available across all variables. In this context, a balanced panel data set is employed, and the estimations are based on 108 observations.

The definitions, measurement units, transformations, and data sources of the variables used in the study are presented in Table 1.

Table 1. Variables and Data Sources

Variable	Definition	Unit of Measurement	Transformation	Source
EI	Energy intensity; the amount of energy consumed per unit of economic output	MJ / 2017 PPP GDP	ln(EI)	World Bank – World Development Indicators (WDI)
RE	Share of renewable energy consumption in total final energy consumption	%	Level	World Bank – WDI
GDP	Real GDP per capita (in purchasing power parity terms)	Constant 2021 international $	ln(GDP)	World Bank – WDI
ETS	Carbon pricing indicator representing carbon taxes and carbon pricing mechanisms	€/ton CO_2	Level	Tax Foundation Europe, OECD Carbon Pricing Dashboard, EU ETS

When Table 1 is examined, energy intensity (EI), used as the dependent variable, refers to the amount of energy consumed per unit of economic output and is considered one of the main indicators of energy efficiency (IEA, 2023). The use of the logarithmic transformation of the energy intensity variable in the model stabilizes the variance of the series and allows the coefficients to be interpreted as elasticities.

The renewable energy variable (RE) represents the share of renewable energy sources in total final energy consumption and serves as an important indicator of the energy transition process. The literature frequently emphasizes that an increase in renewable energy use may have a reducing effect on energy intensity (Sadorsky, 2009; Apergis and Payne, 2010).

The GDP per capita variable, which represents the level of economic development, is measured at constant prices based on purchasing power parity and is included in the model in logarithmic form. This variable is critical for analyzing the relationship between economic growth and energy efficiency (Grossman and Krueger, 1995).

The ETS variable, used to represent carbon policies, is an indicator measured in €/ton CO_2 that reflects carbon taxes and carbon pricing mechanisms. This variable captures the role of the state in influencing production processes through environmental regulatory instruments and is included in the model to measure the impact of market-based environmental policies on energy intensity (OECD,

2023). The ETS variable is constructed as a proxy representing carbon pricing mechanisms implemented across countries, including emissions trading systems and carbon taxes.

4.2. Descriptive Statistics

Table 2. Descriptive Statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
lnEI	108	1.1508	0.2885	0.0862	1.7120
RE	108	20.6519	12.1988	5.6000	57.9000
lnGDP	108	10.7789	0.3002	10.1845	11.6691
ETS	108	16.7782	28.8122	0.0000	117.0000

When the descriptive statistics presented in Table 2 are examined, the mean value of the energy intensity variable (lnEI) is 1.1508, with a notable difference between its minimum and maximum values. This indicates significant heterogeneity in energy efficiency across countries. The renewable energy variable (RE) has an average value of 20.65%, and in some countries, this ratio exceeds 50%. This finding suggests that the energy transition process progresses at different speeds across European countries.

While the GDP per capita variable (lnGDP) exhibits a relatively narrower distribution, the ETS variable, which represents carbon policies, has an average value of 16.78 and a high standard deviation. This indicates that carbon pricing mechanisms are implemented at substantially different levels across countries. In particular, the absence or low level of carbon taxes in some countries constitutes an important source of variation within the dataset.

4.3. Correlation Analysis

Table 3. Correlation Matrix

	lnEI	RE	lnGDP	ETS
lnEI	1.0000	0.2982	-0.3276	0.1481
RE	0.2982	1.0000	0.1604	0.7636
lnGDP	-0.3276	0.1604	1.0000	0.3655
ETS	0.1481	0.7636	0.3655	1.0000

When the correlation matrix presented in Table 3 is examined, a negative relationship is observed between energy intensity (lnEI) and GDP per capita (lnGDP). This finding is consistent with the theoretical expectation that an increase in the level of economic development leads to improvements in energy efficiency.

A strong positive relationship is observed between the renewable energy variable and the carbon policy indicator (ETS). This suggests that carbon pricing mechanisms play an encouraging role in promoting the use of renewable energy.

However, in the simple correlation analysis, a positive relationship is observed between renewable energy and energy intensity. This relationship does not account for structural differences across countries. Therefore, the direction and magnitude of this relationship are evaluated more reliably within the panel data framework by controlling for fixed effects.

4.4. Econometric Method

To analyze the determinants of energy intensity, the following panel data model is estimated:

$$\ln(\mathrm{EI}_{\mathrm{it}}) = \alpha + \beta_1 \mathrm{RE}_{\mathrm{it}} + \beta_2 \ln(\mathrm{GDP}_{\mathrm{it}}) + \beta_3 \mathrm{ETS}_{\mathrm{it}} + \mu_i + \lambda_i + \varepsilon_i$$

Here, *i* denotes countries and *t* represents time. The term μ_i captures country fixed effects, controlling for unobserved structural characteristics specific to each country. The term λ_t represents time fixed effects, accounting for global economic shocks and common trends across countries.

To address potential issues in panel data analysis such as cross-sectional dependence, heteroskedasticity, and autocorrelation, the model is estimated using a two-way fixed effects approach, and Driscoll–Kraay robust standard errors are employed (Driscoll and Kraay, 1998: 549). In addition, the presence of cross-sectional dependence is tested using the Pesaran CD test, and the results indicate that cross-sectional dependence exists among the variables (Pesaran, 2004: 315). This finding justifies the use of the Driscoll–Kraay estimator for robust standard errors.

In determining the appropriate model specification, fixed effects and random effects models are compared, and based on the results of the Hausman test, the fixed effects model is preferred (Hausman, 1978). This result indicates that country-specific effects are correlated with the explanatory variables, supporting the use of the fixed effects approach.

The presence of multicollinearity is examined using the Variance Inflation Factor (VIF) test, and the results indicate that there is no serious multicollinearity

problem among the variables. However, it is acknowledged that there may be potential simultaneity and reverse causality among some variables in the model. Therefore, the findings should be interpreted within an associational framework rather than as strict causal relationships.

Given that the dataset has a relatively short time dimension and the variables may exhibit different orders of integration, cointegration-based methods are not employed. Instead, the analysis is conducted within the fixed effects framework.

The panel data approach used in this study allows for more reliable and consistent estimates by jointly exploiting both the time-series and cross-sectional dimensions of the data. In particular, panel data methods provide significant advantages in analyzing the effects of regulatory mechanisms such as carbon policies, which vary across countries.

However, the relatively short time span of the dataset and the limited implementation of carbon pricing mechanisms in some countries require cautious interpretation of long-run relationships.

5. Empirical Results

5.1. Unit Root Test Results

Before proceeding to the panel data analysis, the stationarity properties of the series are examined. The results of the unit root tests are presented in Table 4.

Table 4. Unit Root Tests (Fisher-ADF)

Variable	Level Statistic	Level p-value	1st Difference Statistic	1st Difference p-value	Result
lnEI	12.874	0.9999	56.099	0.0175	I(1)
RE	10.109	1.0000	235.636	0.0000	I(1)
lnGDP	63.705	0.0030	96.681	0.0000	I(0)
ETS	122.743	0.0000	64.855	0.0000	I(0)*

Note: Since the ETS variable takes zero or constant values in some countries during the 2016–2021 period, the Fisher-ADF test is computed only for country-series that exhibit variation. Therefore, the result for ETS should be interpreted based on the subsample with variation.

Before conducting the panel data analysis, the stationarity properties of the variables are examined using the Fisher-type panel ADF unit root test. The results indicate that the energy intensity (lnEI) and renewable energy (RE) variables are not stationary in levels but become stationary after first differencing. In contrast, the GDP per capita variable (lnGDP) is found to be stationary in levels. The ETS variable, representing carbon policies, is also found to be stationary in levels for the country-series that exhibit variation. These findings suggest that the model includes variables integrated at both I(0) and I(1) levels.

The unit root test results indicate that the variables included in the model have different orders of integration. This necessitates careful consideration in selecting the appropriate econometric methodology for analyzing the relationships among the variables. Given the relatively short time dimension of the panel dataset and the fact that the variables exhibit stationarity properties both in levels and in first differences, the analysis is conducted within the framework of a two-way fixed effects model. Accordingly, the estimation results of the panel data model, which aims to identify the determinants of energy intensity, are presented in the following section.

5.2. Panel Data Estimation Results

The results of the two-way fixed effects model estimated to analyze the determinants of energy intensity are presented in Table 5.

Table 5. Two-Way Fixed Effects Estimation Results

Variable	Coefficient	Std. Error	t-statistic	p-value
Constant	8.5863	0.5309	16.174	0.0000
RE	-0.0081***	0.0015	-5.346	0.0000
lnGDP	-0.6725***	0.0471	-14.263	0.0000
ETS	-0.0012***	0.0004	-2.684	0.0088

Note: *** indicates significance at the 1% level. The model is estimated using a two-way fixed effects approach with Driscoll–Kraay robust standard errors.

According to the model results, the R^2 value, which indicates the explanatory power of the model, is 0.5586, while the within R^2 is 0.7328. In addition, the rejection of the poolability test suggests that the fixed effects model is the appropriate specification. The results presented in Table 5 indicate that renewable energy use (RE), GDP per capita (lnGDP), and the ETS variable representing carbon policies exhibit statistically significant and negative relationships with energy intensity.

The coefficient of the renewable energy variable is negative and statistically significant ($\beta = -0.0081$, $p < 0.01$). This finding indicates that an increase in renewable energy use reduces energy intensity. In other words, a higher share of renewable energy in energy production decreases the amount of energy consumed per unit of output, thereby improving energy efficiency. The coefficient of GDP per capita is also negative and strongly significant ($\beta = -0.6725$, $p < 0.01$). This result suggests that higher levels of economic development are associated with lower energy intensity. This relationship reflects the role of technological

progress, structural transformation, and more efficient energy use accompanying economic growth.

The coefficient of the ETS variable, representing carbon policies, is likewise negative and statistically significant ($\beta = -0.0012$, $p < 0.01$). This finding indicates that carbon pricing mechanisms are associated with a reduction in energy intensity. The increase in carbon costs encourages firms to adopt more efficient and less energy-intensive production techniques. Overall, these findings suggest that energy intensity is shaped not only by economic development and technological progress but also by policy-based instruments such as carbon pricing mechanisms.

5.3. Evaluation of Findings in Relation to the Literature

The empirical findings obtained in this study are largely consistent with the existing literature on the determinants of energy intensity. The negative and statistically significant effect of renewable energy use on energy intensity is in line with studies highlighting the positive impact of the energy transition on efficiency. In this context, the finding that an increase in renewable energy use enhances energy efficiency and reduces energy intensity by decreasing dependence on fossil fuels is consistent with the results reported by Apergis and Payne as well as Barry Sadorsky.

The negative coefficient obtained for the GDP per capita variable indicates that an increase in the level of economic development reduces energy intensity. This finding is consistent with the Environmental Kuznets Curve (EKC) hypothesis, which explains the relationship between economic growth and environmental indicators. As emphasized in the work of Gene Grossman and Alan Krueger, economic development may lead to improvements in environmental efficiency after a certain threshold level of income is reached.

The negative and statistically significant coefficient associated with the ETS variable, representing carbon policies, is also consistent with the literature emphasizing the role of market-based environmental policies in improving energy efficiency. Findings suggesting that carbon pricing mechanisms create cost pressures on production processes, thereby encouraging the adoption of more efficient and less energy-intensive production techniques, are supported by reports published by the OECD and the World Bank.

However, while a positive relationship between renewable energy and energy intensity is observed in the simple correlation analysis, this relationship becomes negative and statistically significant in the panel data model. This shift highlights the decisive role of cross-country structural differences in shaping the results. In

other words, the use of the fixed effects model controls for unobserved country-specific factors, thereby enabling more reliable and consistent estimates.

In conclusion, the findings indicate that energy intensity is shaped not only by economic and technological factors but also by policy-based regulations. In particular, providing empirical evidence on the role of carbon pricing mechanisms in improving energy efficiency constitutes a significant contribution of this study to the existing literature.

6. Conclusion and Policy Implications

This study aims to analyze the effects of energy policies on the economic structure through energy intensity in the transition to a carbon-neutral economy. Using a panel dataset consisting of 18 European countries and Türkiye, the empirical analysis examines the effects of renewable energy use, the level of economic development, and carbon policies on energy intensity.

The findings indicate that renewable energy use has a statistically significant and negative relationship with energy intensity. This result is consistent with the literature suggesting that investments in renewable energy enhance energy efficiency (Apergis and Payne, 2010; Sadorsky, 2009). In this respect, the study demonstrates that the energy transition plays not only an environmental role but also contributes to improving production efficiency.

The negative and strong coefficient associated with GDP per capita confirms that higher levels of economic development are linked to lower energy intensity. This finding is consistent with the Environmental Kuznets Curve (EKC) hypothesis, suggesting that economic growth may improve energy efficiency after a certain threshold level of development (Grossman and Krueger: 1995). However, it should be noted that this relationship is not automatic and largely depends on technological progress and policy choices.

One of the most important findings of the study is the negative and statistically significant effect of the ETS variable, representing carbon policies, on energy intensity. This result indicates that carbon pricing mechanisms create cost signals in production processes, encouraging firms to adopt more efficient and less energy-intensive production techniques. In this regard, the findings are consistent with OECD and World Bank evidence emphasizing the effectiveness of carbon pricing instruments.

This study contributes to the literature by examining the carbon-neutral transition—often addressed at a technical or sectoral level—from a political economy perspective. In particular, conceptualizing the state not only as a regulatory actor but also as a guiding and transformative force constitutes the main originality of the study. The findings suggest that the carbon-neutral

transition cannot be left solely to market mechanisms and must be supported by effective public policies.

From a policy perspective, the results point to three key implications. First, increasing investments in renewable energy is critical not only for emission reduction but also for enhancing energy efficiency. Second, the scope and effectiveness of carbon pricing mechanisms should be expanded. Third, technology-oriented industrial policies should be developed to strengthen the relationship between economic growth and energy efficiency.

However, the study has some limitations. The dataset covers the period 2016–2021, which restricts the analysis of long-term effects. Additionally, the inability to include an institutional variable due to data limitations prevents the direct measurement of state capacity. Future studies are recommended to examine this relationship more comprehensively using longer time periods and models incorporating institutional indicators.

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