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The Role of Structural Reforms on the Price and Financial Stability: Evidence from a Multi-Country PSTR Model

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ABSTRACT

This paper investigates the effects of structural reforms on 84 developed and developing countries between 2002 and 2018 through the Panel Smooth Transition Regression model. In doing so, it attempts to determine if structural reforms have an impact on price stability in real sectors and on financial stability in financial sectors. This research shows that structural reforms have a significant impact on price and financial stability, despite the fact that the regimes are shaped by the value of the output gap threshold that varies between countries. Based on these results, structural reforms can help to improve price and financial stability to the extent that they can eliminate supply-demand imbalances, prevent systemic risks, and improve expectations by supporting new monetary policy strategies.

Keywords: Structural Reforms, Price Stability, Financial Stability, MONA-Database, Nonlinear Panel Data Analysis, PSTR.

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INTRODUCTION

Economic conjuncture after 2007-2008 global financial crisis reactivates the two different policy proposals to eliminate the problems arising from supply and demand structures and to converge to potential sustainable growth rates in developing and developed countries: structural reforms in real and financial sectors (Agnello et al., 2015; Swaroop, 2016) and monetary policy designs for financial and price stability (Fouejieu, 2017; Sethi and Acharya, 2020). Amidst the global financial crisis, developed and developing countries continued to increase their budget deficits and debt stock, which reduced fiscal policy flexibility and accelerated efforts to achieve potential sustainable growth rates with monetary policies (Vredin, 2015). Furthermore, the global financial crisis that occurred when the output and inflationary gap were relatively close to the equilibrium value also showed that there may be bubbles in financial asset prices, and that monetary policies in terms of price stability alone cannot eliminate financial risks (Borio, 2014). In developed and developing countries, these conditions restrain the effectiveness of monetary and fiscal policies in aligning with potential sustainable growth rates, resulting in the conclusion that traditional policy sets have been responsible for nearly all possible policies (CBRT, 2016). Since traditional policies have not been as effective as before, international organizations, including the International Monetary Fund (IMF), the Organization for Economic Co-operation and Development (OECD), and the World Bank (WB), have recommended stronger structural reforms (IMF, 2015; Ullrich, 2019) and new monetary policy designs (Vredin, 2015) in comparison to the pre-global financial crisis for developed and developing countries, in particular (Rieth and Wittich, 2020).

Structure reforms and new monetary policy designs can reduce the output and inflationary gap in developed and developing countries, thereby contributing to convergence to sustainable growth rates. By reducing market constraints and providing productivity (Anderson et al., 2014) as well as efficient resource allocation (Ostry et al., 2009), structural reforms reduce supply-side constraints and increase investments. Demand-side reforms, however, direct consumption, investment, and saving decisions with effective policies (Bouis et al., 2012; and reduce wage and price controls to strengthen

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markets against endogenous and exogenous shocks (Fischer and Stiglbauer, 2018). In this context, structural reforms reduce the output gap by boosting total factor productivity, which drives actual and potential supply growth (De Almeida and Balasundharam, 2018). Moreover, it can reduce the inflationary gap (De Haan and Parlevliet, 2018) by limiting the uncertainty caused by wage-price rigidities on the demand side (Van Riet, 2006). As part of new monetary policy designs, the balance value of the inflationary gap is ultimately considered by central banks when making monetary policy decisions. Micro and macroprudential measures are used to limit the adverse effects of financial risks on price stability (Sethi and Acharya, 2020; Özatay, 2012). New monetary policy designs thus limit the mismatch between exchange rates and capital flows that is determined by global risk appetite for financial sector assets through microprudential measures, and by supply-demand imbalance through macroprudential measures (Başçı and Kara, 2011). In fact, uncertainty in the market can facilitate the implementation of reforms that would not otherwise be implemented (Bonfiglioli et al., 2022). As a result, new monetary policy designs that promote price stability and financial stability help reduce the inflationary gap by limiting the negative effects of financial risks on the actual and targeted inflation outlook (Karanovic and Karanovic, 2015).

To address this issue, the main objective of this paper is to examine how structural reforms in the real sectors of goods-services-labour markets influence price stability, as well as the financial sectors of money and capital markets on financial stability. In this paper, the main argument is that structural reforms in real sectors support price stability. Financial sector reforms, on the other hand, contribute to financial stability by supporting new monetary policy designs, although these effects can differ based on regimes shaped by the output gap. This paper examines the potential impact of structural reforms on price stability and financial stability for the 84 countries[1] classified by the IMF-2020 country classification for 2002-2018 by using the Panel Smooth Transition Regression (*PSTR*) model, which is based on nonlinear panel data analysis and taking into account the cross-sectional dependency, as opposed to linear panel data analysis used in existing studies.

Having introduced the paper, Section 2 discusses structural reform indicators and a literature review. Section 3 presents the empirical analysis and econometric methodology. The findings of the paper are presented in Section 4. Lastly, Section 5 provides a general discussion, policy implications, and recommendations for future studies.

LITERATURE REVIEW: STRUCTURAL REFORM INDICATORS

There are several reform indicators calculated by international organizations[2], but they are proxy indicators that can be indirectly calculated. In some recent studies, examining the shortcomings of these indicators, reform indicators are used as indices based on the number of IMF-MONA reforms that have been successfully and directly implemented in the real and financial sectors (Kouamé and Tapsoba, 2019). In the IMF-MONA database, reform data are derived from comparable information about the objectives and results of Fund-supported regulations that support structural reforms in real and financial sectors in IMF members participating in the MONA programme[3].

The studies on the effects of structural reforms that became popular again after the 2008 financial crisis can be traced back to the 1990s, when the foreign debt structure and economic conditions deteriorated and reform programs gained prominence and wide currency both in developed and developing countries. During the 1990s,

[1] The MONA Database does not include major countries like the G7, so all countries were analyzed together regardless of their development levels in this paper as prices and financial stability are relatively similar.

[2] For example: Economic, Financial Sector, Capital Account, Current Account, Trade, Product Market and Agricultural Liberalization Indexes by IMF (2008); Employment Protection Legislation, Product Market Regulation, Energy, Transport and Communications Regulation Indexes by OECD; Internal and External Markets Liberalization Index, Privatization Index and Banking Reform Index, Labor Market Regulations Index by World Bank (1996); and Liberalization and Privatization Index and Banking and Credit Reform Indexes by EBRD (2010).

[3] The approval and investigating of structural reforms in the IMF-MONA database bases on various policy commitments agreed with the authorities of the countries in the MONA programme. These commitments are classified in four different categories as Prior Actions (PA), Quantitative Performance Criteria (QPC), Indicative Targets (IT) and Structural Benchmarks (*SB*). *SB* presents the reform measures, which are critically important for the countries to achieve their reform targets and generally nonmeasurable, during the investigating these reforms by IMF board. *SB*, which differ in real and financial sectors, are defined as structural reforms in countries included in the MONA program. Furthermore, it is assumed that the *SB* include reform proposals in the related sectors. *SB* in real sectors consist of reforms aimed at controlling wages and prices in the markets and eliminating problems such as restrictions of the entry and exit to goods-service-labour markets; regulating the public revenues and expenditures; managing the budget balance and external borrowing; liberalizing markets; increasing the transparency of economic statistics. However, *SB* in financial sectors comprise of reforms aimed at auditing the financial institutions; decreasing the regulation in the financial system; and regulating the international trade policies, foreign exchange, and capital systems (IMF-MONA, 2020).

most studies examined the interaction channels between structural reforms and micro and macroeconomic variables. In the 2000s, however, studies examining the effects of structural reforms on macroeconomic variables became more popular (IMF, 2015). Although there have been differing results regarding country, regional, sector, and firm structure, the type and sectors of reforms, and the empirical method, structural reforms are generally considered to be related to both micro and macroeconomic economic variables (IMF, 2015). In this context, empirical studies show that structural reforms increase firm employment and partial factor productivity on a micro level and economic growth and total factor productivity on a macro level.

The existing empirical studies on structural reforms since the 2000s employ two different methods to explore their effects on macroeconomic and microeconomic variables. First, Dynamic Stochastic General Equilibrium-DSGE models (Annicchiarico et al., 2013; Papageorgiou and Vourvachaki, 2017; Campagne and Poissonnier, 2018; Gomes, 2018; Grauwe and Ji, 2020) simulate the impact of structural reforms on micro and macroeconomic variables under certain assumptions through various scenarios. Second, Ordinary Least Squares-OLS (Aksoy, 2019; D'Costa et al., 2019; Ostry et al., 2009; Campos and Horváth, 2012; Bouis et al., 2012; Prati et al., 2013; Babecky and Havranek, 2014; Brancaccio et al., 2018; Égert and Gal, 2018), Generalized Method of Moments-GMM (D'Costa et al., 2019; Campos and Kinoshita, 2008; Barlow, 2010; Swiston and Barrot, 2011; Bouis et al., 2012; Christiansen et al., 2013; Babecky and Havranek, 2014; Norris et al., 2016), Dynamic Ordinary Least Squares-DOLS (Égert and Gal, 2018), Vector Auto-Regression-VAR (De Almeida and Balasundharam, 2018), and Logit/Probit (Cuervo-Cazurra and Dau, 2009) models in terms of linear panel data analysis empirically examine the long-term effects of structural reforms on micro and macroeconomic variables.

Micro-level empirical studies examine the effects of structural reforms on economic variables, including productivity, employment, and exports. The results of these studies indicate that structural reforms increase partial factor productivity in the region (Norris et al., 2016), sector (D'Costa et al., 2019), and firm (De Almeida and Balasundharam, 2018) while enhancing firm employment (De Almeida and Balasundharam, 2018) and firm export (Cuervo-Cazurra and Dau, 2009). Macro-level studies also examine how structural reforms affect economic indicators such as economic growth, total factor productivity, investment, employment, unemployment, inflation, and foreign direct investment. According to these studies, structural reforms generally contribute to economic growth (Ostry et al., 2009; Swiston and Barrot, 2011; Campos and Horváth, 2012; Bouis et al., 2012; Christiansen et al., 2013; Prati et al., 2013; Babecky and Havranek, 2014; Papageorgiou and Vourvachaki, 2017; Campagne and Poissonnier, 2018; Aksoy, 2019), total factor productivity (Christiansen et al., 2013; Norris et al., 2016; Égert and Gal, 2018), domestic investments (Christiansen et al., 2013; Annicchiarico et al., 2013), foreign direct investments (Campos and Kinoshita, 2008), and employment (Bouis et al., 2012; Égert and Gal, 2018); decrease in the rate of inflation (Barlow, 2010; Gomes, 2018; Grauwe and Ji, 2020), and unemployment (Bouis et al., 2012), and enhance the functional distribution of income (Brancaccio et al., 2018).

Based on the literature review, there is only one study that estimates structural reform indicators based on the IMF-MONA database. According to Kouamé and Tapsoba (2019), the micro effects of structural reforms on partial factor productivity (labor productivity) in 37 developing countries are empirically analyzed using a nonlinear multilevel mixed-effect model. The results of this study indicate that structural reforms increase labour productivity. In this study, however, structural reform indicators of the real and financial sectors were examined at the macro level through a nonlinear panel data analysis methodology to examine price stability and financial stability, respectively, for 84 developed and developing countries using the PSTR model.

DATA AND METHODOLOGY

Dependent Variables

In this study, 84 developing and developing countries[4] are included out of 104 countries for the 2002-2018 period when data is available on the IMF-MONA database. The study has two dependent variables: price stability (*PRS*) and financial stability (*FNS*). *PRS* is generated by the inflation rate, while financial stability is generated by various variables[5] related to the financial markets. The stability of prices was calculated not only by

[4] Please see Appendix A for sampled countries. Some countries are excluded from the analysis because the data about structural reform in Chile, Equatorial Guinea, Mexico, Morocco, Poland, Serbia-Montenegro and Yugoslavia; tahe data about interest rate or macroeconomic variables related to financial stability in Afghanistan, Comoros, Congo (the Democratic Republic of), Djibouti, El Salvador, Ethiopia, Iraq, Kosovo, Liberia, Mauritania, Montenegro, Solomon Islands and Yemendo are not available.

[5] These variables such as bank credit to bank deposits (%); liquid assets to deposits and short term funding (%); bank capital to total assets (%); bank regulatory capital to risk-weighted assets (%) are generated as index through principal component analysis/min-max approach.

using inflation data, but also by using inflation's standard deviation. *PRS* represents the annual percentage change in Consumer Price Index-CPI (2010=100) that is obtained from the World Development Indicator 2020 (World Bank, 2020) database. For Argentina, Bosnia and Herzegovina, Mozambique, and Sierra Leone, which do not have CPI data, *PRS* is calculated based on the GDP Price Deflator Index (2010=100).

FNS symbolized as a financial stability index is generated as an index through Min-Max (MM) approach by collecting from the Global Financial Development Database 2020 (WB-GFDD, 2020) as an index variable. By using indicators[6] related to financial system stability, it has been determined the level of development of the financial system in terms of accessibility, depth, efficiency, and stability. MM approach is used to derive financial stability indices because it normalizes indicators of financial markets and distributes them in a particular order (Albulescu, 2010; Kondratovs, 2014; Arzamasov and Penikas, 2014; Karanovic and Karanovic, 2015). A MM approach, which enables the measurement of certain indicators of financial stability in the same unit and size, is based on the following equation (Nardo et al., 2005; OECD, 2008):

$$MM = \left(\frac{X_t - X_{Min}}{X_{Max} - X_{Min}}\right) \quad (1)$$

Equation 1 presents an indicator of financial stability with Minimum (X_Min) and Maximum values (X_Max) over time (t), while MM represents the financial stability index. Taking into account these explanations, the *FNS* variable is generated by the MM approach based on Equation 2. As part of the derivation of the *FNS* variable, the following indicators were collected from the GFDD database: 1-) Bank Z-Score; 2-) Bank Credit to Bank Deposits (%); 3-) Liquid Assets to Deposits and Short-Term Funding (%); 4-) Nonperforming loans to gross loans (%); 5-) Capital to Total Assets (%); 6-) Bank Regulatory Capital to Risk-Weighted Assets (%); 7-) Provisions to Nonperforming Loans (%); 8-) Stock Price Volatility.[7]

$$FNS_c = \left(\frac{FNS_{ct} - FNS_{Min,c}}{FNS_{Max,c} - FNS_{Min,c}}\right) \quad (2)$$

As shown by equation 2, (c) and (t) represent the country and year, respectively, and (FNS_{ct}) represents an indicator of financial stability (one of eight associated with financial system stability). In equation 2, terms ($FNS_{Min,c}$) and ($FNS_{Max,c}$) indicate the minimum and maximum values of an indicator of financial stability. As part of the model, (FNS_{ct}) also represents a financial stability index ranging from 0 to 1. As suggested in the GFDD database, the arithmetic averages of eight indicators of the stability of a country's financial system were analyzed separately in order to calculate variable (FNS_{ct}).

In summary, a preliminary analysis of data availability identified 33 countries (the first three indicators); four countries (the first four indicators); 24 countries (the first seven indicators); and 23 countries (the first eight indicators) that have continuous data for the period 2002-2018. The second stage involves separately calculating financial stability indicators as an index using Equation 2. *FNS* is generated as the arithmetic average of the financial stability indices for the sample for 2002-2018 in the third stage. *FNS* is indexed between 0 and 1, so if the variable approaches 1, financial stability has increased.

Threshold Variables

The threshold variable is the output gap defined as the difference between actual and potential production levels. As part of the new monetary policy designs, taking financial stability as well as price stability into consideration, it is important to examine the inflationary pressures arising from demand structure in order to follow up on output gaps and to keep output gaps at a level that will not result in an increase in the inflation rate. Therefore, it is aimed at determining the effects of structural reforms in the real and financial sectors on price and financial stability, respectively, in different regimes shaped by the value of the output gap threshold, through the *PSTR* model when the output gap is given.

In order to estimate the output gap, filtering techniques and a production function approach are used. The cyclical components of filter-based methods such as Hodrick-Prescott and Kalman, however, pose uncertainty problems; while production function-based approaches, which measure output gap according to labor, capital, and technology, are valid under different assumptions. Accordingly, the potential GDP growth rate for the entire sample is calculated by taking the actual GDP growth rate (Orphanides and Norden, 2002; Hamilton, 2017). Therefore, it is aimed to eliminate the effects of the problems of filtering techniques that arise from the overestimation or underestimation and the uncertainties

[6] For more details about indicators, please see (WB GFDD, 2020).

[7] For detailed information about the scope of the GFDD database and these indicators, see WB-Global Financial Development Database and GFDR (2020).

that may arise from the validity of the production function based on certain assumptions on the potential GDP growth rate; and to determine if the potential GDP growth rate is directly comparable to the actual GDP growth rate. Consequently, the *output gap*, symbolized as *OPG*, is determined by the real GDP change values with the 2010 base year collected from the WDI database. As a first step, the average values of the economic growth rate, which is expressed as a percentage change in real GDP, were calculated. Following that, the *OPG* variable is created by subtracting the average economic growth rate values from the annual economic growth rate values (taking the difference from the average).

Independent Variables

The study has four independent variables: *structural reforms in the real sector* (*RSR*) and *financial sector* (*FSR*), *money market interest rate*s (*MIR*) and *broad money supply* (*MS* - % of GDP). While *MIR* and *MS* are collected from IMF International Financial Statistics 2020 (IMF-IFS, 2020), structural reform data are derived from IMF-MONA. Accordingly, the *RSR* and *FSR* data are obtained from the IMF-MONA database by classifying according to their definitions and codes and generated as an index through the *ZS* approach using the data-related *SB* which are successfully implemented, implemented with delay, and modified structural benchmarks.

Based on the Centered-Reduced Normalization method, the *ZS* approach allows the classification of data in a particular order when numerical differences are high (OECD, 2008). Normalization of a specific variable (X) by the *ZS* approach, which is characterized by its average (μ) and standard deviation (σ), comprised of successful *SB* data in real and financial sectors from the IMF-MONA database, based on the following equations (Nardo et al., 2005; OECD, 2008):

$$ZS = \left(\frac{(X-\mu)}{\sigma}\right) \quad (3)$$

According to Equation 3, when the variable (X) is assumed to be composed of successful *SB* data, the value of the *ZS* index will have a normal distribution with a mean of 0 and a standard deviation of 1.

With this standardization, the real and financial sectors can be measured in the same units with similar sizes (average and standard deviation), so that the effects of structural reform can be statistically significant compared (Kouamé and Tapsoba, 2019). In keeping with these explanations, the *RSR* and *FSR* variables, which are calculated with successful *SB* data for the sample, are generated as indexes using the *ZS* approach, as seen in the following equation.

$$\text{Structural Reform Index}_{\text{ct}} = \left(\frac{(SB_{ct} - SB_{\mu t})}{SB_{\sigma t}}\right) \quad (4)$$

(SB_{ct}) presents the total number of successful *SB* of a particular country from the sampled (*c*) in the (*t*) year. The terms of ($SB_{\mu t}$) and ($SB_{\sigma t}$) indicate the average and standard deviation of the number of successful *SB*s in all sampled countries in a particular (*t*) year. If the number of successful *SB*s for the sample in a particular year is equal to the average number of *SBs*, the *Structural Reform Index* takes 0; otherwise, it takes a value different from 0 as how much it is above the average.

RSR and *FSR* variables are collected using Equation 4 in two different ways to verify the reliability and consistency of the indices. The first method involves calculating the real and financial structural reform indices as *RSR-1* and *FSR-1* by considering the approval date and initial end date during the test process of successful *SB* data. In the first stage of the first method, date ranges for the period of 2002-2018 are determined (usually three years, but sometimes two or one year), followed by categorizing the structural reforms within those dates into the real and financial sectors corresponding to those reforms. A second stage involves extending structural reforms in accordance with the approval and initial end dates. These are the first two stages of the first method, where numbers of real and financial reforms are calculated based on date ranges in the test. The third stage utilizes Equation 4 to calculate the structural reform indices (*RSR-1* and *FSR-1*) in the financial and real sectors. Using the method used by Kouamé and Tapsoba (2019), the calculation of structural reform indices in the real and financial sectors is based on the effects of structural reforms on the test process.

According to the second method, *RSR-2* and *FSR-2* are calculated as follows. In the first stage, test dates of structural reforms are determined, with the number of structural reforms categorized into real and financial reforms based on the years they were implemented. In the second stage, *RSR-2* and *FSR-2* for each sector are calculated separately through the *ZS* approach using Equation 4. In this way, it aims to calculate the structural reform indices for both real and financial sectors, based on the year-based effects of structural reforms.

Lastly, the variable of *MIR* includes the annual values of monetary policy-related for 28 countries, money market for 27 countries, lending for 22 countries, and discount interest rates for 7 countries.

Model and Methodology

The *PSTR* model is used in examining the nonlinear relationships between variables in panel data analysis (Gonzalez et al., 2005), while Panel Transition Regression (*PTR*) model is used in changing assumptions that modelling of the transition process between regimes (Hansen, 1999). The *PTR* model assumes that the variable defined as the threshold drives the transition between regimes, but the effects of the threshold variable on the dependent variable are based on the regime below and above the threshold. In other words, the coefficients of independent variables differ depending on what variable is used as a threshold. *PTR* models assume that while coefficients of independent variables change abruptly in transition between regimes, the regimes are acutely separated depending on threshold values (Hansen, 1999; Gonzalez et al., 2005). The *PSTR* model, however, allows the transition process of coefficients of independent variables by stating that these assumptions can be realized not abruptly, but over time (Gonzalez et al., 2005).

In this study, when the output gap is the threshold variable, the *PSTR* models, which are to be used to determine the effects of structural reforms in real sectors on price stability and structural reforms in financial sectors on financial stability, can be divided into two regimes as follows:

$$PRS_{it} = \mu_i + \beta_0 RSR_{it} + \beta_1 MIR_{it} * g(OGP_{it};\gamma,c) + \varepsilon_{it} \quad (5)$$

$$FNS_{it} = \mu_i + \beta_0 FSR_{it} + \beta_1 MIR_{it} * g(OGP_{it};\gamma,c) + \varepsilon_{it} \quad (6)$$

In Equations 5 and 6, (*i*) and (*t*) indicates the number of section units and time size of the panel, (ε) denotes the error term and (μ) represents the fixed effect coefficients of the units. Model 1 shows how structural reforms in the real sector affect price stability, whereas Model 2 shows how structural reforms in the financial sector affect financial stability. Due to the fact that structural reforms in the real and financial sectors are represented by variables calculated by two different methods as *RSR-1*, *RSR-2*, *FSR-1*, *and FSR-2*, the study estimates two different variations of Model 1 and Model 2, A and B.

In the equations, *OPG* represents the threshold variable, which is defined as the output gap in Models 1 and 2, (*c*) and (*y*) represent the parameters of the threshold variable and the slope parameter, respectively. Equations 5 and 6 also use the term of $g(OGP_{it};\gamma,c)$ as a transition function and define it as a logistic function as follows:

$$g(OGP_{it};\gamma,c) = \left[1 + exp\left(-\gamma \prod_{j=1}^{m}(OGP_{it} - c)\right)\right]^{-1} \quad (7)$$

The term (*c*) indicates the parameter of the threshold variable between the two-regime corresponding to the regimes of $g(OGP_{it};\gamma,c)$=0 and $g(OGP_{it};\gamma,c)$=1 . The slope parameter in the form of (*y*), with ($\gamma>0$) in the equation, indicates the level of the change in the values of the transition function in the logistic form, and the transition between regimes. The transition function $g(OGP_{it};\gamma,c)$ between regimes changes abruptly when the slope parameter approaches infinity ($\gamma \to \infty$) in the equation, and the threshold variable parameter transition (*c*) between regimes occurs instantly when the slope parameter approaches infinity. If this is the case, equations *5* and *6* should be estimated using the *PTR* model. In the case of approaching of the slope parameter to zero ($\gamma \to 0$), the transition function becomes equal to a constant, and when the equation is $g(OGP_{it};\gamma,c)$, transition function transforms into a form containing the effects of the horizontal section units in the panel by reducing to a linear function. This requires estimating equations *5* and 6 using the *PSTR* model, which gives a cross-sectional view of the panel (Gonzalez et al., 2005; Fouquau et al., 2008).

Equations *5* and *6* depend on the parameters of the transition function defined in Equation 7. In the regression, if the transition function takes the values ($g(OGP_{it};\gamma,c) = 0$) and ($g(OGP_{it};\gamma,c) = 1$), then the independent variables take the values (β_0) and $\beta_0 + \beta_1$, respectively. However, if transition function takes the values between ($0 < g(OGP_{it};\gamma,c) < 1$, the parameters of the independent variables in the regression take the values created from the weighted averages of (β_0) and (β_1). Therefore, the *PSTR* model is better for determining whether independent variables have a positive impact on dependent variables (Fouquau et al. 2008). Additionally, if equations 5 and 6 define two regimes, they can be expanded to multi-regimes. In this case, the *PSTR* model with multi-regime can be generated by expanding the equations according to the other regime numbers.

Three successive stages are involved in the estimation of *PSTR* models. In the first stage, a simple Taylor expansion is applied to the transition function (replacing ($g(OPG_{it};\gamma,c)$ with ($\gamma = 0$)) in equations

5 and 6 to investigate the linearity of the models under the null hypotheses of linearity in the form of $\gamma = 0$ or $\beta_0 = \beta_1$. These hypotheses are investigated by Lagrange Multipliers (LM), LM Fisher Tests (LMF), and Likelihood Ratio Tests (LRT), all of which are based on standard F-type nonlinearity tests statistics. There are different assumptions used when calculating residuals and degrees of freedom for the model and determining whether the transition function is nonlinear (Colletaz and Hurlin, 2006). The rejection of the null hypothesis of linearity indicates that regime change (r) (threshold effect) is important in models, and this rejection requires the use of the *PSTR* model. Having determined that the models are not linear, the second stage involves determining the number of regime changes (r) in the models. This stage tests the null hypothesis of $r = r^* = 1$ (the model consists of one regime) against the alternative hypothesis of $r = r^* + 1$ (the model consists of two regimes). This process is repeated until the null hypothesis is accepted. In the third stage, the fixed effects of the section unit in the panel are subtracted from the time average, and the transformed equations are estimated using the nonlinear OLS method (Fouquau et al., 2008; Duarte et al., 2013).

EMPIRICAL FINDINGS

A description of the variables used in the models is provided in Table 1 when the output gap is the threshold variable.

After descriptive statistics, firstly, the cross-sectional dependency (CD) of variables among countries in the panel in terms of model and model variables is analyzed by using Lagrange Multiplier (LM) tests developed by Pesaran (2004) by taking into account the time (t) and unit (n) dimensions. In addition to affecting the consistency of estimation results, CD tests can have a significant impact on the selection of unit root tests (Menyah et al., 2014). Additionally, CD in models/model variables is also analyzed by the LM and CD-LMadj tests developed by Pesaran et al. (2008) that can adjust the deviations in the LM test by adding the mean and variance of the panel units (Pesaran, 2004; Pesaran et al., 2008). Table 2 shows the LM test results for the models and model variables. As seen in Table 2, the probability values of LM and LMadj test statistics calculated in the form of Constant + Trend (CT) for the models and model variables are less than 0.01 and it is therefore rejected at a significance level of 1% that "there is no CD in the model and model variables." This suggests that the CD between panel units should be taken into account when using analysis methodology (Baltagi 2008).

Using the CD between panel units, unit root tests are performed after determining the CD in order to analyze whether or not the model is stationary. For panel data analysis to avoid spurious regressions, the variables need to be stationary and not contain unit roots (Tatoğlu, 2013). Therefore, the stationarity of the variables is tested by Cross-Sectional Augmented Dickey-Fuller (CADF) (Pesaran, 2007), and panel unit root test (UO) (Ucar and Omay, 2009). CADF and UO tests show that all variables are stationary at [I(0)] with 1% or 5% significance levels, as shown in Table 3. In this case, the CIPS test statistics in the form of CT are greater than the absolute value at 0.01 or 0.05 significance levels and the hypothesis that "the variables have unit roots" has been rejected. Similarly, the UO test statistics in the form of Demeaned and Detrended (DD) for model variables are less than 0.05 of the probability values and the hypothesis that "variables follow the linear unit root process" has been rejected.

Table 1: Descriptive Statistics (2002-2018)

Statistics	Mean	Median	Maximum	Minimum	Std. Dev.	Skew-ness	Kurto-sis
PRS	2.400	-0.539	81.00	-20.61	6.483	4.067	39.88
FNS	3.621	-0.085	296.78	-87.76	30.428	2.359	15.94
OPG	6.900	0.180	111.15	-72.96	5.850	1.934	129.11
MIR	0.337	-1.173	511.11	-1391.09	57.853	-7.814	248.62
RSR-1	-0.000	-0.517	6.070	-0.851	0.976	1.976	7.992
RSR-2	0.003	-0.462	8.603	-0.790	0.996	2.430	11.65
FSR-1	0.048	-0.466	9.871	-0.733	1.086	2.996	17.19
FSR-2	0.025	-0.460	7.251	-0.580	1.014	2.565	10.59
Obs	1428	1428	1428	1428	1428	1428	1428

Note: In the Table, Std. Dev. is the abbreviation of the standard deviations of the variables and Obs. indicates the number of observations on the panel.

Table 2: CD-LM Test Results

Test Statistics (CT)							
Variables	**CD-LM**	**$CD\text{-}LM_{adj}$**	**L**	**Models**	**CD-LM**	**$CD\text{-}LM_{adj}$**	**L**
PRS	69.56[a][0.000]	249.63[a][0.000]	3	——	——	——	—
FNS	15.48[a][0.000]	252.31[a][0.000]	3	——	——	——	—
OPG	31.65[a][0.000]	359.32[a][0.000]	2	——	——	——	—
MIR	23.63[0.000]	14.07[a][0.000]	1	——	——	——	—
RSR-1	17.15[a][0.000]	476.01[a][0.000]	1	Model 1A	46.72[a][0.000]	43.76[a][0.000]	2
RSR-2	9.76[a][0.000]	476.01[a][0.000]	1	Model 1B	47.02[a][0.000]	47.97[a][0.000]	2
FSR-1	16.15[a][0.000]	476.01[a][0.000]	1	Model 2A	4.87[a][0.000]	6.57[a][0.000]	2
FSR-2	12.10[a][0.000]	476.01[a][0.000]	1	Model 2B	4.87[a][0.000]	6.82[a][0.000]	2

Note: The "[a]" sign indicates that there is a CD in the variable/model at 1% significance level. The "L" column presents the optimal lag lengths determined with the Schwarz information criterion. The values in the square brackets "[]" show the probabilities of the test statistics.

Table 3: CADF and UO Panel Unit Root Test Results

Test Statistics			**CT**		**DD**	
			CIPS		**UO**	
Variables			**Level**	**L**	**Level**	**L**
PRS			-2.65[b]	3	-2.36[b][0.010]	2
FNS			-2.67[b]	3	-1.91[b][0.049]	2
OPG			-2.64[b]	2	-2.34[b][0.030]	2
MIR			-2.69[b]	1	-2.24[b][0.010]	2
RSR-1			-2.85[a]	1	-2.68[b][0.049]	2
RSR-2			-3.02[a]	1	-2.55[b][0.010]	2
FSR-1			-2.92[a]	1	-2.14[b][0.043]	2
FSR-2			-2.67[b]	1	-2.34[b][0.040]	2
Critical Values	% 1	% 5	-2.74	-2.60		

Note: The "a" and "b" signs indicate that the variables are stationary at 1% and 5% significance level, respectively. CIPS Critical Table Values indicate the values taken from Pesaran (2007) studies, according to T and N conditions. For the "L" column and the square "[]" brackets, see Table 2.

Table 4: Tests for the Linearity

Threshold Variables (OPG)	**Model -1**		**Model-2**	
H_0:r=0 H:r=1	**Model 1A**	**Model 1B**	**Model 2A**	**Model 2B**
LM	7.670[b][0.022]	7.682[b][0.021]	5.062[b][0.040]	6.171[b][0.046]
LMF	3.623[b][0.027]	3.629[b][0.027]	2.987[b][0.042]	2.992[b][0.045]
LRT	7.690[b][0.021]	7.703[b][0.021]	5.071[b][0.039]	6.184[b][0.045]

Note: H_0 and H_1 hypotheses are calculated under the assumption that the LM and LRT and LMF test statistics show an asymptotic distribution of $X^2\ (mK)$ and F(mK,TN * N - m(K+1)) respectively. The symbol "r" indicates the number of transition functions in the models, the sign "[b]" indicates the significance level of 5% and the values in the square brackets "[]" indicate the test statistics probabilities.

Table 5: Tests for the Remaining Non-Linearity of The PSTR Models

Threshold Variables (*OPG*)	Model-1		Model-2	
H_0:r=1 H_1:r=2	**Model 1A**	**Model 1B**	**Model 2A**	**Model 2B**
LM	0.523[0.770]	0.309[0.857]	0.523[0.770]	0.595[0.743]
LMF	0.245[0.783]	0.145[0.865]	0.245[0.783]	0.279[0.757]
LRT	0.523[0.770]	0.309[0.857]	0.523[0.770]	0.595[0.743]

Note: For the symbols and abbreviations in the table, see Table 4.

Table 6: Estimated Results of The PSTR Model

	Model 1				Model 2			
Threshold Variables (*OPG*)	**Model 1A**		**Model 1B**		**Model 2A**		**Model 2B**	
	Parameters		**Parameters**		**Parameters**		**Parameters**	
	Regimes		Regimes		Regimes		Regimes	
Variables	r=1	r=2	r=1	r=2	r=1	r=2	r=1	r=2
RSR-1	2.084^{b} [0.989]	-1.872^{b} [0.885]	—	—	—	—	—	—
RSR-2	—	—	2.534^{a} [1.110]	-2.417^{b} [1.111]	—	—	—	—
FSR-1	—	—	—	—	5.521^{b} [2.499]	-5.617^{b} [2.617]	—	—
FSR-2	—	—	—	—	—	—	6.751^{a} [2.319]	-7.169^{a} [2.528]
MIR	0.063^{a} [0.024]	-0.051^{b} [0.024]	0.055^{a} [0.022]	-0.053^{b} [0.023]	-0.202^{a} [0.081]	0.214^{a} [0.081]	-0.223^{b} [0.098]	0.234^{a} [0.098]
LP ()	-5.222		-5.111		-8.133		-8.113	
SP ()	3.079		3.244		1.629		2.504	
AIC	3.71		3.71		6.79		6.79	
BIC	3.74		3.73		6.81		6.82	
RSS	58023.084		57945.725		1255435.753		1255593.588	

Note: Values in square brackets "[]" show the standard errors of the coefficients, the signs "a" and "b" indicate that the coefficients are significant at 1% and 5% significance level, respectively. The abbreviations *AIC*, *BIC* and *RSS* indicate Akaike Information Criterion, Bayes Information Criterion and Error Squares Total calculated for the models, respectively.

The three successive steps of the *PSTR* model estimation process begin with determining the stationarity of variables. The first step is to determine whether the regime change in the models is significant by analyzing the linearity of the *PSTR* by LM, LMF, and LRT tests as seen in Table 4. The probability values of the LM, LMF, and LRT test statistics are less than 0.05, and the linear hypotheses have been rejected at a 5% level of significance. The results indicate that *PSTR* models contain at least one nonlinear regime change (threshold effect), which is accepted with alternative hypothesis. A linear model cannot be used to estimate the effects of real and financial structural reforms on price and financial stability.

In the second stage, the number of regime changes (threshold number) in the models is determined through LM, LMF, and LRT tests. Based on table 5, the null hypothesis that "the model contains a threshold effect" cannot be rejected at the 1% significance level when the probability values of the LM, LMF, and LRT test statistics are greater than 0.05. This indicates that the *PSTR* model contains a threshold and should be estimated as a two-regime model. In the third stage, when the output gap is the threshold variable, the results of the *PSTR* models are estimated for the entire sampled countries, as presented in Table 6.

When the *PSTR* findings in Table 6 are examined in terms of the slope parameters (*SP*) in Model 1 and Model

2, the *SP* is relatively close to zero for Model 1A (3.079), Model 1B (3.244), Model 2A (1.629), and Model 2B (2.504). *PSTR* is a consistent estimator for all models because the transition process between regimes is gradual and regimes are separated smoothly from one another.

As a threshold variable in Model 1 and Model 2, when the *PSTR* findings in Table 6 are analyzed in terms of the output gap and its *transition parameters* (*LP*), it can be seen that the *LP*s for Model 1A (-5.222) and Model 1B (-5.111) and Model 2A (-8.133) and Model 2B (-8.113) are similar in size. These findings require the analysis of the effect of structural reforms in real sectors (*RSR-1* and *RSR-2*) on the *PRS* and structural reforms in financial sectors (*FSR-1* and *FSR-2*) on FNS under two different regimes that are below and above these thresholds.

In this context, when the *PSTR* findings in Table 6 are analyzed in terms of Model 1, it is shown that *RSR-1* (2.084), *RSR-2* (2.534), and *MIR* (0.063 and 0.055) are positive and statistically significant when the output gap is below the threshold value of (-5%) in the first regime (r = 1). The results indicate that a one-unit increase in structural reforms in real sectors and money market interest rates leads to an increase in the price stability variable from 2.084 to 2.534 and (0.055 to 0.063) in the first regime, where the negative output gap increased. The findings show that structural reforms in the real sector and an increase in money market interest rates at the same time adversely affect price stability during economic recessions because they increase deviations in inflation.

Alternatively, when the *PSTR* findings in Table 6 are analyzed in light of Model 1, it becomes apparent that *RSR-1*s (-1.872), *RSR-2*s (-2.417), and *MIR*s (-0.051 and -0.053) are statistically significant and negative in the first regime (r = 2) when the output gap exceeds the threshold value. According to these results, a one-unit increase in structural reforms in real sectors and money market interest rates decreases the price stability variable by (-1.872 to -2.417) and (-0.051 to -0.053), respectively, in the second regime, where the negative output gap decreased. The findings show that structural reforms in real sectors and an increase in the simultaneous interest rate in the money markets positively affect price stability during economic expansion periods by decreasing the deviations in the inflation rate when financial and structural reforms are implemented.

According to *PSTR*, in terms of model 2 in table 6, the variables *FSR-1* (5.521), *FSR-2* (6.751), and *MIR* (-0.202 and -0.223) are statistically significant at r=1, where the output gap is below (-8%) threshold. According to these results, an increase of one unit in structural reforms and money market interest rates in the first regime, where the output gap widens, leads to an increase in financial stability variables (5.521 to 6.751) and a decrease in financial stability variables (-0.223 and -0.202). It has been shown that real structural reforms in the financial sectors support financial stability but that increases in simultaneous interest rates on money markets increase financial fragility when real structural reforms are given.

Alternatively, Table 6 presents that the *FSR-1* (-5.617), *FSR-2* (-7.169), and *MIR* (0.214 and 0.234) variables are statistically significant at r=2, where the output gap is above the threshold value of (-8%). These findings indicate that when structural reforms in financial sectors are increased by one unit and money market interest rates are increased in the second regime, where the negative output gap decreases, the financial stability variables decrease between (-5.617 to -7.169) and increase (0.214 to 0.234). In real structural reforms, the findings show that while structural reforms in financial sectors increase financial fragility, an increase in the simultaneous interest rate in the money markets supports financial stability.8

RESULT AND DISCUSSION

This study examined the effects of structural reforms on price and financial stability by analyzing how structural reforms and new monetary policy designs reduced the output gap and inflationary gap after the global financial crisis of 2007-2008 in developed and developing countries. Based on *PSTR* models, it has been determined that the output gap contains a negative threshold value (-5%); structural reforms in real sectors and money market interest rates influence price stability in two different regimes that are below and above this threshold value. In the first regime, it has been determined that the variables of structural reform and money market interest rates in real sectors have a negative impact on the price stability variable during the economic recession. When a negative

[8] With the new monetary policy designs, developed and emerging central banks can direct the relationship between price stability and financial stability through the money supply channel as well as the interest channel. Considering this situation, the models in which *MIR* is used as the control variable in Equations 5 and 6 in the study were reanalyzed using *MS* variable as the control variable and the *PSTR* model methodology, where consistency (robustness) was determined in the Appendix B. The findings show that the effects of real sector structural reforms on price stability and financial sector structural reforms on financial stability are similar compared to regimes in case the money supply is variable in control as presented in Appendix B. In this regard, the model(s) estimated in the study are consistent with the findings and show structural reforms have a significant impact on price and financial stability when the interest rate or money supply is used as monetary policy instruments.

output gap is given and structural reforms are given, these findings indicate that the structural reform regulations in real sectors, which are implemented concurrently with the economic recession, and the increases in interest rates in the money market result in a greater contraction in total supply than total demand and deterioration of expectations in contrast to general expectations. Due to this process, inflationary pressures can be created on general prices through increased costs and deteriorating expectations, and inflationary pressures can surpass deflationary pressures. Accordingly, this result indicates that structural reform regulations in real sectors and rising money market interest rates during the recession cause price instability by increasing inflation deviations (Borio, 2014).

When negative output gaps are given and structural reforms in financial sectors are given, these findings indicate that structural reform regulations in real sectors, implemented simultaneously with the economic recession, and increased interest rates in the money market, can balance the demand-side inflationary pressures and improve expectations, as similar results with Barlow (2010), Gomes (2018), and Grauwe and Ji (2020) have shown. The result shows that structural reforms in the real sector and increases in interest rates in the money market are able to compensate for inflationary pressures caused by increasing demand and better expectations. Hence, structural reform regulations in real sectors and contractionary monetary policy support price stability by reducing inflation deviations.

The output gap has been determined to create a negative threshold value (-8%) in *PSTR* models that analyze the effects of structural reforms in financial sectors on financial stability. In the two different regimes occurring below and above this threshold, structural reforms in the financial sectors and money market interest rates affect financial stability. In the first-regime, where the negative output gap is below the threshold value of (-8%), structural reform in the financial sector and money market interest rate have a positive and negative effect on price stability, respectively. Based on these findings, structural reforms in the financial sector can reduce systemic financial risks (Sethi and Acharya, 2020; Özatay, 2012) if they are implemented simultaneously with an economic recession. When there is a negative output gap and structural reforms are implemented in real sectors, the money market interest rate may increase as well. Thus, structural reform regulations in the financial sector contribute to financial stability if they can be managed as signals that uncontrolled systemic risks will not be allowed. Furthermore, contractionary monetary policies restrict access to finance, resulting in cash flow difficulties and deterioration in balance sheets during economic recessions by increasing the marginal cost of money. In response to the deterioration in the financial sector, market actors perceive uncertainty and trust to be increasing, which results in financial risk. As a result, a rise in money market interest rates can increase financial vulnerability, resulting in financial instability.

On the other hand, in the second-regime, where the negative output gap is above the threshold value of (-8%) in *PSTR* models, it has been found that the variables of structural reform in the financial sectors and money market interest rate have a negative and positive effect on the financial stability variable, respectively. Based on these findings, structural reform regulations are unable to compensate for systemic financial risks that may occur during economic expansions if they are not implemented in the financial sector simultaneously with the economic expansion in a way that is appropriate for scope, communication, time, and credibility; a contractionary monetary policy promotes financial stability. This result can be evaluated as structural reform regulations in financial sectors, along with increases in the policy interest rate implemented simultaneously with the economic expansion, can contribute to financial stability to the extent that they can prevent systemic financial risk and reduce financial vulnerabilities (Karanovic and Karanovic, 2015).

Based on the results of all *PSTR* models, the structural reforms in the real and financial sectors have significant effects on price stability and financial stability for the sample countries between 2002 and 2018. These effects can, however, be altered by regimes shaped by the output gap. According to the results, structural reforms in real sectors contribute to price stability only during times of economic expansion, while structural reforms in financial sectors contribute to financial stability only during times of economic recession. Accordingly, structural reforms in the real and financial sectors need to be implemented at the right time. These reforms can also contribute to improving price and financial stability to the extent that they eliminate supply-demand imbalances, prevent systemic risks, and positively affect a deterioration in expectations by enabling new monetary policy designs. Results such as these can also be observed in Sethi and Acharya (2020), Özatay (2012), Karanovic and Karanovic (2015), and Başçı and Kara (2011).

A policymaker in sampled countries should apply the structural reforms that aim to regulate the goods-services-labour and money-capital markets by considering the equilibrium conditions during the economic recession and expansion in order to provide price and financial stability when the output gap is given. Therefore, policymakers should be informed to apply structural reforms in a way that these reforms can eliminate supply-demand imbalances, prevent systemic risks, and positively affect a deterioration in expectations with the right timing and scope in order to provide price and financial stability at the level of the output gap is given. As for the limitations, this paper contains data from 84 countries, each with a different level of development, institutional structure, and macroeconomic structure. Due to this, the results of this paper show heterogeneous countries. In future studies, homogeneity will be considered regarding the level of development, the institutional, and legal structure of sampled countries.

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Appendix A: Sampled Countries

Albania	Bulgaria	Cyprus	Guinea	Lesotho	North Macedonia (Republic of)	Sri Lanka
Angola	Burkina Faso	Dominica	Guinea-Bissau	Madagascar	Pakistan	St. Kitts and Nevis
Antigua and Barbuda	Burundi	Dominican Republic	Haiti	Malawi	Paraguay	Suriname
Argentina	Cameroon	Ecuador	Honduras	Maldives	Peru	Tajikistan
Armenia	Cape Verde	Egypt	Hungary	Mali	Portugal	Tanzania
Bangladesh	Central African Republic	Gabon	Iceland	Moldova	Romania	Togo
Barbados	Chad	Gambia	Ireland	Mongolia	Rwanda	Tunisia
Belarus	Colombia	Georgia	Jamaica	Mozambique	Sao Tome and Principe	Turkey
Benin	Congo (Republic of)	Ghana	Jordan	Nepal	Senegal	Uganda
Bolivia	Costa Rica	Greece	Kenya	Nicaragua	Serbia	Ukraine
Bosnia and Herzegovina	Cote D'Ivoire	Grenada	Kyrgyz Republic	Niger	Seychelles	Uruguay
Brazil	Croatia	Guatemala	Latvia	Nigeria	Sierra Leone	Zambia

Appendix B: Estimated Results of The PSTR Model

	Model 3				**Model 4**			
Threshold Variables (*OPG*)	**Model 3A**		**Model 3B**		**Model 4A**		Model 4B	
	Parameters		Parameters		Parameters		Parameters	
	Regimes		Regimes		Regimes		Regimes	
Variables								
RSR-1	0.438[b] [0.201]	-0.549[b] [0.270]	—	—	—	—	—	—
RSR-2	—	—	6.137[a] [2.405]	-5.948[a] [2.396]	—	—	—	—
FSR-1	—	—	—	—	1.093[b] [0.542]	-2.721[b] [1.337]	—	—
FSR-2	—	—	—	—	—	—	0.416[b] [0.204]	-3.524[b] [2.075]
MS	-0.085[a] [0.022]	-0.213 [0.151]	-0.123[b] [0.061]	0.017 [0.114]	-0.276[a] [0.075]	0.637[a] [0.239]	-0.273[a] [0.075]	0.618[a] [0.236]
LP ()	4.368		-8.344		2.959		2.960	
SP ()	2.114		20.541		8.701		8.546	
AIC	3.70		3.70		6.78		6.78	
BIC	3.73		3.72		6.81		6.81	
RSS	5.7492.000		57342.407		1250306.383		1255593.588	

Note: For the symbols and abbreviations in the table, please see Table 6.