The Impact of Structural Reforms on Economic Growth in Turkey: Evidence from Linear and Nonlinear ARDL Modeling*

El Impacto de las Reformas Estructurales en Turquía: Evidencia de Modelos ARDL Lineales y No Lineales

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Abstract

This paper investigates the relationship between structural reforms and economic growth in Turkey during the 1990-2019 period. Employing a novel database (the MONA database), it constructs structural reform indexes for the fiscal, financial, real, and trade sectors with two different approaches (z-score and min-max). The study uses both the linear ARDL and nonlinear ARDL (NARDL) models to provide additional robust evidence of the response of economic growth to structural reforms. The findings indicate that financial, fiscal, real, and total structural reforms have positive and statistically significant effects on economic growth in Turkey, although the growth potential of trade structural reforms seems not to have been realized.

Key words: *Structural Reforms, Economic Growth, ARDL Model, Turkish Economy.*

JEL Classification: *O23, O24, O40, C22.*

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Resumen

Este trabajo investiga la relación entre las reformas estructurales y el crecimiento en Turquía para el periodo 1990-2019. Utilizando una nueva base de datos (MONA), se construyen índices de reformas fiscal, financiera, real y comercial. Se utilizan modelos ARDL lineales y no lineales que proveen evidencia robusta de la respuesta del crecimiento a las reformas. Se encuentra que todas las reformas, a excepción de la comercial, han afectado significativa y positivamente.

Palabras clave: *Reformas estructurales, crecimiento económico, modelos ARDL, Turquía.*

Clasificación JEL: *O23, O24, O40, C22.*

1. Introduction

Following the global financial crisis of 2008, governments in both developed and developing countries have taken significant action to strengthen economic recovery; however, the global economy is still fragile and remains clouded by trade tensions, geopolitical conflicts, and an uncertain economic-political environment. Global growth, which fell to 2.9% in 2019–its lowest level since the financial crisis–is expected to remain well below its precrisis potential of 4%-4.5% over the next two years (The Organisation for Economic Co-operation and Development [OECD], 2019; International Monetary Fund [IMF], 2019). These recent challenges, including the low growth trap, have heightened the need for structural reforms (SRs); briefly, these refer to the major changes in the structures of the economic and social institutions in an economy. SRs are emphasized as a significant part of achieving strong and sustainable economic growth (Ostry, *et al.*, 2009; Babecky and Havranek 2014; Marrazzo and Terzi 2017; Mizutani *et al.*, 2018) through improvements in employment (Bouis and Duval, 2011; Bordon *et al.*, 2016; Krebs and Scheffel, 2016; Almeida and Balasundraham, 2018), productivity (Salgado, 2002; Lusinyan, 2018; Bouis and Duval, 2011; Arnold and Barbosa, 2015; Gouveia *et al.*, 2017; Kouamé and Tapsoba, 2019), foreign direct investments (Campos and Kinoshita, 2008), trade openness and market efficiency (Swaroop, 2016), and economic resilience (IMF, 2015).

This view has directed governments to carry out comprehensive SR programs to strengthen their macroeconomic performance and has raised researchers' interest in investigating the growth effects of SRs. However, SRs are seen as more difficult to measure than conventional economic policies, restricting the scope for a quantitative analysis of their effects. Therefore, much of the research to date has mostly used proxies for SRs (see Khan and Qayyum, 2006; Bara *et al.*, 2016; Şahin and Akar, 2018; Yu *et al.*, 2014; Mizutani *et al.*, 2018), such as liberalization indexes (see Christiansen *et al.*, 2013; Prati *et al.*, 2013; Arnold and Barbosa, 2015; Bekaert *et al*., 2001; Norris *et al*., 2016), and certain indicators, such as employment protection legislation (EPL), product market regulation (PMR) and regulation in energy, transport, and communications (ETCR) (see Egert and Gal, 2016; Amable *et al*., 2016; Fatas, 2015, Brancaccio *et al*., 2018). Although these proxies or indicators can be useful for measuring SRs, they may not provide a comprehensive and direct picture of SRs. Considering this gap in the literature, Kouamé and Tapsoba (2019) constructed new SR indexes for four key sectors (namely, the fiscal, financial, real, and trade sectors) to assess the effects of SRs on labor productivity growth in 37 developing countries by employing a novel database (IMF-Monitoring of Fund Arrangements [MONA] database). The MONA database is an IMF-maintained database used to monitor comparable data related to the economic objectives and outcomes of Fund-supported arrangements and indicates the cumulative history of Fund-supported programs from Executive Board approval through their completion. Following the study of Kouamé and Tapsoba (2019), the present study constructs new SR indexes for Turkey to explore the growth effects of SRs in those sectors during the period 1990-2019. Faced with heightened uncertainty in the economic-political environment, continued geopolitical conflicts in the Middle East, and a low-growth trap, the Turkish economy is considered to be one of the developing economies most in need of SRs and, thereby, provides an interesting field for such an analysis. To the best of our knowledge, this is the first study investigating the growth effects of SRs in four sectors in Turkey by constructing new SR indexes for the country, even if it is not the first to employ the MONA database. This study uses two different approaches (namely, the z-score and min-max approaches) to construct SR indexes and employs the standard, or linear, ARDL (autoregressive distributed lag) and nonlinear ARDL (NARDL) methodologies to estimate the econometric models in order to confirm the robustness of the link between SRs and economic growth.

The remaining part of the study proceeds as follows. Section 2 reviews the literature on the link between SRs in the fiscal, financial, trade, and real sectors and economic growth. Section 3 describes the data, variables, and approaches used to construct the SR indexes. Section 4 is concerned with the methodology used in the study, and the last section focuses on the main conclusions.

2. Literature Review

This section reviews the empirical literature on the link between SRs and economic growth and the channels through which SRs impact the growth performance of countries. There is a large and growing body of literature relevant to the topic that postulates that SRs could be powerful tools for economic growth and development, even if growth responses to SRs vary across countries. However, this study focuses on the literature that deals directly with the growth effects of the four key SRs (fiscal, financial, trade, and real sector reforms). First, *fiscal reforms* could play a critical role in supporting strong and long-lasting economic growth by ensuring macroeconomic stability and boosting private investment, employment, and productivity (IMF, 2015). Using the difference-in-differences approach, Ding *et al.* (2019) estimated the impact of the tax sharing system (TSS) reform on economic growth in China. In particular, they found that the TSS reform resulted in per capita GDP growth rates that were approximately 18% higher than the average growth rates in the pre-reform period. Employing the synthetic control method, Ormaechea *et al*. (2017) analyzed the impact of nine fiscal reform episodes on economic growth in seven high-income countries. They found that the reform countries achieved a higher annual real GDP growth rate and that the countries that were initially less developed experienced larger growth effects after their reforms. Likewise, employing province-level panel data from mainland China for the period 1970-1993, Lin and Liu (2000) found that fiscal decentralization has made a significant contribution to per capita GDP growth, mainly by improving the efficiency of resource allocation.

Second, *financial reforms* are expected to exert a positive effect on economic growth because they remove financial restrictions and lower the cost of capital (Kouamé and Tapsoba, 2019), mobilize savings and then allocate credit to productive activities, and create favorable conditions in financial institutions (Hasan *et al*., 1996). Using an indicator variable for equity market liberalization, Bekaert *et al.* (2001) provide evidence that stock market liberalization has a positive and statistically significant impact on per capita GDP. This result is robust to a variety of experiments, including those using different country groups, different time horizons for measuring economic growth, and alternative sets of liberalization dates. Christiansen *et al*. (2013) examined the simultaneous effects of different types of economic reforms by constructing a domestic financial liberalization indicator and reported that domestic financial reforms are robustly associated with faster growth. Employing the pooled mean group approach, Aksoy (2019) found a long-term positive relationship between financial reforms and real per capita GDP in 33 developing countries during the period 1973-2016. However, using a dummy variable that takes on the value of one from the year a country launched its financial reforms onward and zero in the contrary case, Bara *et al*. (2016) found that financial reforms are not sufficient to drive economic growth.

Third, existing research recognizes the key role played by *trade reforms* in the economic growth performance of an economy by reducing trade barriers among countries, improving efficiency in the production process, and fostering physical capital accumulation (Wacziarg and Welch, 2008; Salinas and Aksoy, 2006; Khan and Qayyum, 2006). Employing an unbalanced panel dataset on 150 countries during the period 1995-2015, Gnangnon (2018) found that economic growth is strongly associated with multilateral trade liberalization in both the entire sample and different subsamples. In the same vein, using three different liberalization indicators in a dynamic panel framework, Greenaway *et al*. (2002) found that liberalization has a positive effect on economic growth, even if the effect would appear to be relatively modest and lagged. However, the growth potential of trade reforms may not always be realized. While most trade-centered reforms have been successful, in some cases, they have not had a meaningful impact on growth because they target the wrong problems, have incoherent policies, and lack credibility (Hallaert, 2010)). In this context, Wacziarg and Welch (2008) showed that countries that tended to deepen trade reforms experienced a higher annual growth rate, while countries that tended to have suffered from political instability were faced with negative or zero growth performance after liberalization. They also showed that post-liberalization investment rates increased 1.5-2.0 percentage points, confirming that liberalization boosts economic growth through its effect on physical capital accumulation. A comprehensive study conducted by Irwin (2019) reviewed three strands of recent work on the relationship between trade reforms and economic growth: synthetic control methods studying specific reform episodes, cross-country regressions considering within-country growth, and studies investigating the channels through which restrictions on trade barriers may promote higher productivity. The study reported that trade reforms are positively associated with economic growth, on average, even if the growth effect of these reforms is heterogeneous across countries.

Fourth, it has been observed that *real sector reforms* can stimulate employment and investment (OECD, 2016), improve innovation and total factor productivity (Griffith and Harrison, 2004; Amable, *et al*., 2016), and therefore contribute to economic recovery and sustainable growth (Fatas, 2015; Bourles *et al*, 2010; Banerji *et al.*, 2017). By improving efficiency in productive factors and expanding flexibility, SRs in labor and product markets improve growth prospects and the ability of economies to adjust to shocks (Canton *et al.*, 2014). However, several lines of evidence have reported that there is no stable relationship between real sector reforms and growth. For example, Belot *et al*. (2007) found an inverse U-shaped association between employment protection and economic growth, while Brancaccio *et al*. (2018) suggested that there is no link between real sector reforms and economic growth.

In view of all that has been mentioned so far, one may suppose that SRs in the fiscal, financial, trade, and real sectors may play a critical role in supporting economic growth through different channels, although the growth responses to SRs in these sectors vary from country to country.

3. Datasets

This study covers the Turkish economy over a thirty (30) year period spanning from 1990 to 2019[1]. The data are obtained from three different sources. The SR indexes are computed by using the IMF-MONA database. Data on the real gross domestic product, real fixed capital investments, total natural resources, and research and development (R&D) investments are culled from the World Bank World Development Indicators (WDI), and data on the employed labor

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1 The reason why this study covers the 1990-2019 period is that the data on SR variables for Turkey are available in the MONA database for this period.

force and education level of the active population are collected from the Penn World Table (PWT-version 9.1).

3.1. The MONA Database and Construction of the SR Indexes

In constructing the financial, fiscal, real, trade, and total SR indexes, this study uses the IMF-MONA database and employs two different approaches (namely, the z-score and min-max approaches) to ensure the reliability of the indexes and the consistency of the empirical results.

The MONA database covers data prepared on the basis of comparable information on the targets and outcomes of Fund-supported regulations for SRs in these four key sectors. In this respect, the MONA database, which covers all the conditions of these regulations in countries within a Fund-supported program, presents the cumulative history of Fund-supported programs from Executive Board approval through its completion. Based on the data collected during the approval and on the review date of SRs since 2002, the MONA database includes structural reform data for 101 countries within the program for the 2002-2019 period. It also includes archival data on SRs for the 1990-2003 period, created by following a similar methodology for 90 of the 101 countries (for a list of these countries, see the MONA database: https://www.imf.org/external/np/pdr/mona/index.aspx).

Approval and evaluation of SRs in the MONA database are based on the policy commitments agreed upon by authorities in these countries, and these commitments are classified into four different forms: prior actions (PA), quantitative performance criteria (QPC), indicative targets (IT), and structural benchmarks (SB). PAs present the measures that countries in the program agreed to take on as SRs before the IMF Executive Board approved financing or completed review, ensuring the necessary basis for successful implementation by putting structural reforms back in focus if the reforms diverge from the agreed-upon commitments. QPCs related to macroeconomic variables controlled by country authorities are certain and measurable conditions that countries have to meet to pass a Board review. ITs set out indicative targets to assess the progress of the countries in the reform process and can be set in the case of missing QPCs due to data uncertainty in economic trends, and they are converted to QPCs with convenient modifications as uncertainty decreases. SBs are nonquantifiable reform measures that vary across programs and are crucial for achieving program targets and for assessing program implementation during review (IMF-MONA database, 2019). SBs in countries within the program are grouped into four specific categories by economic classification according to their identifications and codes in the MONA database, as shown in table (1).

Here, the financial reforms cover SRs in the banking and financial sectors to ensure the supervision of these sectors and to reduce regulation. Fiscal reforms cover SRs in public and fiscal sectors aimed at controlling expenditures and revenues in the public sector, managing foreign borrowing, and increasing fiscal transparency. Real sector reforms cover wage, price, and goods and labor

TABLE 1
DESCRIPTIONS OF STRUCTURAL REFORMS

Reforms	SB Codes	Description
Financial	2	2. Central bank 2.1. Central bank operations and reforms 2.2. Central bank auditing, transparency, and financial controls.
	6	6. Financial sector 6.1. Financial sector legal reforms, regulation, and supervision 6.2. Restructuring and privatization of financial institutions.
Fiscal	1	1. General government 1.1. Revenue measures, excluding trade policy 1.2. Revenue administration, including customs 1.3. Expenditure measures, including arrears clearance 1.4. Combined expenditure and revenue 1.5. Debt Management 1.6. Expenditure auditing, accounting, and financial controls 1.7. Fiscal transparency (publication, parliamentary oversight) 1.8. Budget preparation (e.g., submission or approval) 1.9. Inter-governmental relations.
	4	4. Pension and other social sector reform 4.1. Pension reforms 4.2. Other social sector reforms (e.g., social safety nets, health and education).
	10	10. Economic statistics (excluding fiscal and central bank transparency and similar measures).
	11	11.4 Anti-corruption legislation/policy.
Real	3	3. Civil service and public employment reforms, and wages.
	5	5. Public enterprise reform and pricing (non-financial sector) 5.1. Public enterprise pricing and subsidies 5.2. Privatization, public enterprise reform and restructuring, other than pricing 5.3. Price controls and marketing restrictions.
	9	9. Labor markets, excluding public sector employment.
	11	11. Other structural measures 11.1. Private sector legal and regulatory environment reform (non-financial sector) 11.2. Natural resource and agricultural policies (excl. public enterprises and pricing) 11.3. PRSP development and implementation.
Trade	7	7. Exchange systems and restrictions (current and capital).
	8	8. International trade policy, excluding customs reforms.

market regulations. Trade sector reforms cover SRs in international trade policy, exchange systems, and current and capital accounts.

Using data on successful SBs (met, implemented with delay, and modified structural benchmarks) and considering the data range (approval data-initial end date) in the implementation process of the SRs, the SR indexes were computed in three stages. In the first stage, the data ranges (three years for all reforms) for the implementation of SRs in Turkey during the 1990-2019 period were determined, and the number of SRs during this period was summed after the SRs were grouped into financial, fiscal, trade, and real sector reforms[2]. In the second stage, the SRs were extended to take on the same values from the approval date to the initial end date. These two stages were conducted in a similar manner for all SRs in the sample period, and the number of financial, fiscal, trade, real, and total SRs in the Turkish economy was obtained based on the data ranges in the implementation process. By performing the above two steps, SR indexes were computed by considering the effects of SRs during the implementation process (within a certain date range). In the third stage, the SR indexes were computed by employing the z-score (ZS) and min-max (MM) normalization methodologies[3]. Each normalization methodology relies on classifying the data in terms of its distribution over a certain range when the numerical differences between the data are high, as in the SB data in this study, and allows data of different scales to be compared (OECD, 2008: 27-30).

The ZS approach converts a given variable, which is characterized by its mean and standard deviation, into an index by the reduced-centered normalization methodology. The normalization of data in the ZS approach is based on the following equations (Nardo *et al*., 2005: 60; OECD, 2008: 84).

(1) $$ZS = \left(\frac{(X-\mu)}{\sigma}\right)$$

In equation (1), ZS follows a reduced-centered normal distribution, with a standard deviation of one and a mean of zero, if X is normally distributed. With this standardization, SR variables formed by using successfully met SB data can be expressed in the same units (namely, standard deviations) and can therefore be meaningfully compared in terms of their effects. In this way, the normalized SR indexes for the Turkish economy are computed for the 1990-2019 period by using the following equation:

(2) $$\text{Structural Reform Index}_{\text{ct}} = \left(\frac{(SB_{ct} - SB_{c\mu})}{SB_{c\sigma}}\right)$$

where (SB_{ct}) indicates the total number of SBs successfully met in Turkey (c) during the last review by the IMF board in year (t). ($SB_{c\mu}$) and ($SB_{c\sigma}$) indicate the mean and standard deviation of the number of SRs in Turkey during the

2 The number of SRs in Turkey during the sample period is shown in table (3) in the appendix. Descriptive statistics for the SRs and the other variables used in the econometric analysis are shown in table (4) in the appendix.

3 In contrast to the z-score, min-max scaling results in smaller standard deviations. Therefore, this study also used min-max normalization to reduce the effects of outliers and to check the robustness of the estimated effects of SRs on economic growth.

sample period, respectively. If the total number of successful SBs is equal to the mean number of SBs, then SRI takes on the value zero.

3.2. Other Macroeconomic Data

Together with the SR indexes, this study also includes six different macroeconomic variables (namely, real gross domestic product (RGDP), real fixed capital investments (RGFI), total natural resource rents (NR), research and development investments (R&D), the employed labor force (EL), and the education level of the active population (EI)). Data on RGDP (representing economic growth as a dependent variable) were obtained from the WDI in real per capita terms. Data on NR (the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents) were obtained from the WDI in nominal USD as a share of GDP. Data on R&D (representing the level of technological development) were also obtained from the WDI in nominal USD as a share of GDP. The EI variable was used to represent the qualitative dimension of human capital accumulation. Based on the average duration of schooling for the different educational levels in the working-age population, data on this variable were obtained from the PWT database as the education index in per capita terms.

In addition, some of the variables were transformed before being used in estimations. For example, data on the RGFI obtained from the WDI variable were computed in per capita terms by dividing real fixed capital investments by the total population (obtained from the same database) in the middle of the year. The EL variable was used to represent the quantitative dimension of human capital accumulation. Data on this variable obtained from the PWT were computed by dividing the active labor force series obtained from the PWT database by the total population (obtained from the same database) in the middle of the year. Table (2) summarizes the definitions and sources of the variables.

TABLE 2
DEFINITIONS AND SOURCES OF THE VARIABLES

Variables	Definitions	Sources
RGDP	Real Gross Domestic Product (2010-USD).	The World Bank-WB (World Development Indicators-WDI-2019).
RGFI	Real Fixed Capital Investments (2010-USD).	
NR	Total Natural Resources Rents	
RD	R&D Investments	
EL	Employed Labour Force	Penn World Table-PWT (PWT Version 9.1-2019).
EI	Education Level of Active Population	

Variables	Definitions	Sources
FNSR	Financial Structural Reforms	International Monetary Fund-
FSSR	Fiscal Structural Reforms	MONA Database-2019
RESR	Real Structural Reforms	(Arrangements, 2002-Current Full
TRSR	Trade Structural Reforms	Dataset).
TOSR	Total Structural Reforms	Authors' self-calculation.

This study uses the logarithmic values of the RGDP, RGFI, NR, RD, EL, and EI variables and the level values of the SR indexes. Descriptive statistics of the variables used in the econometric analysis are shown in table (4) in the appendix.

4. Methodology and Findings

In this study, econometric models estimated to detect the growth effects of SRs in Turkey are based on an extension of the Cobb-Douglas (CD)-type stochastic total production function developed by Solow (1956) within the neoclassical growth model. Considering the development of theories on the determinants of economic growth, CD-type production functions can be extended by including the technological development level and other potential determinants of economic growth within the scope of the modern (endogenous) growth theories developed by Romer (1986), Lucas (1988) and Barro (1990). For some basic studies in this context, see Barro (1991), Mankiw *et al*. (1992), Sala-i-Martin (1997), Rodrik (2012), and Alagidede *et al*. (2016). In this way, a CD-type production function can be written as follows:

$$Y_t = A_t K_t^{\alpha} L_t^{\tau} E_t^{\rho} N_t^{\sigma} SR_t^{\gamma} \mu_t^{\delta} \tag{3}$$

where (μ_t) indicates the error term; (E_t) indicates the educational level of the active population; (N_t) indicates the level of natural resources; (L_t) indicates the employed labor force; (K_t) indicates physical capital accumulation; (A_t)[4] indicates the technological development level; and (SR_t) indicates financial, fiscal, trade, real, or total structural reforms.

By taking the natural logarithm of both sides of equation (3), the general form of the extended CD-type production function can be rewritten as follows:

$$Y_t = \alpha + \partial_t RD_t + \alpha_t K_t + \tau_t L_t + \rho_t E_t + \sigma_t N_t + \gamma_t SR_t + \varepsilon_t \tag{4}$$

[4] Considering the evolution of modern growth theory, the technological development level (A_t) is assumed to be composed of R&D investments that directly reflect the level of technological development, rather than the number of patents, foreign direct investment, the openness ratio, etc. (Romer, 1990: 71-101; Grossman and Helpman, 1994: 23-44). Therefore, the level of technological development in the extended CD-type production function can be expressed as $A_t = f(RD)_t^{\partial}$.

In this context, this study estimates the following econometric model for Turkey for the period 1990-2019 by employing ARDL and NARDL models[5], which depend on the unrestricted error correlation model (UECM). Based on Pesaran *et al.* (2001) and Shin *et al.* (2014), the ARDL and NARDL models, which use lagged values of the variables to address autocorrelation and endogeneity issues, are designed to investigate the linear and nonlinear short- and long-term relations among variables that are integrated of different orders, [I(0)], [I(1)] or a combination of them.

(5) $$RGDP_t = \alpha + \beta_1 RGFI_t + \beta_2 EL_t + \beta_3 EI_t + \beta_4 NR_t + \beta_5 RD_t + \beta_6 SR_t + \varepsilon_t$$

where (α) indicates the constant term; (β) indicates the slope coefficients; and (ε) indicates the error term. As the SR indexes are represented by five different variables, five different variations of the basic model defined in equation (5) are estimated to avoid multicollinearity. The short- and long-term symmetric relations between the two variables (as (y_t) and (x_t)) are investigated in the ARDL (p, q) model with the following equation:

(6) $$y_t = \sum_{i=1}^{p} \lambda_i y_{t-i} \sum_{i=0}^{q} \delta_i^{*'} x_{t-i} + \varepsilon_t$$

where (y_t) is the dependent variable; (x_t) is the external variable vector with (k x 1) dimensions; (p, q) indicates the distributed lag values of the (y_t) and (x_t) variables, respectively; $\left(\delta_i^{*'}\right)$ indicates the (k x 1) dimensional coefficient vector for the external variables; (λ_i) indicates the scalar vector; and (ε_t) indicates the error term with mean zero and finite variance. Equation (6) can be written in symmetric and UECM forms as follows:

(7) $$\Delta y = \phi y_{t-1} + \beta_i' x_t + \sum_{i=1}^{p-1} \lambda_i^* \Delta y_{t-i} + \sum_{i=0}^{q-1} \delta_i^{*'} \Delta x_{t-i} + \varepsilon_t$$

Given that $\phi = -1\left(1 - \sum_{j=1}^{p} \lambda_j\right)$, $\beta_i = \sum_{i=0}^{q} \delta_i$, $\lambda_i^* = \sum_{m=i+1}^{p} \lambda_m$ with $i = 1, 2, \dots p-1$ and $\delta_i^* = \sum_{m=i+1}^{q} \delta_m$ with $i = 1, 2, \dots q-1$, equation (7) can be rewritten as follows:

(8) $$\Delta y_t = \phi(y_{t-1} - \theta_i' x_{t-1}) + \sum_{i=1}^{p-1} \lambda_i^* \Delta y_{t-i} + \sum_{i=0}^{q-1} \delta_i^{*'} \Delta x_{t-i} + \varepsilon_t$$

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5 This study uses the EViews 10.0 and WinRATS 9.2 packages to estimate the defined models.

where $\left(\theta = -\left(\frac{\beta}{\phi}\right)\right)$ indicates the coefficients computed for the long-term relation between (y_t) and (x_t); $\left(\lambda_i^*\right)$ and $\left(\delta_i^*\right)$ indicate the short-term coefficients calculated for lagged values of the changes in (y_t) and (x_t), respectively; and (ϕ) indicates the symmetric error correction coefficient. The error correction coefficient shows the speed of the adjustment of (y_t) from disequilibrium (because of shocks in (x_t)) to the long-run equilibrium and is expected to be between 0 and –1 (Pesaran *et al.*, 2001: 290-310).

The NARDL (*p, q*) model, which is based on an extension of equation (7) to include asymmetric relations among the variables and asymmetric short- and long-run relationships between (y_t) and (x_t), can be investigated with the following regression equation.

(9) $$y_t = \beta^+ x_t^+ + \beta^- x_t^- + u_t$$

(10) $$x_t = x_0 + x_t^+ + x_t^-$$

where (β^+) and (β^-) indicate long-run asymmetric parameters related to (x_t^+) and (x_t^-) ; (u_t) shows deviations from the long-run equilibrium; and (x_t) consists of two components, (x_t^+) and (x_t^-) , which indicate the partial sums of positive and negative changes. Equation (10) can be rewritten by separating the partial sums of the positive and negative changes in (x_t) as follows.

(11) $$x_t^+ = \sum_{j=1}^{t} \Delta x_j^+ = \sum_{j=1}^{t} Max\left(\Delta x_j, 0\right)$$

(12) $$x_t^- = \sum_{j=1}^{t} \Delta x_j^- = \sum_{j=1}^{t} Min\left(\Delta x_j, 0\right)$$

After inserting these two components of (x_t) into the ARDL model, the NARDL (*p, q*) model that allows the detection of the effects of positive and negative changes in (x_t) on (y_t) can be expressed in UECM form as follows (Shin *et al.*, 2014: 285-290):

(13) $$\Delta y_t = \phi\left(y_{t-1} - \theta_1' x_{t-1}^+ - \theta_2' x_{t-1}^-\right) + \sum_{i=1}^{p-1} \lambda_i \Delta y_{t-i} + \sum_{i=0}^{q-1} \delta_{1i}^{*'} \Delta x_{t-i}^+ + \sum_{i=0}^{q-1} \delta_{2i}^{*'} \Delta x_{t-i}^- + \varepsilon_t$$

From equation (13), the presence of asymmetric short- and long-run relationships among the variables (x_t) and (y_t) can be tested by the standard Wald test. In this context, this study examines short-run symmetry (W_{SR}), where $\left(\delta_i^+ = \delta_i^-\right)$, and long-run symmetry (W_{LR}), where $(\theta = \theta^+ = \theta^-)$.

Based on Sek (2017) and Lacheheb and Sirag (2019), this study estimates the ARDL and NARDL models defined in equation (8) and equation (13) in five stages. In the first stage, the stationarity conditions of the variables are examined by using unit root tests to confirm that none of the series are integrated beyond I(1)[6]. In the second stage, the optimal lag lengths of the ARDL and NARDL models are detected by using the Schwarz information criterion (SIC). In the third stage, the long-run linear and nonlinear cointegration relations between the dependent and independent variables are investigated by the bound testing approach. This approach allows for an investigation of whether there are long-term cointegration relationships among the variables when the series are of different orders (but they should not be I(2)). In the fourth stage, equations (8) and (13) are estimated by OLS (ordinary least squares) with a specification determined by the SIC, and the short- and long-term symmetric-asymmetric ARDL coefficients for the independent variables are computed. In the last stage, diagnostic tests including tests for heteroskedasticity, autocorrelation, and normality, for the estimated ARDL and NARDL models are performed, and whether the models meet the stability conditions is investigated. In addition, to determine the direction and degree of the relationships between the economic growth and SR variables, this study also performs the weak exogeneity tests developed by Hendry and Mizon (1998). According to the exogeneity Wald test results, the variables appear to be weakly exogenous for the parameters of interest (see table 8 in the appendix). This result implies that a model in which either the economic growth or SR variables are the dependent variable can be established. However, since this study aims to examine the effects of SRs on economic growth, the SR variables are accepted as the exogenous variables, while economic growth is accepted as the endogenous variable.

Since the stationarity condition of the variables is the first and most basic step in the estimation of the ARDL and NARDL models, the stationarity of the variables is investigated by using linear (augmented Dickey-Fuller [ADF] and Phillips-Perron [PP]) and nonlinear (Kapetanios, Shin and Snell [KSS] and Sollis [SLS]) unit root tests. The ADF and PP unit root tests developed by Dickey and Fuller (1976-1979) and Phillips and Perron (1988) can be used when the time series have linear trends and can be used to perform stationarity analysis under various assumptions to remove autocorrelation in the variables. In the ADF unit root test, it is assumed that the autocorrelation in the error terms is removed by adding the lagged values of the independent variable to the model, and accurately determining the degree of autocorrelation in the error terms is necessary to apply the test. In the PP unit root test, an assumption related to the distribution of the random shocks in the ADF test is developed, and stationarity analysis is carried out nonparametrically to control for the degree of correlation in the time series (Phillips and Perron, 1988: 335-46). In these two tests, if the

6 As the ARDL model can be applied when the variables are I(0) or I(1), it is necessary to determine the order of integration of the variables to avoid spurious results.

test statistics computed in both constant and trend (CT) forms are higher than the critical values (calculated by MacKinnon (1996)) in absolute value, the null hypothesis that "the series has a unit root" can be rejected. On the other hand, the KSS and SLS unit root tests developed by Kapetanios et al. (2003) and Sollis (2009) can be used to perform stationarity analysis under various assumptions when the variables have symmetrical or asymmetrical properties. In the KSS unit root test, it is assumed that the asymmetric time series follows an exponential smooth transition autoregressive (ESTAR) process. The KSS test is given by the following specification:

(14) $$\Delta y_t = \delta y_{t-1}^3 + \varepsilon_t$$

where (y_{t-1}^3) indicates ESTAR nonlinearity and (y_t) is the demeaned or detrended time series of interest. The equation is estimated by the least squares method, and the nonlinear t-statistics are computed with the formula $(t_{NL} = \hat{\delta} / s\hat{\delta})$. Here, $\hat{\delta}$ indicates the OLS estimate of δ, and $s\,\hat{\delta}$ indicates the standard error of $\hat{\delta}$. The null hypothesis of nonstationarity in the KSS test is $H_0 : \delta = 0$, which is examined against the alternative $H_1 : \delta < 0$ with equation (14). If the (t_{NL}) test statistics are lower than the KSS critical values (obtained from Kapetanios *et al.*, (2003)), the null hypothesis that "the series has a unit root" cannot be rejected (Kapetanios *et al.*, 2003:359-379).

In the SLS unit root test, it is assumed that symmetric or asymmetric time series follow either exponential or logistic smooth transition autoregressive processes. The SLS test is given by the following specification:

(15) $$\Delta y_t = \delta_1 y_{t-1}^3 + \delta_2 y_{t-1}^4 + \varepsilon_t$$

where $\left(y_{t-1}^3\right)$ and $\left(y_{t-1}^4\right)$ indicate symmetric and asymmetric ESTAR nonlinearity. The null hypothesis of nonstationarity in the SLS test is $H_0 : \delta_1 = \delta_2$, which is examined against the alternative $H_0 : \delta_1 \neq \delta_2 \neq 0$ with equation (15). If the F-statistics are lower than the SLS critical values (obtained from Sollis (2009)), the null hypothesis that "the series has a unit root" cannot be rejected (Sollis, 2009:118-125).

Findings obtained from following the stages above are reported in tables (5), (6), and (7) in the appendix. The linear ADF and PP unit root tests reveal that all variables are stationary after the first difference (I(1)), while the results obtained from the KSS and SLS unit root tests indicate that the EL and EI variables are stationary at level (I(0)) and the other variables are stationary after the first difference (I(1)) (see table (5)). In short, all unit root tests concluded that all variables are not integrated of order two (I(2)); this fulfills the requirement to proceed to the ARDL and NARDL models.

As seen in Panel C in both table (6) and table (7), the null hypothesis that "there is no cointegration among the variables in the model" can be rejected, as the FPSS bound test statistics are higher than the lower and upper bounds of the critical values taken from Pesaran *et al*. (2001) and Shin *et al*. (2014). Therefore, we can conclude that there is a long-run cointegration relationship between the dependent and independent variables in all ARDL and NARDL models defined in this study[7]. In addition, since the probability values of the test statistics calculated for the Ramsey reset (RR), Lagrange multiplier (LM) and autoregressive conditional heteroskedasticity (ARCH) tests are higher than 0.05 and the Cusum (CS) and Cusum of Squares (CS^2) test results are stable, the models are found to have passed the diagnostic tests, ensuring that there are no identification errors, autocorrelation, heteroskedasticity, or structural instability. For normality, it is seen that the residuals in the ARDL models are not normally distributed (except for Model 4), while residuals in the NARDL models are normally distributed (except for Model 4) since the probability values of the Jarque-Bera (JB) test statistics are lower and higher than 0.05 in the ARDL and NARDL models, respectively.

The symmetric and asymmetric short- and long-term coefficients computed for the explanatory variables in the ARDL and NARDL models are reported in Panel A and Panel B in both table (6) and table (7). The findings in both Panels B indicate that the coefficients on the error correction term (ECM_{t-1}) are statistically significant and take on values between 0 and -1 for both the ARDL and NARDL models. This shows that any disequilibrium that occurred in the short run because of symmetric/asymmetric shocks between the variables are removed in the long run.

Table (7) presents the results of the short- and long-run symmetry test for the pair research and development (RD) and economic growth[8]. According to the Wald test results, the null hypothesis of short- and long-run symmetry among RD changes can be rejected since the probability values of the test statistics W_{SR} $(RD = RD^{+} = RD^{-})$ and W_{LR} $(RD_i^{+} = RD_i^{-})$ are lower than 0.05. These results confirm that positive and negative changes in RD expenditures have a statistically significant effect on economic growth in both the short and long run.

The short-run ARDL estimates reported in Panel A in table (6) indicate that the significance and signs of the symmetric coefficients related to the conventional determinants of economic growth (RGFI, EL, EI, NR, RD) vary from period to period and model to model. For example, economic growth responds positively to real fixed capital investments (except in the one-period lag), the employed labor force and natural resources (except in model 4), and R&D investments or technological development (except in the current period and one-period lag).

7 The lower and upper bounds are determined as 2.88-3.99 for the ARDL models and 2.73-3.90 for the NARDL models.

8 On the basis of the extended CD-type production function within the scope of endogenous growth theories, it is acknowledged that changes in technology affect the efficiency of other production factors. For this reason, asymmetry is considered for the RD variable. In other words, this study suggests that the effect of asymmetry may be caused by positive or negative shocks to R&D investments (because of technological shocks).

The educational level has a negative impact on economic growth, but the sign of the impact becomes positive after one lag. In regard to the SR indexes, the short-run linear estimates show that economic growth is positively associated with fiscal, financial, real, and total SRs, but no statistically significant effect from trade reforms is found. Specifically, all else being equal, an additional one-unit increase in financial, fiscal, real, and total SRs leads to increases in growth of 0.89%, 0.83%, 0.84%, and 0.83%, respectively. Additionally, the long-run ARDL estimates reported in Panel B in table (6) show that there is a statistically significant and positive association between economic growth and real fixed investments, the employed labor force, the educational level of the active population, total natural resources (except in model 4), and R&D investments or technological development. More importantly, the long-run linear estimates indicate that fiscal, financial, real, and total SRs have a positive and statistically significant impact on economic growth; however, no significant impact from trade reforms is found. Specifically, all else being equal, an additional one-unit increase in financial, fiscal, real, and total SRs leads to increases in growth of 0.73%, 0.69%, 0.69%, and 0.68%, respectively.

The short-run NARDL estimates reported in Panel A in table (7) indicate that the significance and signs of the asymmetric coefficients related to the conventional determinants of economic growth vary from period to period and model to model. For example, economic growth responds positively to the employed labor force, natural resources, and real fixed capital investments (except in the two-period lag). The educational level has a negative impact on growth, but the sign of the impact turns positive after one lag. A positive shock in technological development (RD) is also shown to positively affect economic growth, while a negative shock suggests otherwise (except in the two-period lag). In regard to the SR indexes, all short-run nonlinear estimates show that economic growth is positively associated with fiscal, financial, real, and total SRs, but no statistically significant effect from trade reforms is found. Specifically, all else being equal, an additional one-unit increase in financial, fiscal, real, and total SRs leads to increases in growth of 0.83% (0.65%), 0.78% (0.74%), 0.76% (0.64%), and 0.77% (0.73%), respectively. (The values in parentheses indicate the estimations for a one-period lag.) Additionally, the long-run NARDL estimates reported in Panel B in table (7) show that there is a statistically significant and positive association between economic growth and real fixed capital investments, the employed labor force, total natural resources (except in model 4), and the educational level of the active population. The only exception is that negative shocks to technological development (R&D) are found to be insignificant. More importantly, the long-run nonlinear estimates indicate that all SRs, except for trade reforms, have a positive and statistically significant impact on economic growth. Specifically, all else being equal, an additional one-unit increase in financial, fiscal, real, and total SRs leads to increases in growth of 0.96%, 0.96%, 0.91%, and 0.94%, respectively.

These findings point to SRs implemented in Turkey during the period 1990-2019 being potentially key factors that improved the growth performance of the economy. This study also performs a sensitivity analysis to check the robustness of the effects of SRs on economic growth. In this context, the SR indexes are standardized using the min-max approach. Findings obtained using the same models (ARDL/NARDL) again indicate that all SRs, except for trade reforms, are strongly associated with economic growth in both the short and long run in Turkey over the sample period.

5. Conclusion

This study attempts to analyze the relationship between structural reforms and economic growth in Turkey during the 1990-2019 period. For this purpose, this study constructs financial, fiscal, real, trade, and total structural reform indexes using the MONA database and two different approaches (namely, z-scores and min-max standardization), whereas previous studies have mostly focused on liberalization indexes and proxy variables that may not directly measure structural reforms. To provide additional evidence of robustness, this study estimates five different models based on an extended Cobb-Douglas-type production function by employing both linear ARDL (autoregressive distributed lag) and nonlinear ARDL (NARDL) models.

The findings obtained from the study can be summarized as follows. First, the bounds test of the ARDL and NARDL specifications indicates the presence of cointegration relations among the variables. Second, according to the linear and nonlinear estimates, the significance levels and signs of the coefficients related to the conventional determinants of economic growth vary from period to period and model to model in the short run. In addition, the long-run linear and nonlinear estimates indicate that real fixed investments, the employed labor force, natural resources (except in model 4), technological development (except for negative shocks), and the educational level of the active population have a positive and statistically significant impact on economic growth. Third, the linear and nonlinear estimates robustly show that structural reforms, except for trade reforms, are positively associated with economic growth in Turkey in both the short and long run. In other words, regardless of which method is used to construct the structural reform indexes and to estimate the models, the evidence from the ARDL and NARDL model estimations reveals that financial, fiscal, real and total structural reforms have positive and statistically significant effects on economic growth. These results are consistent with those of Ormaechea *et al*. (2017), Bekaert *et al*. (2005), Aksoy (2019), Christiansen *et al*. (2013), and Ding *et al*. (2019). However, the growth potential of trade structural reforms seems not to have been realized in Turkey. The possible reason behind this result could be that trade reforms were the least implemented reforms in the country during the sample period. Therefore, it may not be useful to compare different structural reforms in terms of their effectiveness because a given reform (i.e., a trade reform) could have a strong growth effect but may be very costly to implement.

These findings point towards the fact that structural reforms may play a critical role in supporting strong and sustainable economic growth in a developing country, Turkey. Hence, along with sufficiently developing its institutions, Turkish policymakers should extend the structural reforms to lift the country's potential growth performance. While this study considered only structural reforms in four key economic sectors, a better understanding of the economic growth impact of social structural reforms, particularly in the health and education fields, may be another important question to address. In addition, since this study considers the MONA sample, there may be sample selection bias. That is, countries in MONA programs treated with reforms are precisely those with inefficient policies/outcomes. Therefore, these results may differ for other countries that are not in this sample or that have good policies/outcomes. Consistent with the findings obtained from this study, the arguments made in the theoretical and empirical literature that structural reforms can lead to economic growth by encouraging investments and job creation and improving productivity implicitly mention that structural reforms cause economic growth. However, one could easily argue the reverse case. In other words, progress in economic conditions leads to better institutions that in turn cause structural reforms. Therefore, a further study could assess the possible determinants of structural reforms (i.e., economic growth, institutional quality, macroeconomic stability, etc.) or the causal relationship between structural reforms and these possible determinants.

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APPENDIX

TABLE 3
NUMBER OF SUCCESSFUL REFORMS (STRUCTURAL BENCHMARKS)

Country	SB Arrange ID	Approval Year	Initial End Year	Review Type	Fiscal Reforms	Financial Reforms	Real Reforms	Trade Reforms	Total Reforms
Turkey	317	22/12/1999	21/12/2002	R10	1	2	3	0	6
	418	04/02/2002	03/02/2005	R8	1	3	2	2	8
	556	05/11/2005	05/10/2008	R7	7	11	11	0	29

Source: Authors' classification based on MONA database.

TABLE 4
DESCRIPTIVE STATISTICS

Statistics	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
RGDP	9.172	9.143	9.620	8.811	0.264	0.295	1.730
RGFI	7.683	7.667	8.379	7.064	0.463	0.121	1.491
EL	3.369	3.369	3.511	3.285	0.061	0.581	2.592
EI	0.739	0.738	0.895	0.589	0.100	0.049	1.743
NR	–1.039	–1.012	–0.357	–2.095	0.409	–0.478	3.180
RD	–0.603	–0.613	0.003	–1.608	0.465	–0.519	2.255
FNSR	0.150	0.000	1.000	0.000	0.309	2.017	5.350
FSSR	0.152	0.000	1.000	0.000	0.289	1.886	5.113
RESR	0.164	0.000	1.000	0.000	0.305	1.806	4.768
TRSR	0.133	0.000	1.000	0.000	0.346	2.157	5.653
TOSR	0.155	0.000	1.000	0.000	0.289	1.851	5.011
Observations	30	30	30	30	30	30	30

TABLE 5
UNIT ROOT TEST RESULTS

Test Statistics		**ADF**			**PP**			**KSS**			**SLS**		
Variables		**LV**	**FD**	**L**	**LV**	**FD**	**L**	**LV**	**FD**	**L**	**LV**	**FDF**	**L**
RGDP		–2.49	–4.84[a]	0	–2.57	–4.78[a]	2	–1.42	–3.67[b]	3	4.00	7.49[b]	3
RGFI		–2.64	–5.59[a]	0	–2.69	–5.66[a]	1	–1.37	–4.86[a]	1	4.10	14.57[a]	1
NR		–2.54	–5.28[a]	0	–2.48	–5.54[a]	5	–2.34	–3.70[b]	1	4.52	9.61[a]	1
RD		–3.17	–6.92[a]	0	–3.04	–10.21[a]	4	–2.96	–4.71[a]	1	4.22	14.76[a]	1
EL		–1.67	–5.32[a]	2	–1.69	–5.33[a]	2	–4.27[a]	–	4	12.32[a]	–	4
EI		–2.72	–3.91[b]	0	–2.73	–3.88[b]	0	–6.90[a]	–	2	33.13[a]	–	2
FNSR		–2.07	–5.45[a]	0	–2.21	–5.45[a]	3	–1.98	–3.65[b]	1	2.51	13.77[a]	1
FSSR		–2.05	–5.85[a]	0	–2.16	–5.88[a]	3	–1.92	–3.62[b]	1	2.66	14.25[a]	1
RESR		–2.11	–5.60[a]	0	–2.21	–5.61[a]	3	–1.90	–5.13[a]	1	2.53	12.77[a]	1
TRSR		–2.12	–5.02[a]	0	–2.21	–5.02[a]	1	–2.09	–5.20[a]	1	2.25	12.99[a]	1
TOSR		–2.05	–5.87[a]	0	–2.16	–5.90[a]	3	–1.92	–5.40[a]	1	2.67	14.02[a]	1
Critical	*%1*		**–4.30**			**–4.30**			**–3.93**			**8.79**	
Table	*%5*		**–3.57**			**–3.57**			**–3.40**			**6.54**	
Values	*%10*		**–3.22**			**–3.22**			**–3.13**			**5.41**	

Note: "a" and "b" indicate that the variables are stationary at 1% and 5% significance levels, respectively. Column "L" indicates optimal lag lengths determined by using the Schwarz Information Criterion (in the ADF, KSS, and SLS tests) and Bartlett Kernel methodology (in the PP test). The terms "FD" and "LV" indicates the first difference and level, respectively.

TABLE 6
ARDL MODEL ESTIMATION RESULTS

Panel A: Short-Run Estimates	Model-1 (2, 1, 2, 1, 0, 2, 0)		Model-2 (2, 1, 2, 1, 0, 2, 0)		Model-3 (2, 1, 2, 1, 0, 2, 0)		Model-4 (1, 0, 1, 2, 0, 2, 2)		Model-5 (2, 1, 2, 1, 0, 2, 0)	
	CE.	SE.	CE.	SE.	CE.	SE.	CE.	SE.	CE.	SE.
$RGDP_{t-1}$	-0.2902^{c}	0.1586[0.090]	-0.2808	0.1682[0.119]	-0.2863	0.1627[0.102]	0.0668	0.0388[0.108]	-0.2809	0.1683[0.118]
$RGDP_{t-2}$	0.0697^{b}	0.0307[0.040]	0.0735^{b}	0.0328[0.043]	0.0669^{c}	0.0314[0.052]	—	—	0.0728^{b}	0.0328[0.045]
$RGFI_{t}$	0.3031^{a}	0.0097[0.000]	0.3035^{a}	0.0103[0.000]	0.3072^{a}	0.0100[0.000]	0.2774^{a}	0.0136[0.000]	0.3043^{a}	0.0103[0.000]
$RGFI_{t-1}$	-0.0609	0.0421[0.172]	0.0651	0.0448[0.170]	0.0635	0.0433[0.166]	—	—	0.0655	0.0448[0.168]
EL_{t}	0.1318^{b}	0.0445[0.010]	0.1264^{b}	0.0469[0.019]	0.1331^{b}	0.0458[0.012]	0.0873	0.0535[0.126]	0.1270^{b}	0.0470[0.018]
EL_{t-1}	0.2987^{a}	0.0438[0.000]	0.3022^{a}	0.0465[0.000]	0.2889^{a}	0.0452[0.000]	0.3951^{a}	0.0558[0.000]	0.3001^{a}	0.0465[0.000]
EL_{t-2}	0.2933^{a}	0.0861[0.005]	0.2774^{a}	0.0904[0.009]	0.2896^{a}	0.0882[0.006]	—	—	0.2778^{a}	0.0905[0.008]
EI_{t}	-0.6076^{c}	0.2821[0.051]	-0.6001^{c}	0.2995[0.066]	-0.6600^{b}	0.2924[0.042]	-0.2043	0.3708[0.591]	-0.6114^{c}	0.3003[0.063]
EI_{t-1}	1.4339^{a}	0.2829[0.000]	1.3917^{a}	0.2986[0.000]	1.4689^{a}	0.2927[0.000]	0.4602	0.4795[0.355]	1.4012^{a}	0.2993[0.000]
EI_{t-2}	—	—	—	—	—	—	0.4665	0.3027[0.147]	—	—
NR_{t}	0.0129^{a}	0.0039[0.006]	0.0119^{b}	0.0041[0.012]	0.0129^{a}	0.0041[0.007]	0.0009	0.0047[0.840]	0.0121^{b}	0.0041[0.012]
RD_{t}	0.0073	0.0107[0.506]	0.0076	0.0113[0.515]	0.0059	0.0109[0.595]	-0.0101	0.0149[0.511]	0.0073	0.0113[0.530]
RD_{t-1}	0.0148	0.0119[0.234]	0.0172	0.0125[0.193]	0.0161	0.0121[0.207]	0.0546^{a}	0.0167[0.006]	0.0173	0.0125[0.190]
RD_{t-2}	0.0924^{a}	0.0179[0.000]	0.0875^{a}	0.0186[0.000]	0.0904^{a}	0.0183[0.000]	0.0307^{c}	0.0144[0.052]	0.0875^{a}	0.0186[0.000]
SR_{t}	0.0089^{a}	0.0019[0.000]	0.0083^{a}	0.0019[0.000]	0.0084^{a}	0.0018[0.001]	0.0009	0.0022[0.666]	0.0083^{a}	0.0019[0.001]
SR_{t-1}	—	—	—	—	—	—	-0.0038	0.0023[0.130]	—	—
SR_{t-2}	—	—	—	—	—	—	0.0060^{b}	0.0025[0.032]	—	—
C	5.4571^{a}	0.6492[0.000]	5.3862^{a}	0.6869[0.000]	5.4477^{a}	0.6661[0.000]	5.4477^{a}	0.6661[0.000]	5.3887^{a}	0.6873[0.000]
Panel B: Long-Run Estimates	**CE.**	**SE.**	**CE.**	**SE.**	**CE.**	**SE.**	**CE.**	**SE.**	**CE.**	**SE.**
$RGFI$	0.2983^{a}	0.0093[0.000]	0.3052^{a}	0.0092[0.000]	0.3041^{a}	0.0088[0.000]	0.2972^{a}	0.0169[0.000]	0.3060^{a}	0.0091[0.000]
EL	0.5931^{a}	0.0349[0.000]	0.5846^{a}	0.0365[0.000]	0.5837^{a}	0.0344[0.000]	0.5169^{a}	0.0493[0.000]	0.5834^{a}	0.0363[0.000]
EI	0.6770^{a}	0.0582[0.000]	0.6555^{a}	0.0638[0.000]	0.6634^{a}	0.0605[0.000]	0.7742^{a}	0.1069[0.000]	0.6338^{a}	0.0639[0.000]

Continuation Table 6

Panel A: Short-Run Estimates		Model-1 (2, 1, 2, 1, 0, 2, 0)		Model-2 (2, 1, 2, 1, 0, 2, 0)		Model-3 (2, 1, 2, 1, 0, 2, 0)		Model-4 (1, 0, 1, 2, 0, 2, 2)		Model-5 (2, 1, 2, 1, 0, 2, 0)	
		CE.	SE.	CE.	SE.	CE.	SE.	CE.	SE.	CE.	SE.
NR		0.0105[a]	0.0032[0.006]	0.0099[b]	0.0034[0.012]	0.0106[a]	0.0033[0.007]	0.0010	0.0051[0.840]	0.0099[b]	0.0034[0.011]
RD		0.0938[a]	0.0108[0.000]	0.0930[a]	0.0116[0.000]	0.0922[a]	0.0110[0.000]	0.0807[a]	0.0189[0.000]	0.0928[a]	0.0116[0.000]
SR		0.0073[a]	0.0015[0.000]	0.0069[a]	0.0016[0.000]	0.0069[a]	0.0015[0.000]	0.0033	0.0029[0.278]	0.0068[a]	0.0016[0.001]
C		4.4713[a]	0.0683[0.000]	4.4609[a]	0.0758[0.000]	4.4677[a]	0.0710[0.000]	4.6497[a]	0.1147[0.000]	4.4603[a]	0.0759[0.000]
ECM_{t-1}		-1.2205[a]	0.0933[0.000]	-1.2074[a]	0.0987[0.000]	-1.2193[a]	0.0959[0.000]	-0.9331[a]	0.0200[0.000]	-1.2082[a]	0.0988[0.000]
Panel C: Bound Test and Diagnostic Statistics											
FPSS		13.89*		12.16*		13.11*		17.36*		12.14*	
Adjusted R^2	F	0.99	6198.03[0.000]	0.99	5503.46[0.000]	0.99	5885.93[0.000]	0.99	3392.98[0.000]	0.99	5499.20[0.000]
RR		0.742[0.473]		0.596[0.562]		0.569[0.579]		0.129[0.899]		0.574[0.576]	
ARCH	LM	0.019[0.888]	0.922[0.356]	0.088[0.769]	0.848[0.375]	0.001[0.972]	0.982[0.341]	0.196[0.662]	1.267[0.282]	0.074[0.787]	0.893[0.363]
JB	$CS(CS^2)$	9.35[0.009]	S(S)	6.47[0.039]	S(S)	5.99[0.049]	S(S)	2.04[0.360]	S(S)	6.12[0.046]	S(S)

Note: "CE." and "SE." indicate coefficients and standard errors. "a", "b", and "c" indicate that the coefficients are statistically significant at 1%, 5%, and 10% significance levels, respectively. "t" indicates the lag order determined by Schwarz Information Criterion (SIC) while t=0. "*" indicates the presence of co-integration relationship between the variables at 1% significance level. Model-1, Model-2, Model-3, Model-4, and Model-5 respectively cover financial (FN), fiscal (FS), real (RE), trade (TR), and total (TO) structural reforms (SRs). Probabilities of the variables are given in box brackets. Model specifications (2,1,2,1,0,2,0) in models 1,2,3, and 5, and (1,0,1,2,0,2,2) in model 4 were determined by using general to specific approach and SIC with a maximum of two lags for dependent and independent variables.

TABLE 7
NARDL MODEL ESTIMATION RESULTS

Panel A: Short-Run Estimates	Model-1 (2, 2, 2, 2, 0, 1, 2, 1)		Model-2 (2, 2, 2, 2, 0, 1, 2, 1)		Model-3 (2, 2, 2, 2, 0, 1, 2, 1)		Model-4 (1, 0, 2, 1, 2, 0, 2, 0)		Model-5 (2, 2, 2, 2, 0, 1, 2, 1)	
	CE.	**SE.**	**CE.**	**SE.**	**CE.**	**SE.**	**CE.**	**SE.**	**CE.**	SE.
$RGDP_{t-1}$	-0.8105[b]	0.2627[0.018]	-0.8669[b]	0.2717[0.015]	-0.8187[b]	0.2625[0.016]	-0.0761	0.0499[0.156]	-0.8668[b]	0.2709[0.015]
$RGDP_{t-2}$	0.2852	0.1697[0.137]	0.2822	0.1707[0.142]	0.2707	0.1647[0.144]	—	—	0.2798	0.1694[0.143]
$RGFI_t$	0.3160[a]	0.0139[0.000]	0.3196[a]	0.0144[0.000]	0.3202[a]	0.0143[0.000]	0.3198[a]	0.0134[0.000]	0.3203[a]	0.0145[0.000]
$RGFI_{t-1}$	0.1899[b]	0.0706[0.031]	0.2094[b]	0.0726[0.024]	0.1979[b]	0.0710[0.027]	—	—	0.2103[b]	0.0726[0.023]
$RGFI_{t-2}$	-0.1027	0.0554[0.106]	-0.0985	0.0551[0.117]	-0.0961	0.0532[0.114]	—	—	-0.0975	0.0545[0.117]
EL_t	0.3991[a]	0.0952[0.004]	0.4318[a]	0.1029[0.004]	0.3827[a]	0.0912[0.004]	0.2057[b]	0.0717[0.015]	0.4271[a]	0.1015[0.004]
EL_{t-1}	0.3843[a]	0.0742[0.001]	0.3943[a]	0.0743[0.001]	0.3744[a]	0.0736[0.001]	0.2015[a]	0.0599[0.006]	0.3917[a]	0.0741[0.001]
EL_{t-2}	0.5234[a]	0.1334[0.005]	0.5668[a]	0.1421[0.005]	0.5086[a]	0.1309[0.006]	0.1529[c]	0.0771[0.073]	0.5622[a]	0.1409[0.005]
EI_t	-2.2758[a]	0.6123[0.007]	-2.5289[a]	0.6636[0.006]	-2.222[a]	0.5998[0.007]	-0.7189	0.5058[0.183]	-2.5076[a]	0.6574[0.007]
EI_{t-1}	1.6283[b]	0.5389[0.019]	1.5971[b]	0.5418[0.022]	1.6155[b]	0.5309[0.019]	1.7215[a]	0.3862[0.001]	1.5974[b]	0.5396[0.021]
EI_{t-2}	1.4111[b]	0.5591[0.039]	1.5917[b]	0.5589[0.025]	1.4214[b]	0.5553[0.038]	—	—	1.5856[b]	0.5574[0.025]
NR_t	0.0379[a]	0.0105[0.008]	0.0398[a]	0.0112[0.009]	0.0366[a]	0.0101[0.008]	0.0230[b]	0.0081[0.016]	0.0395[a]	0.0111[0.009]
NR_{t-1}	—	—	—	—	—	—	-0.0092	0.0058[0.144]	—	—
NR_{t-2}	—	—	—	—	—	—	-0.0132[b]	0.0055[0.037	—	—
RD^+_t	0.0816[a]	0.0206[0.006]	0.0865[a]	0.0215[0.005]	0.0815[a]	0.0205[0.005]	0.0502[b]	0.0182[0.018]	0.0863[a]	0.0215[0.005]
$RD^+t\text{-}1$	0.0819[b]	0.0271[0.019]	0.0911[b]	0.0278[0.014]	0.0783[b]	0.0266[0.022]	—	—	0.0899[b]	0.0276[0.014]
RD^-t	-0.1358[a]	0.0299[0.003]	-0.1406[a]	0.0308[0.003]	-0.1325[a]	0.0292[0.003]	-0.0971[a]	0.0266[0.003]	-0.1398[a]	0.0306[0.003]
$RD^-t\text{-}1$	-0.0859[b]	0.0499[0.013]	-0.1002	0.0531[0.101]	-0.0758	0.0485[0.162]	0.0129	0.0378[0.739]	-0.0977	0.0526[0.101]
$RD^-t\text{-}2$	0.1927[a]	0.0475[0.005]	0.1951[a]	0.0485[0.005]	0.1973[a]	0.0483[0.005]	0.1202[b]	0.0387[0.010]	0.1962[a]	0.0486[0.005]
SR_t	0.0083[a]	0.0021[0.006]	0.0078[a]	0.0020[0.006]	0.0076[a]	0.0019[0.006]	-0.0027	0.0019[0.188]	0.0077[a]	0.0020[0.006]
SR_{t-1}	0.0065[b]	0.0026[0.040]	0.0074[b]	0.0028[0.034]	0.0064[b]	0.0025[0.038]	—	—	0.0073[b]	0.0028[0.033]
C	5.7853[a]	1.1155[0.001]	5.8899[a]	1.1155[0.001]	5.9584[a]	1.0991[0.001]	4.7452[a]	0.3156[0.000]	5.9221[a]	1.1079[0.001]
Panel B: Long-Run Estimates	**CE.**	**SE.**	**CE.**	**SE.**	**CE.**	**SE.**	**CE.**	**SE.**	**CE.**	SE.
$RGFI$	0.2644[a]	0.0116[0.000]	0.2716[a]	0.0096[0.000]	0.2726[a]	0.0092[0.000]	0.2972[a]	0.0102[0.000]	0.2729[a]	0.0093[0.000]
EL	0.8567[a]	0.1157[0.000]	0.8791[a]	0.1186[0.000]	0.8176[a]	0.1031[0.000]	0.5204[a]	0.0869[0.000]	0.8702[a]	0.1156[0.000]

Continuation Table 7

Panel A: Short-Run Estimates		Model-1 (2, 2, 2, 2, 0, 1, 2, 1)		Model-2 (2, 2, 2, 2, 0, 1, 2, 1)		Model-3 (2, 2, 2, 2, 0, 1, 2, 1)		Model-4 (1, 0, 2, 1, 2, 0, 2, 0)		Model-5 (2, 2, 2, 2, 0, 1, 2, 1)	
		CE.	SE.	CE.	SE.	CE.	SE.	CE.	SE.	CE.	SE.
EI		0.5001^{b}	0.1454[0.011]	0.4164^{b}	0.1547[0.031]	0.5262^{a}	0.1388[0.007]	0.9316^{a}	0.1900[0.000]	0.4255^{b}	0.1524[0.027]
NR		0.0248^{b}	0.0076[0.014]	0.0251^{b}	0.0075[0.013]	0.0236^{b}	0.0071[0.013]	0.0006	0.0053[0.906]	0.0246^{b}	0.0074[0.012]
RD^{+}		0.1072^{a}	0.0167[0.000]	0.1121^{a}	0.0173[0.000]	0.1032^{a}	0.0155[0.000]	0.0466^{b}	0.0168[0.018]	0.1110^{a}	0.0169[0.000]
RD^{-}		-0.0189	0.0292[0.536]	-0.0288	0.0292[0.355]	-0.0071	0.0278[0.805]	0.0334	0.0431[0.454]	-0.0259	0.0287[0.396]
SR		0.0096^{b}	0.0028[0.011]	0.0096^{b}	0.0027[0.010]	0.0091^{a}	0.0026[0.009]	-0.0025	0.0017[0.172]	0.0094^{a}	0.0026[0.009]
C		3.7928^{a}	0.2502[0.000]	3.7169^{a}	0.2626[0.000]	3.8492^{a}	0.2626[0.000]	4.4094^{a}	0.2213[0.000]	3.7315^{a}	0.2574[0.000]
ECM_{t-1}		-1.5253^{a}	0.1378[0.000]	-1.5846^{a}	0.1433[0.000]	-1.5479^{a}	0.1390[0.000]	-1.0761^{a}	0.0226[0.000]	-1.5870^{a}	0.1432[0.000]
W_{SR}	W_{LR}	12.75[0.002]	11.72[0.005]	12.70[0.002]	11.69[0.006]	13.16[0.001]	11.80[0.005]	16.80[0.001]	13.22[0.001]	12.82[0.002]	11.76[0.006]
Panel C: Bound Test and Diagnostic Statistics											
FPSS		6.35*		6.34*		6.43*		14.35*		6.37*	
Adjusted R^2	F	0.99	5061.09[0.000]	0.99	5020.49[0.000]	0.99	5172.29[0.000]	0.99	4149.85[0.000]	0.99	5055.92[0.000]
RR		1.557[0.170]		0.946[0.380]		1.519[0.179]		0.276[0.788]		0.972[0.369]	
ARCH	LM	0.133[0.718]	0.031[0.867]	0.722[0.404]	0.205[0.667]	0.433[0.516]	0.053[0.826]	0.058[0.812]	0.491[0.499]	0.809[0.377]	0.202[0.669]
JB	$CS(CS^2)$	0.639[0.726]	S(S)	0.838[0.658]	S(S)	0.850[0.653]	S(S)	6.37[0.041]	S(S)	0.848[0.654]	**S(S)**

Note: For information on terms, symbols and models in this table, see table 6. WSR refers to the Wald test of the additive short-run symmetry condition, while WLR refers to the Wald test of long-run symmetry.

TABLE 8
EXOGENEITY WALD TEST RESULTS

Exogeneity Wald Tests			
Null Hypotheses ($H_{0:}$ Weak Exogenous)		Chi-Sq. Stat.	Prob.
RGDP	FNSR	0.006	0.941
	FSSR	4.940	0.998
	RESR	0.001	0.971
	TRSR	0.514	0.473
	TOSR	6.020	0.993
FNSR	RGDP	1.638	0.201
FSSR		1.188	0.276
RESR		1.075	0.299
TRSR		3.508	0.861
TOSR		1.102	0.293

Note: The test results obtained when the optimal lag length was (1) with the information criteria of LR, FPE, AIC, SC, and HQ for all variables.