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## Article

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## ACCOUNTING, CORPORATE GOVERNANCE & BUSINESS ETHICS | RESEARCH ARTICLE

# Measuring real exchange rate misalignment: an industry-level analysis of Pakistan using ARDL approach

Aqsa Shaukat<sup>1\*</sup>, Eatnaz Ahmad<sup>1</sup> and Waseem Shahid Malik<sup>2</sup>

**Abstract:** Having an exchange rate close to its equilibrium is critical for foreign investors and policymakers during times of macroeconomic instability. This study measures the real exchange rate (RER) misalignment in eight Pakistani manufacturing industries from January 2002 to June 2020. The ARDL approach is used to examine the long-run relationship between the RER and its fundamentals in each industry. The findings show that government spending and interest rates significantly explain RER at the aggregate and industrial levels. Furthermore, the misalignment of RER varies significantly across industries. Some industries have highly misaligned RER, while others have close to zero misalignments. These findings can assist us in making fiscal policy and competitive devaluation decisions to improve the trade deficit.

**Subjects:** Economic Theory & Philosophy; Macroeconomics; Microeconomics; Industrial Economics; Econometrics; Economic Forecasting; Development Economics

**Keywords:** Real exchange rate misalignment; industries; ARDL; Pakistan

### 1. Introduction

The country's real exchange rate (RER) may not be misaligned at the aggregate level but at disaggregate levels. Prior research measured it at the aggregate level (Demir & Razmi, 2022; Nouira et al., 2011; Zhang & Zhang, 2001). In fact, when the producers of a particular industry perceive the aggregate exchange rate to be misaligned but are unaware of the misalignment of that industry, their investment decision is hampered (Nouira et al., 2011). Measuring misalignment at the Industry-Level is a novel concept in this area.

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The misaligned exchange rate, whether undervaluation or overvaluation, varies by industry (Aftab et al., 2017; Mohsen & Brooks, 1999). When the RER becomes overvalued, it has an immediate impact on the external competitiveness of export-producing industries, making it difficult to sell products in the international market, mainly when an industry is a price taker, as is typically the case in developing countries such as Pakistan. As a result, the survival of these industries is at significant risk due to a decline in profit margins.

However, the evidence on the undervaluation is ambiguous. According to the Mundell Fleming model, depreciation of the domestic currency stimulates output by shifting expenditures from imported to domestic goods by raising their relative prices (Mundell, 2001). This is true at the aggregate level because the evidence is drawn from aggregate studies that do not explain how undervaluation affects a specific industry (Mohsen & Brooks, 1999). However, when we look at its impact at the Industry-Level, we see that it varies by industry. It is determined by the characteristics of the industry, such as whether it is capital or labour intensive, the degree of labour and capital substitution, and the use of imported raw materials. Suppose there is a high degree of substitution; in this case, industries will be more labour intensive, lowering the cost of producing goods. Scholars, Masunda (2010), Shokry et al. (2018), and Fauceglia et al. (2014) argued that by disaggregating the economy into sectors, undervaluation promotes growth only in the short-run. In the long-run, however, it harms all sectors, including manufacturing and agriculture; regardless of the switching effect or the sectors with higher exports, the effect is negative for all sectors.

The manufacturing sector plays an important role in all sectors and provides significant benefits for growth (David et al., 2010; Mlambo, 2020; Ududechinyere et al., 2018). Pakistan's manufacturing sector is the third largest, accounting for approximately 14% of GDP and 16.1% of total labour force employment. Its output has decreased from 20% in 2001 to 12.79% in 2020 (Pakistan Bureau of Statistics). Many factors may be responsible for this decline, but the misaligned exchange rate is the most significant (Abbas et al., 2015; Hamid & Mir, 2017). Its economy relies heavily on foreign markets for raw materials and oil imports.

In the context of Pakistan, a competitive or equilibrium exchange rate has received little attention; instead, it appears to be an ignored central bank objective. Many studies find that an exchange rate close to the equilibrium becomes an essential condition for a country when its imports and exports industries are already facing higher costs of production, and devaluation is considered not to improve the performance of these industries (Javed et al., 2016). Bhatti et al. (2018a, 2018b) measured REER misalignment and found the Pak rupee was undervalued by 17 % in 1980 and overvalued by 24% from 1991 to 1985. After that, it remained undervalued. Similarly measured misalignment for Pakistan and the results indicate that government spending, trade openness, and capital formation have a substantial role in estimating equilibrium RER. However, these studies measured misalignment at the aggregate level.

Pakistan followed the fixed exchange rate policy, known as the Bretton Woods system, at the time of independence. Pakistan pegged its currency parity at 3.32 rupees against one US dollar in 1948, changed it to 4.78 in 1955, then to 11.04 in 1972, and finally to 9.9 in 1973, which stayed till 1982. Pakistan followed the floating exchange rate policy in 1999, allowing its currency to adjust according to market conditions. Since then, the PKR continued to depreciate from 50.42 PKR per US \$ in 1999 to 221 nowadays 2022 (State Bank of Pakistan). A floating exchange rate gives an edge to an exchange rate's equilibrium level that can help restore the balance of payments imbalances automatically (Annicchiarico et al., 2011).

The literature on measuring misalignment at the industrial level is limited. Few studies have looked at the impact of misalignment on economic activity at the disaggregate level. They did, however, use aggregate measures of misalignment in their analysis. Masunda (2010) examined the RER misalignment and output of Nigeria's agriculture, manufacturing, and mining sectors. Undervaluation or overvaluation of the real exchange rate is harmful to sectoral output. Similarly,

Diop et al. (2018) examine the impact of real effective exchange rate misalignment on manufacturing sector output in Senegal. The findings show that the misaligned exchange rate destroys the sector's output. Cho et al. (2003) measured misalignment and saw its impact on the economy's manufacturing, chemicals, machinery, and agriculture exports. Misalignment is especially harmful to the agricultural sector's exports.

This study contributes in two ways. Firstly, to identify the appropriate measure of real exchange rate misalignment when disaggregating its relationship with macroeconomic variables. To the best of our knowledge, no study has yet measured misalignment at a disaggregate level in Pakistan. Secondly, to eliminate aggregation bias by focusing on disaggregated data.

Misaligned exchange rates discourage activity in one industry but encourage it in another. We must go into detail about the correct measure of misalignment as monetary and exchange rate policy is the same for all industries, but fiscal can be different. In such a case, it is necessary to determine the correct form of misalignment in each industry. Exploring misalignment at the industrial level may be very important in terms of fiscal policy. It would enable us to identify industries that could be harmed or benefit from under and overvaluation, regardless of whether contractionary or expansionary fiscal policy is used in those industries.

The structure of the study is as follows. Section 2 presents theoretical and empirical literature on estimating equilibrium RER; Section 3 contains the definition and calculation of industry-specific RER and empirical model. Finally, section 6 includes results and discussion.

## 2. Literature review

### **2.1. Theoretical framework for estimating equilibrium real exchange rate and review of the empirical literature**

Since Cassel (1918) opened the RER Pandora's box, many related concepts have emerged in the literature. It is not surprising that many equilibrium exchange rate determination theories lead to conflicting policy advice (Edwards, 1988). The precise approach to RER determination has become more important, given the role of misaligned RER in explaining different countries' uneven development performance (Demir & Razmi, 2022).

The theories that evolved in determining real exchange rates were PPP, UIP, Balassa Samuelson, Portfolio Balance, Fundamentals, and Behavioural equilibrium exchange rate models. Purchasing power parity (PPP) theory was first originated by Cassel (1918), which is based on inflation differentials with other countries and the law of one price. According to Cassel (1918), the real exchange rate remains constant with the nominal exchange rate, and prices converge in the long-run. The originators of PPP have considered the open economy an extension of the Quantity Theory of Money (Friedman, 1989). Until the late seventies, the government took measures to correct inflation differentials with other countries to get control of their exchange rate misalignments. The PPP theory argues that the exchange rate between two countries is equal to the ratio of their aggregate price levels but cannot be tested empirically (Bhatti et al., 2018b) because price indexes are not constructed for an internationally standardized basket of goods. Each country has a different weight for different commodities.

The PPP also provides the basis for other models, such as the interest parity model, which is later combined with portfolio balance and monetary models. Extensive research and understanding of other factors that affect exchange rates begin to be taken in the model. Finally, the behavioural equilibrium exchange rate (BEER) approach, which addresses the problems of PPP and includes the nominal and real economic factors, seems to be an appropriate approach for determining the equilibrium exchange rate. Estimating the BEER model depends on theoretical guidance for selecting relevant economic factors. In previous studies, Edwards (1988) found

**Table 1. Empirical literature on real exchange rate fundamentals**

<b>Authors</b>	<b>Countries</b>	<b>Fundamentals of exchange rate</b>	<b>Methods</b>
Edwards (1988)	12 countries (Colombia, Malaysia, Israel, etc.)	Trade Openness, Government Expenditures, Terms of trade, import tariff, domestic credit. And productivity differentials,	Panel data, Beveridge-Nelson method, fixed effect equation.
Béreau et al. (2012)	Advance and emerging economies	Terms of trade, FER, net foreign assets, productivity differentials.	Panel Smooth Transition Regression models.
Sekkat Sekkat & Varoudakis, (2000)	22 Sub-Saharan African countries.	Terms of trade, trade restrictions, capital inflow, nominal exchange rate, domestic credit and the time index.	Fixed effect model.
Couharde and Sallenave (2013)	Developed and emerging countries.	Relative productivity and openness to trade.	Panel smooth transition regression.
Cuestas et al. (2020)	Nine eastern and central European countries.	Balassa -Samuelson effect and interest rate differential.	Co-integration technique.
Komlakh et al. (2022)	OPEC member's countries.	Capital account openness, exchange rate flexibility, and trade openness.	Generalized method of moment (GMM) technique.
Mukaila and Arene (2022)	Nigeria	Trade openness, government expenditures, terms of trade, and capital inflow.	Co-integration technique.
Ebaidalla (2014)	Sudan	Taxes, trade openness, government expenditures, productivity, terms of trade, and foreign income.	ECM Co-integration technique.
Diop et al. (2018)	Senegal	Relative productivity, terms of trade, investment, govt expenditures, and productivity differentials.	ARDL co-integration approach.
Masunda (2010)	Zimbabwe	Capital inflows, trade openness, and government consumption.	Feasible generalized least square.
Zakaria (2010)	Pakistan	Terms of trade, govt expenditures, capital inflow, trade restrictions, foreign reserves, and domestic credit.	Co-integration technique.
Rizwanulhassan (2019)	Pakistan	Trade openness, terms of trade, foreign reserves, capital inflows and government expenditure.	VECM and ARDL models.
Fiaz et al. (2021)	Pakistan	Interest rate, net foreign assets, terms of trade, govt consumption, and govt investment.	Markov Regime Switching model
Wong (2013)	Malaysia	Interest rate differentials, Productivity Differentials, Oil prices, Reserves	Co-integration Approach

that misalignment occurs as a result of shocks from both countries. Following Edwards (1988), numerous studies on identifying such factors are presented in Table 1.

Once the factors are identified, the BEER model directly estimates the relationship between the real exchange rate and these factors. In this way, the BEER model takes advantage of new techniques, such as co-integration, which allows for an equilibrium relationship between the actual real exchange rate and its fundamentals. Achy (2001) examined the real effective exchange rate (REER) behaviour of five countries from 1985 to 1997: Morocco, Turkey, Egypt, Tunisia, and Algeria. He used co-integration to examine the long-run relationship between REER and its fundamentals. According to the findings, all five countries' REERs were overvalued. After 1987, it was significantly overvalued, owing to a budget deficit financed by printing money and poor trade terms (decline in oil sector revenue). Despite progress in the oil industry in 1997, it remained overvalued. Madouni (2014) used the behavioural equilibrium exchange rate approach to assess the degree of misalignment of the Algerian Dinar from 1971 to 2012. He reasoned that it was due to trade openness, relative productivity, and government spending. The results show that all of these factors appreciate RER except productivity differences, which are associated with a decline in the real value of the Algerian dinar.

Tipoy et al. (2018) studied the misalignment using the BEER approach and its impact on developing countries economic growth. Panel data spanning the years 1970 to 2014 were used. The study discovered that a small amount of misalignment increases output while a large amount decreases output. Ahmed (2021) investigated the Tunisian economy's equilibrium exchange rate and misalignment using the BEER approach. The error correlation method was used to cover the period 1990Q1 to 2020Q4, and the results show real exchange rate undervaluation and overvaluation episodes. Furthermore, trade and monetary policy shocks have a low impact on the real exchange rate. Tarawalie (2021) measured the level of misalignment in Sierra from 1980 to 2018. The BEER approach was used within the Johansen co-integration framework to estimate the equilibrium level of the real effective exchange rate. The findings show that the money supply and government spending significantly impact the real effective exchange rate in the long-run. Moreover, it experienced a significant deviation from its equilibrium level throughout the entire study period.

Building upon a BEER model, studies by previous scholars (Coudert et al., 2013; El-Shagi et al., 2016; Fidora et al., 2021; Frenkel & Mussa, 1985; Jeong et al., 2010) have taken into account all potential sources of misalignment, the Eurozone's real effective exchange rate misalignment was found to be less than that of its trading partners. Amaira (2021) investigated the Tunisian dinar misalignment from 1986 to 2015. He used co-integration to examine the long-run relationship between the real effective exchange rate and its fundamentals. According to the findings, the equilibrium level is determined by trade terms, productivity, and government spending. Two periods are observed: overvaluation from 2004 to 2015 and undervaluation before 2004. The difference between the actual and equilibrium real exchange rates is very small in Tunisia, which may be due to the flexibility of the exchange rate, which has reduced the exchange rate's imbalance.

A misaligned exchange rate is widely assumed to have serious economic consequences, and the Pakistani rupee is misaligned. In Pakistan, Chishti et al. (1993) investigated the use of PPP using data from 1957 to 1992. They discovered that the PPP approach is useless. Afridi (1995) examined the factors influencing the real effective exchange rate from 1960 to 1990. He discovered that trade terms have no effect on REER in Pakistan. On the other hand, capital inflows and demand for domestic credit boost it. Fiaz et al. (2021) looked into the main causes of real exchange rate misalignment. The time period covered was 1991 to 2020. The BEER approach was used to investigate misalignment behaviour. The findings show that foreign assets, trade terms, government investment, interest rate differentials, and government consumption significantly impact RER.

### 3. Data and methodology

#### 3.1. Measurement of real exchange rate misalignment

Misalignment in each industry is measured as the gap between the actual RER and its equilibrium counterpart.

$$MIS_{it} = RER_{it} - \widehat{RER}_{it}$$

From the estimated long-run coefficients, it is possible to calculate the difference between actual and observed RER by the formula given above. According to that, there may be three possibilities:

- (i) If Mis is positive, the RER is overvalued;
- (ii) If Mis is negative, the RER is negative;
- (iii) If Mis is zero, there will be no misalignment.

Further, the misalignment in percentage form can be calculated as follows;

$$MIS_{it} = (RER_{it} - \widehat{RER}_{it}) / \widehat{RER}_{it} * 100$$

#### 3.2. Real exchange rate measurement

The selection of the right real exchange rate measure is not an easy task. As we look for long-run equilibrium RER, one probe is to which RER measure is chosen and empirically implemented the measure. What macroeconomic variables can estimate long-run equilibrium levels and, ultimately, misalignment?

The right measure of RER depends on the economy's structure, its position in foreign markets, and its import and export structure (Demir & Razmi, 2022). However, the most widely used measure compares one country's price level to another. Suppose two countries produce tradable goods, imperfect substitutes, and infinite export price elasticity. Assuming also that producers of both countries set equal prices of their goods,  $p$  and  $p^*$ , in a domestic and foreign market, then the RER is measured as;

$$RER = eP^*/P$$

When analyzing exporters of primary commodities or doing empirical practice, the RER is measured as given (Lee & Chinn, 2006).

$$RER = eP_X/P_M$$

Where  $e$  represents the exchange rate,  $P_X$  and  $P_M$  are the aggregate prices of exports and imports. Generally, countries consume and produce both types of goods (tradable and non-tradable); thus, the price indexes are the weighted average of both tradable and non-tradable (Lee & Chinn, 2006). Furthermore, in the dependent country case, where the country is a price taker in a foreign market, the goods have close substitutes in a foreign market, and the terms of trade (TOT) are determined exogenously, then the definition of RER is as given;

$$RER_t = e P_t^T / P_t^N$$

Where  $P_t^T$  and  $P_t^N$  are prices of tradable and non-tradable, respectively, measured in common currency; for practical purposes, RER is written as  $RER_t = eWPI_t/CPI_t$  Where WPI (CPI) are whole-sale (consumer) price index, a proxy for tradable and non-tradable, in precise, different RER measures have different assumptions, and data availability is the main factor in determining RER measures (Gubler & Sax, 2019).

**Table 2. Manufacturing industries**

S No.	Industry	Description
1.	Food	Food, beverages, and tobacco
2.	Beverages	Non-alcoholic beverages
3.	Tobacco and Tobacco Products	Tobacco and manufactured tobacco products
4.	Textile	Textiles, Textile Products, and Leather
5.	Footwear	Footwear
6.	Road Vehicles	Motor Vehicles
7.	Motor Tyre	Rubber tires and tubes of vehicles
8.	Medicines	Drugs and Prescription Medicines

Source: Pakistan Bureau of Statistics

### 3.3. The measurement of prices

Theoretical considerations and data availability dominate the choice of price indexes. If one wishes to capture international price competitiveness should employ a price index to weigh tradable goods, i.e., wholesale price index (WPI), producer price index (PPI), or unit labour cost (Nouira et al., 2011). In a dependent country like Pakistan, the non-tradable to tradable is proxied by the PPP to CPI (consumer price index). Due to the limited availability of PPP data in most industries, we are limited to using CPI. Most empirical studies rely on CPI (Cheng et al., 2016; Demir & Razmi, 2022; Nouira et al., 2011). Furthermore, there is a lack of discussion in the literature on the reasons behind the correct price index in calculating RER.

### 3.4. Industry-Level real exchange rate

The formula for the Industry-Level real exchange rates is given:

$$RER_{it} = NER_t \left( P_{it}^{usa} / P_{it}^{pak} \right)$$

For real exchange rates, we use the month-end-period nominal exchange rates from the State Bank of Pakistan for January 2002 to June 2020. The nominal exchange rate is the same for all the industries, while the price indices are industry-specific. The data for the Consumer price index of US industries are taken from the Bauru of Labour Statistics, and for Pakistan, it is from the Pakistan Bureau of Statistics. The CPI base period is 2005–06 (July 2005 to June 2006).

For our industry-wise analysis, we picked up eight industries as listed in Table 2. Our choice of industries has been constrained by difficulties in matching the industries in Pakistan and the United States for consumer price index data and limited availability of monthly data on output.<sup>1</sup> Additionally, we avoid a higher level of disaggregation due to the limited data availability. We follow the Pakistan Bureau of Statistics classification system as most disaggregated data we use in our study are from this source.

### 3.5. Empirical model

The theoretical approach adopted in this study is the BEER of Clark and MacDonald (1998) for estimating the equilibrium exchange rate and following the work of Masunda (2010) and Diop et al. (2018) for measuring misalignment at the disaggregated level. This approach considers trade openness, government expenditures, interest rate, technological progress, and foreign exchange reserves to determine the RER. However, many other variables have been put forward in the literature as the determinants of the exchange rate. But, the review of empirical work on the selection of variables of the real exchange rate was useful to strengthen the model other than those identified by the theoretical models.

Thus, the model is given as follows;

$$\text{LOGRER}_{it} = \beta_0 + \beta_1 \text{LOGTOOPENNESS}_{it} + \beta_2 \text{LOGGOVT}_t + \beta_3 \text{RIR}_t + \beta_4 \text{LOGFER}_t + \beta_5 \text{TP}_{it} + U_{it} \quad (1)$$

The variables are as follows:  $\text{RER}_t$  refers to the Industry-Level real exchange rate,  $\text{OPEN}_t$  is the Industry-Level trade openness index,  $G_t$  represents real government consumption expenditures,  $\text{RIR}_t$  represents real interest rates, and  $\text{TP}_t$  represents technological progress as measured by the output growth rate of each industry, capturing the Balassa Samuelson effect.  $U_{it}$  is the error term, and subscript  $t$  refers to the period.  $\beta_s$  are the estimated coefficients. The variables are described in the subsequent section. The log-linear form is used, which is expected to reduce the variations, and the estimated coefficients can be interpreted as elasticities.

The model assumes that the equilibrium exchange rate is appreciated with less trade openness, higher government expenditures towards non-traded goods, higher productivity in tradable goods relative to non-tradable goods, higher interest rate and foreign exchange reserves, and vice versa.

### 3.6. How to measure variables?

#### 3.6.1. Trade openness ( $\text{TO}_{it}$ ) ( $\pm$ )

Trade openness is measured as the ratio of the sum of exports and imports to GDP and is used to represent trade policy variables. Since data on import and export subsidies, quotas, tariffs, etc., are not easily available (Raji, 2013; Ricci et al., 2013). To calculate the trade openness variable for a particular industry, we will take the ratio of the sum of exports and imports to that industry's output. The data on exports and imports are taken from the State Bank of Pakistan and are given in US\$. The study converts the exports and imports values in Pak rupee using the monthly nominal exchange rate to make it divisible by output.

#### 3.6.2. Real government expenditures ( $G_t$ ) ( $\pm$ )

Government expenditures are government consumption expenditures in real terms, used by the government to buy goods and services. This data is sourced from the Ministry of Finance in US\$. This variable is used at an aggregate level due to the reason that Industry-Level data is not available.

#### 3.6.3. Real interest rate ( $\text{RIR}_t$ ) ( $\pm$ )

The study uses a discount rate adjusted for inflation to capture monetary policy response. As monetary policy is the same for all industries, this variable is also taken at the aggregate level.

#### 3.6.4. Foreign exchange reserves ( $\text{FER}_t$ ) ( $\pm$ )

The FER data is taken from International Financial Statistics in US\$. The study converts it into the Pak rupee using the nominal exchange rate. This variable is also used at the aggregate level.

#### 3.6.5. Technological progress ( $\text{TP}_{it}$ ) ( $\pm$ )

To capture the Balassa Samuelson effect, a good measure is given by Solow Residuals, but measuring Solow residuals is not an easy task. For this purpose, different studies use different proxies.<sup>2</sup> However, we will apply the industry's output growth rate as a TP measure.

$$\text{TP}_{it} = (\text{pro}_{it} - \text{pro}_{it-1}) / \text{pro}_{it-1}$$

## 4. Empirical results

The augmented Dickey-Fuller (ADF) test is used to see the behavior and integration of all variables at the level and first difference. To use the ADF test, the following regression is used for each industry;

**Table 3. Results of unit root tests (ADF t-statistics)**

Industry Variable	Test at level	Test at First Difference	Order of Integration
Aggregate			
RER	-1.783	-12.445*	I(1)
TOPENNESS	-2.191	-4.723*	I(1)
Govt	0.068	-3.597*	I(1)
AIR	-2.244	-15.099*	I(1)
FER	-3.252**	-5.217*	I(0)
TP	0.301	-2.099*	I(1)
Food			
RER	-2.057	-13.074*	I(1)
TOPENNESS	-1.757	-10.773*	I(1)
TP	-5.682**	-10.527*	I(0)
Beverages			
RER	-1.895	-7.429*	I(1)
TOPENNESS	-1.855	-3.779*	I(1)
TP	-3.001**	-12.312*	I(0)
Tobacco and Tobacco Products			
RER	-1.672	-17.521*	I(1)
TOPENNESS	-2.599	-9.191*	I(1)
TP	-5.112**	-8.086*	I(0)
Textile			
RER	-1.856	-11.742*	I(1)
TOPENNESS	-3.379**	-3.816*	I(0)
TP	-2.420	-6.324*	I(1)
Footwear			
RER	-2.184	-10.573*	I(1)
TOPENNESS	-1.867	-3.897*	I(1)
TP	-2.115	-9.842*	I(1)
Road Vehicles			
RER	-2.743**	-4.996*	I(0)
TOPENNESS	-4.535**	-6.501*	I(0)
TP	-3.415**	-7.924*	I(0)
Motor Tyres			
RER	-1.005	-15.286*	I(1)
TOPENNESS	-3.518**	-10.137*	I(0)
TP	-4.566**	-9.223*	I(0)
Medicines			
RER	-0.380	-11.256*	I(1)
TOPENNESS	-4.838**	-7.792*	I(0)
TP	-5.531**	-9.259*	I(0)

Note: The symbols \* and \*\* indicate significance at 1% and 5%, respectively. Furthermore, (0) and (1) represent stat.

Stationarity at the level and first difference, respectively.

$$\Delta X_{it} = \alpha_i + \theta_{it-1} + \sum_{j=1}^{12} \delta_j \Delta X_{it-j} + \mu_{it} \quad (2)$$

Where ‘ $\Delta$ ’ is the difference operator, ‘ $X$ ’ represents the tested series and ‘ $j$ ’ is the maximum number of lags used in each series. To reject the null hypothesis of ‘the unit root time series, the calculated value of the ADF test must be larger than the critical value. Table 3 represents that the variables in each industry’s regression show mixed stationarity; some variables are stationary at the level, and some are at first different. This confirms that Auto Regressive Distributed Lag (ARDL), developed by Pesaran et al. (2001), is appropriate to analyze the short-run and long-run relationship between RER and all other (control) variables.

The ARDL representation of eq (1) is as given:

$$\begin{aligned} \Delta \text{LOGRER}_{it} = & \alpha_1 + \sum_{j=1}^p \alpha_j \Delta \text{LOGRER}_{it-j} + \sum_{k=0}^q \alpha_k \Delta \text{LOGTOPENNESS}_{it-k} \\ & + \sum_{l=0}^r \alpha_l \Delta \text{LOGGOVT}_{t-l} + \sum_{m=0}^s \alpha_m \Delta \text{RIR}_{t-m} + \sum_{n=0}^t \alpha_n \Delta \text{LOGFER}_{it-n} \\ & + \sum_{o=0}^u \alpha_o \Delta \text{TP}_{it-o} + \delta_1 \text{LOGTOPENNESS}_{it-1} + \delta_2 \text{LOGGOVT}_{t-1} \\ & + \delta_3 \text{RIR}_{t-1} + \delta_4 \text{LOGFER}_{t-1} + \delta_5 \text{TP}_{it-1} + \varepsilon_{it} \end{aligned} \quad (3)$$

Where  $\alpha_j$  to  $\alpha_o$  represent short-run and  $\delta_1$  to  $\delta_5$  are long-run coefficients. The null hypothesis  $H_0: \delta_1, \delta_2, \delta_3 \dots \delta_5 = 0$  of no long-run relationship is tested against  $H_1: \delta_1, \delta_2, \delta_3 \dots \delta_5 \neq 0$ . The no co-integration among variables depends on F-statistics for each industry. Aike information criteria (AIC) is used to select an optimal lag length for each variable. A long-run relationship exists if F-statistics is greater than the critical upper bound. The summary of the bound test result is given in Table 4, which clearly shows that a long-run relationship is established for each industry, and we can go ahead with a full ARDL analysis.

Furthermore, the Error Correction Model (ECM) shows the short-run effects and how disequilibrium is removed in each period. Therefore, we estimate the ECM in equation 4.

$$\begin{aligned} \Delta \text{LOGRER}_{it} = & \sum_{j=1}^p \alpha_j \Delta \text{LOGRER}_{it-j} + \sum_{k=0}^q \alpha_k \Delta \text{LOGTOPENNESS}_{it-k} \\ & + \sum_{l=0}^r \alpha_l \Delta \text{LOGGOVT}_{t-l} + \sum_{m=0}^s \alpha_m \Delta \text{RIR}_{t-m} + \sum_{n=0}^t \alpha_n \Delta \text{LOGFER}_{t-n} \\ & + \sum_{o=0}^u \alpha_o \Delta \text{TP}_{it-o} + \lambda \text{ECT}_{it-1} + \varepsilon_{it} \end{aligned} \quad (4)$$

Table 5 shows that ECM coefficients are highly significant for all industries and have the correct signs. The coefficients suggest from low (Beverages) to moderate (Vehicles) speed of convergence to long-run equilibrium, which is about (4%) to (17%) respectively.

The short-run and long-run results are presented in Appendix. The results of the baseline model are given in the first section, where the long-run coefficients are in an aggregate form without disaggregating the economy. The results from the other industries are included in the remainder of the table. According to the long-run coefficients, government spending and interest rates are highly significant variables in explaining RER at the aggregate level and for all industries except tobacco and tobacco products. Another variable that significantly impacts RER in most industries is trade openness, except for footwear, tobacco and tobacco products, and road vehicles. Furthermore, the technological progress, which is insignificant at the aggregate level and in a few industries (textile, road vehicles, motor tires, and medicines), is significant in the food, beverages, tobacco and tobacco products, and footwear industries.

Our main goal is to find the correct measure of misalignment, both at the aggregate and an industrial level, and the periods of undervaluation and overvaluation. The actual, equilibrium, and misalignment series are shown in Figure 1. Furthermore, the misalignment series in percentage form are shown in Figure 2. It indicates that the ERE is not a single value but a time path. The noise in the ERE series shows that they are allowed to change when fundamentals change. The monthwise explanation of misalignment is not an easy task. In general, misalignment series in all industries fluctuated over the periods, although the periods of misalignment are different. The study compares the misalignment results with the aggregate results for industry analysis. Also, it attempts to point out the causes of different behavior of misalignment series in the light of the inflationary trend of the industry, particularly the price levels in Pakistan. The misalignment at an aggregate level and in the food industry shows an almost similar pattern. From FY02 to FY07, the PKR against US\$ was volatile in both series. Since FY2008, the Pak rupee depreciation varied largely till FY13. Many reasons were behind this large depreciation. The year-wise average depreciation of PKR against during the period from FY08 to FY13 of aggregate series was

**Table 4. Results of bound test**

Industries	F-Statistic	Lower Bound Critical Value	Upper Bound Critical Value	Conclusion
Aggregate	3.807**	2.75	3.79	Co-integration exists
Food	2.844**	2.75	2.75	Co-integration exists
Beverages	2.925**	1.75	2.87	Co-integration exists
Tobacco and Tobacco Products	6.672*	3.12	4.25	Co-integration exists
Textile	4.446*	2.39	3.38	Co-integration exists
Footwear	4.811*	3.12	4.25	Co-integration exists
Road Vehicles	4.907*	3.12	4.25	Co-integration exists
Motor Tyre	4.703*	2.87	4	Co-integration exists
Medicines	4.891*	2.39	3.38	Co-integration exists

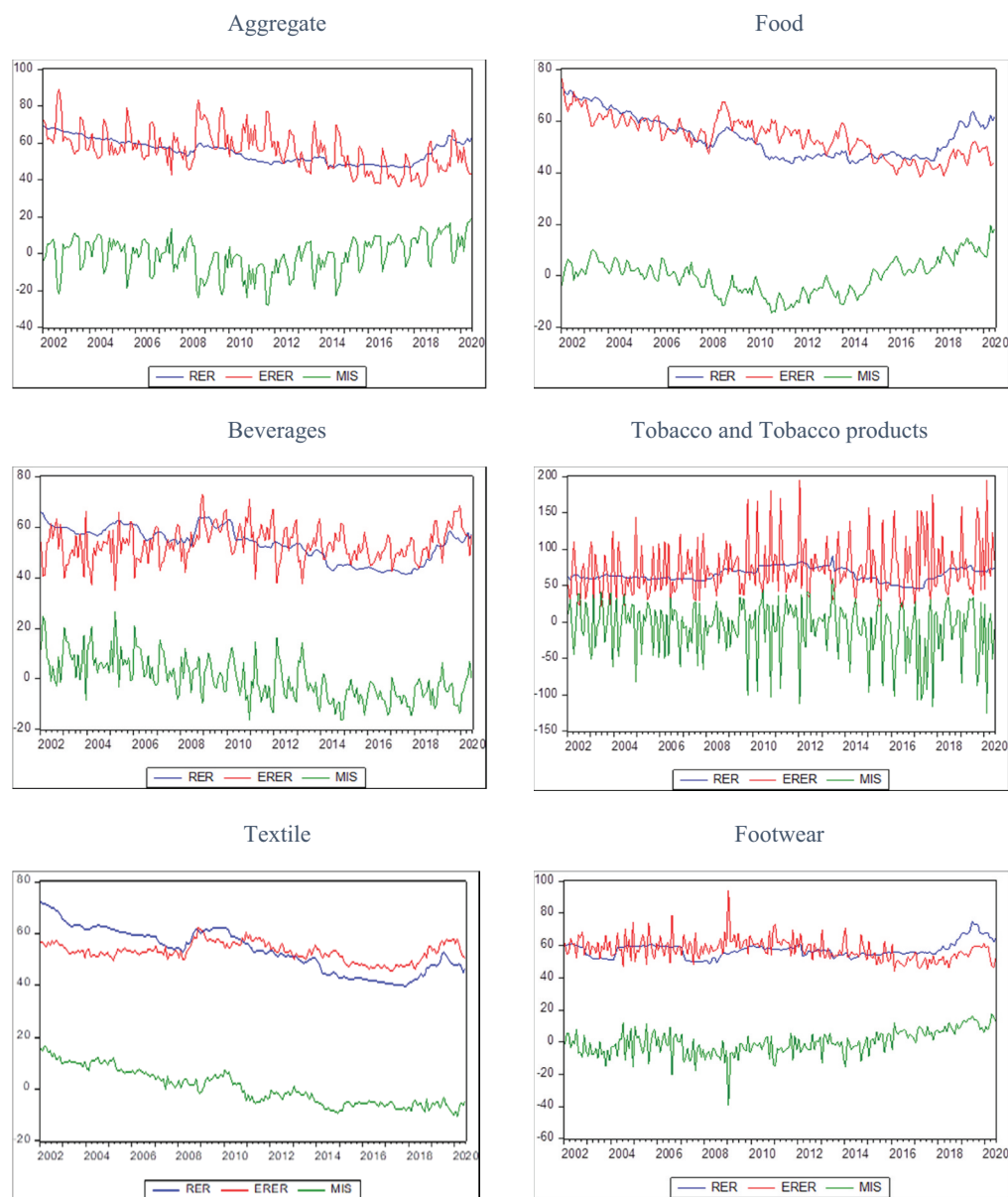
Note: The symbols \* and \*\* indicate significance at 5% and 10%, respectively.

**Table 5. Error correction coefficients**

Industry	Coefficient	t-Statistic
Aggregate	-0.056	-4.719*
Food	-0.063	-4.059*
Beverages	-0.047	-4.183*
Tobacco and Tobacco Products	-0.059	-6.404*
Textile	-0.137	-5.665*
Footwear	-0.107	-5.439*
Road Vehicles	-0.177	-5.504*
Motor Tyre	-0.064	-5.821*
Medicines	-0.066	-5.939*

Note: The symbols \* and \*\* indicate significance at 5% and 10%, respectively.

**Figure 1. RER: Actual, estimated, and misalignment by industry.**



**Figure 1. (Continued).**

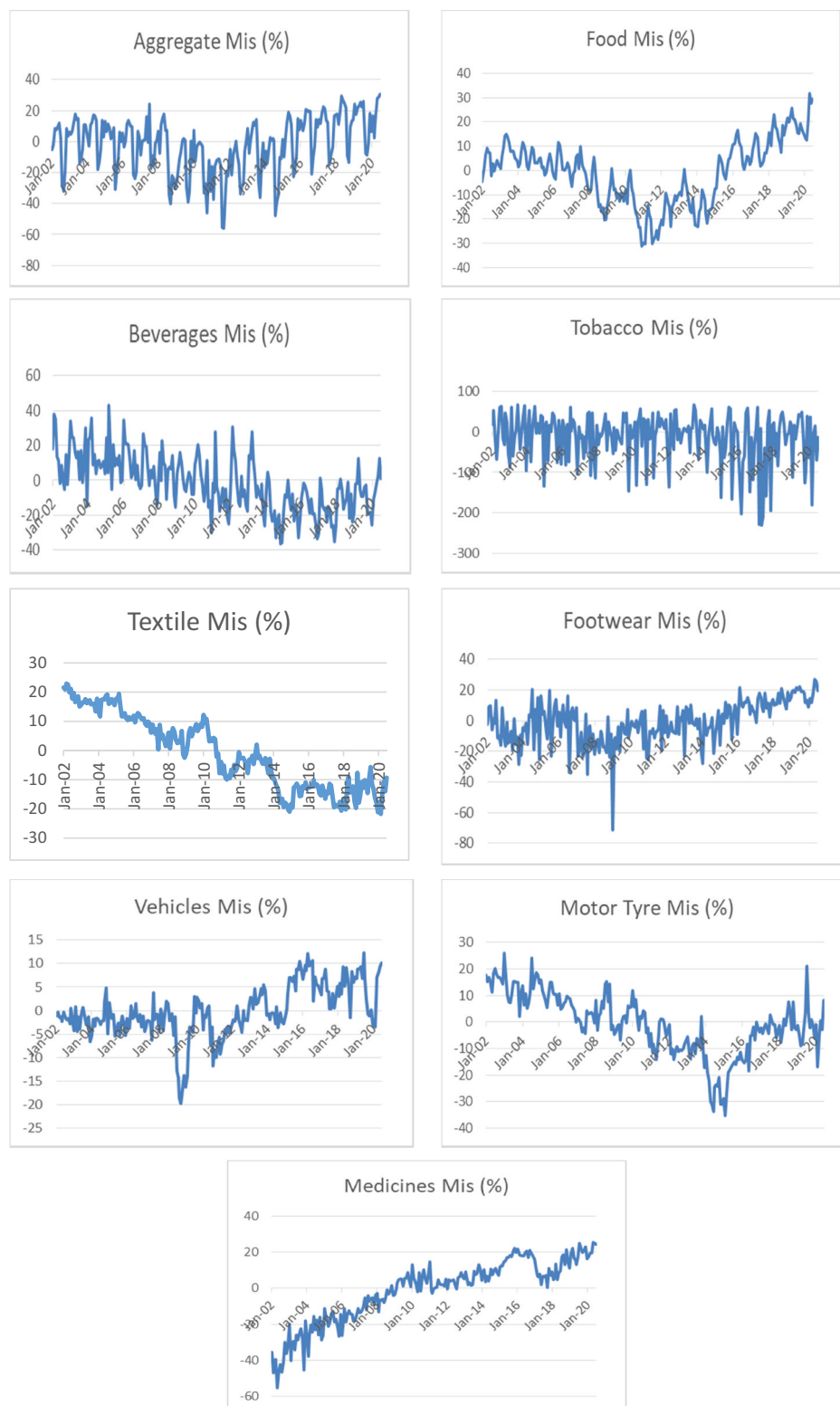


–7.69% in FY08; –14.82% in FY09; –13.79% in FY10; –25.81% in FY11; –13.37% in FY12; and –3.86% in FY13 while it was –10.25% in FY08; –9.26% in FY09; –14.37% FY10; –24.62% in FY11; –15.05% in FY12; and –11.69% in FY13 in the food industry (see, Figure 2).

The rupee depreciation during the FY08 to FY13 period was mainly a reflection of the low balance of payment. The situation of the economy worsens significantly in FY08 and the few months of FY09 due to a large exogenous price shock (food and oil) in the foreign markets, terrorism, global financial crises, and policy delays in the political transition. Furthermore, the deficit in the current account widened to \$13.9 billion in FY08, and the surplus in the balance of payments declined to \$8.3 billion from \$10.3 billion, resulting in a decline in foreign reserves of SBP at the end of FY08. Reserves further declined to \$3.5 billion in FY08, adding these factors kept the rupee under pressure; the rupee depreciated by –14.82 % in FY09. The government entered into the IMF program in late 2008, which moderately improved the foreign reserves and eased the pressure on PKR significantly. While the deficit remained low, the financial and capital accounts declined continuously after FY10, resulting in large depreciation in FY11, i.e., –25.81. To come out of this situation, the government has taken multiple steps, which include inflows from different sources. After FY14, this measure started yielding positive results: inflows from bilateral and multilateral sources started realizing, which strengthened PKR against US\$.

In the beverages industry, we see a trend of undervaluation of PKR. From FY02 to FY13, the misalignment was volatile. After FY13, it remained undervalued. The beverage industry's upward inflationary trend was the reason behind this continued depreciation. In contrast to these industries, the misalignment in the tobacco industry was highly volatile throughout the entire period of analysis, and most of the time, the PKR was depreciated. However, the RER remained close to its

**Figure 2. Monthwise misalignment by industry.**



equilibrium in textile and footwear due to its stable prices. It, however, was overvalued till FY08 and then started undervalued in the textile industry.

Interestingly, the misalignment in the vehicle industry was close to zero before FY08 due to stable prices. After that, we see small changes in the misalignment series except in Feb 2009, when depreciation was  $-19.68\%$  (see figure 3). Since FY14, the PKR has remained overvalued due to the low price level. The misalignment in the tire and medicines industries shows the opposite trend. The PKR remained depreciated in the tire industry throughout the period from FY03 to FY20. It largely depreciated to  $-33.69\%$  in June 2014. The actual value of RER was less than its long-run value till FY08 in the medicine industry, and after that, it started appreciating gradually.

## 5. Discussion

This section goes deep into the empirical evidence and its significance. It can be concluded that trade openness, government expenditures, interest rates, foreign exchange reserves, and technological progress are the most important factors influencing Pakistan's real exchange rate. However, starting with trade openness, the findings show both a positive and negative impact on the real exchange rate (Candelon et al., 2007; Rizwanulhassan, 2019; Zakaria & Ghauri, 2011). The impact is negative for the food, beverage, vehicle, and tyre industries but not significant for the vehicle industry. This is consistent with our expectations, as lowering trade barriers appreciates the real exchange rate. Furthermore, the negative relationship generally explains when exports contribute more to a country's trade than imports (Algieri, 2013; Candelon et al., 2007; Madouni, 2014; Raza & Afshan, 2017).

On the other hand, at the aggregate level and in some industries, it shows a positive response, indicating the depreciation of the real exchange rate in the long-run by increasing openness. Tobacco and tobacco products, textiles, footwear, and medicines are among these industries. The findings are surprising because they contradict the theoretical predictions. Studies by Zhang and Zhang (2001), Li (2003), and Hyder and Mahboob (2006) find that the real exchange rate depreciates after countries liberalise trade. In the case of Pakistan, imports outnumber exports, which is reflected in the depreciation at the aggregate level. Pakistan's exports are primarily primary goods, whereas imports are primarily necessary goods, such as oil and petroleum products, accounting for 12 percent of total imports.

Moving on to the effect of government spending on the real exchange rate, the findings show that it appreciates the real exchange rate at the aggregate level and in all industries except beverages, tyres, and medicines. This is akin to our expectations. Our findings show that it depreciates in imported goods only, such as tyres, medicines, and beverages. Furthermore, in the case of Pakistan, Afridi (1995), Rizwanulhassan (2019), and Fiaz et al. (2021) find similar results at the economic level. In the case of China, Zhang and Zhang (2001) also finds a negative relationship between government spending and real exchange rate. Madouni (2014) observes that government spending is associated with the appreciation of the Algerian Dinar. Unlikely, our findings differ from previous empirical studies on the impact of interest rates on real exchange rates. They show a positive and highly significant relationship in the long-run, both at the aggregate level and for all industries. Still, they are consistent with Gente and Leon-Ledesma (2006) findings, which find no evidence of a negative relationship in the case of a debtor country. Hnatkovska et al. (2013) also suggest that only minor increases in interest rates strengthen the currency, whereas larger increases weaken it.

Furthermore, if all other factors influencing currency value were removed, an increase in interest rates would result in currency appreciation. This is because rising interest rates give investors a high return, causing demand for the currency to rise and, as a result, its value to rise. However, if inflation is too high, the impact of high-interest rates is mitigated. In Pakistan, the inflation rate has historically gone through three distinct phases. It ranged from 3.15 percent to 7.60 percent from 2001 to 2007, then reached double digits from 2008 to 2011, rising from 20 percent to 11.92 percent. However, it has remained in the single digits with volatility since 2011 and

continues to do so today. This explains the depreciation impact of interest rate on real exchange rate in Pakistan.

In terms of the effect of foreign exchange reserves on the real exchange rate, the results confirm Kasman and Ayhan (2008) and Saeed et al. (2012) finding, that an increase in reserves appreciates the real exchange rate at the aggregate level and across all industries except tobacco. The reason is that reserves are held to ensure that the state bank has backup in the event their local currency devalues or it becomes insolvent.

When considering technological progress, both positive and negative responses are observed. The response is positive overall for other industries, such as tobacco and footwear, indicating currency depreciation due to technological advancement. However, the response is insignificant on an economic level. This outcome was unexpected because it contradicted the theoretical expectation that technological advances would appreciate the real exchange rate. Chishti et al. (1993) and Madouni (2014) find that when technological progress occurs, export expansion is expected to occur, at least in the short-run, increasing the balance of payments. Such an increase will immediately impact the real exchange rate's appreciation. However, in the long-run, due to competition in the foreign market, the initial advantage will gradually deplete, causing a decline in foreign exchange reserves and, as a result, a depreciation in the real value of the currency.

For other industries, such as food, beverages, textiles, vehicles, tires, and medicines, the results are consistent with prior studies, for instance, Afridi (1995) and Hyder and Mahboob (2006) indicating that R&D spending improves any economy's learning capacity, resulting in increased productivity and profits in international trade. In other words, adopting technological innovations lowers the cost of domestic goods, causing the exchange rate to appreciate.

## 6. Conclusion and policy recommendations

This study adds to understanding the equilibrium real exchange rate and misalignment. The concept of equilibrium and misalignment of RER are very important for policymakers. Despite its importance, no serious attempt has been made to compute RER, ERER, and misalignment at the Industry-Level in Pakistan. Thus, this study has tested the long-run relationship between the real exchange rate and its fundamentals in the aggregate and eight manufacturing industries of the Pakistan economy. The empirical findings from the ARDL approach suggest that a long-run co-integration relationship exists between real exchange rate, trade openness, government expenditures, interest rate, foreign reserves, and technological progress. Like other empirical studies, government expenditures and interest play a vital role in explaining RER in the long-run. From industry-wise misalignment results, all industries show a very different pattern. On average, misalignment remained smooth in some industries (footwear and vehicles) over the entire period, while in the tobacco industry, it was highly volatile.

The study's findings reveal several challenges for policymakers and the government in determining Pakistan's exchange rate policy. First, the presence of a long-run relationship between variables for these industries demonstrates the effectiveness of focusing on one variable (real exchange rate in our case) in determining the long-run movements of other variables. Second, if they intend to take action to correct misalignment, they must recognize the relevant fundamentals of the equilibrium exchange rate at both the economy and industrial levels. In industries where the real exchange rate is undervalued most of the time, they can use expansionary fiscal policy by cutting taxes, while in industries where it is overvalued, contractionary fiscal policy can be used by raising taxes.

Third, trade openness policies depreciate the real exchange rate at the aggregate level as well as in some, but not all, industries. The government should keep enforcing these policies until the real exchange rate reaches its equilibrium level, which is the appropriate level.

Finally, higher interest rates depreciate the real exchange rate at the aggregate level and across all industries in the long-run. This necessitates monetary policy tightening, but the monetary authorities should continue to implement policies until the gap between the actual real exchange rate and its equilibrium gets minimum.

### 6.1. Research limitations

Even though this study validates fundamentals-based RER theory at both the aggregate and disaggregates levels, it has the following limitations. To begin, it can be improved by including more industry-specific variables in estimating the equilibrium exchange rate, increasing the sample size, and expanding the number of industries. Furthermore, the study suggests that more research be conducted into the effects of misaligned exchange rates on various economic sectors.

Second, we used industry-specific real exchange rates to explain industry differences. Instead, we believe that the real effective exchange rate, based on industry-specific price and trade data, is a more informative measure than the real exchange rate. This metric takes into account both price and trade differences across industries. Due to a lack of monthly price data for industries in the countries used to calculate this measure, we could not use it in our analysis.

Finally, in terms of variable measurement, the study constructs output growth as a proxy for industrial, and technological progress. This necessitates focus. Data on the variable of technological progress was not available on an industry-wide basis. Trade openness has also been built, defined as the ratio of imports and exports to GDP. However, these flaws will remain a part of future authors' research.

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### Notes

1. Although we do not need output data for the computation of real exchange rates, the data availability of industry-wise output is a matter of concern for calculating output growth.
2. Edwards (1987, Edwards, 1988, p. 1989), Afridi (1995), Chishti et al. (1993), and BOUZAHAH and BACHAR (2014) use the growth rate of real GDP, while Balassa (1964) and Calderón (2005), use per capita income and the index of manufacturing output growth.

### Disclosure statement

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## Appendix

### Results of Long-Run Relationship

<b>Industry Variables</b>	<b>Coefficients</b>	<b>t-statistic</b>	<b>P-value</b>
<i>Aggregate</i>			
TOPENNESS	0.739	2.109*	0.035
GOVT	−0.791	−4.036*	0.000
IR	0.055	2.941*	0.004
FER	−0.148	−2.405*	0.017
TP	0.017	0.450	0.653
<i>Food</i>			
TOPENNESS	−0.153	−1.929**	0.055
GOVT	−0.738	−4.012*	0.000
IR	0.025	1.983*	0.049
FER	−0.196	−2.339*	0.020
TP	−0.010	−2.305*	0.022
<i>Beverages</i>			
TOPENNESS	−0.098	−4.293*	0.000
GOVT	0.253	4.242*	0.000
IR	0.031	2.845*	0.005
FER	−0.025	−0.306	0.761
TP	−0.004	−1.959**	0.055
<i>Tobacco and Tobacco Products</i>			
TOPENNESS	0.056	0.743	0.459
GOVT	−0.082	−0.349	0.727
IR	0.049	1.898**	0.059
FER	0.073	0.507	0.613
TP	0.027	2.843*	0.005
<i>Textile</i>			
TOPENNESS	0.202	3.682*	0.000
GOVT	−0.096	−6.404*	0.000
IR	0.022	5.638*	0.000
FER	−0.066	−2.182*	0.030
TP	−0.001	−0.072	0.942
<i>Footwear</i>			
TOPENNESS	0.026	0.416	0.678
GOVT	−0.316	−1.931**	0.055
IR	0.025	2.724*	0.007
FER	−0.015	−0.304	0.762
TP	0.004	2.605*	0.009

(Continued)

<b>Industry Variables</b>	<b>Coefficients</b>	<b>t-statistic</b>	<b>P-value</b>
<i>Road Vehicles</i>			
TOPENNESS	−0.027	−0.739	0.460
GOVT	−0.169	−2.229*	0.027
IR	0.019	3.153*	0.002
FER	−0.074	−2.631*	0.009
TP	−0.001	−0.479	0.632
<i>Motor Tyre</i>			
TOPENNESS	−0.463	−4.047*	0.000
GOVT	0.266	1.664**	0.098
IR	0.018	2.148*	0.033
FER	−0.061	−1.162	0.246
TP	−0.001	−0.312	0.755
<i>Medicines</i>			
TOPENNESS	0.324	2.493*	0.014
GOVT	0.159	6.439*	0.000
IR	0.014	2.231*	0.027
FER	−0.158	−2.127*	0.035
TP	−0.004	−1.480	0.140

Note: The symbols \* and \*\* indicate significance at 5% and 10%, respectively.

### Results of Short-Run Relationship

Industry Variables	Coefficients	t-statistics	p-values
<i>Aggregate</i>			
$\Delta(\text{RER}(-1))$	0.137	1.947	0.053
$\Delta(\text{RER}(-2))$	-0.145	-1.982	0.049
$\Delta(\text{RER}(-3))$	0.124	1.679	0.095
$\Delta(\text{TOPENNESS})$	0.031	2.092	0.037
$\Delta(\text{TOPENNESS}(-1))$	-0.032	-1.705	0.089
$\Delta(\text{TOINDEX}(-2))$	-0.045	-2.424	0.016
$\Delta(\text{TOPENNESS}(-3))$	-0.039	-2.141	0.034
$\Delta(\text{TOPENNESS}(-4))$	-0.016	-0.918	0.360
$\Delta(\text{TOPENNESS}(-5))$	-0.029	-2.064	0.041
$\Delta(\text{FER})$	-0.038	-3.306	0.001
$\Delta(\text{FER}(-1))$	-0.057	-5.083	0.000
$\Delta(\text{GOVT})$	-0.087	-3.195	0.002
$\Delta(\text{GOVT}(1))$	0.023	1.087	0.279
$\Delta(\text{GOVT}(2))$	0.041	1.864	0.063
$\Delta(\text{GOVT}(3))$	-0.014	-0.422	0.673
$\Delta(\text{GOVT}(4))$	0.008	0.262	0.793
$\Delta(\text{GOVT}(5))$	-0.009	-0.256	0.797
$\Delta(\text{GOVT}(6))$	0.018	0.548	0.585
$\Delta(\text{GOVT}(7))$	0.032	0.974	0.331
$\Delta(\text{GOVT}(8))$	-0.087	-2.904	0.004
$\Delta(\text{TP})$	0.001	1.046	0.297
$\Delta(\text{TP}(-1))$	0.000	0.070	0.944
$\Delta(\text{TP}(-2))$	-0.00	-1.021	0.308
$\Delta(\text{TP}(-3))$	-0.000	-0.578	0.564
$\Delta(\text{TP}(-4))$	0.001	1.379	0.169
$\Delta(\text{TP}(-5))$	-0.001	-2.692	0.007
$\Delta(\text{RIR})$	0.004	4.342	0.000
$\Delta(\text{RIR}(-1))$	-0.002	-1.591	0.113
$\Delta(\text{RIR}(-2))$	-0.001	-0.881	0.379
$\Delta(\text{RIR}(-3))$	-0.003	-2.453	0.015
$\Delta(\text{RIR}(-4))$	-0.004	-4.329	0.000
<i>Food</i>			
$\Delta(\text{RER}(-1))$	0.146	2.163	0.031
$\Delta(\text{RER}(-2))$	-0.157	-2.383	0.018
$\Delta(\text{RER}(-3))$	0.094	1.433	0.153
$\Delta(\text{GOVT})$	-0.038	-1.684	0.093
$\Delta(\text{GOVT}(1))$	-0.000	-0.385	0.700

(Continued)

Industry Variables	Coefficients	t-statistics	p-values
$\Delta(\text{GOVT}(2))$	0.063	3.386	0.000
$\Delta(\text{RIR})$	0.006	6.262	0.000
$\Delta(\text{FER})$	-0.019	-1.161	0.246
$\Delta(\text{FER}(-1))$	-0.053	-3.341	0.001
$\Delta(\text{TP})$	0.000	0.176	0.860
$\Delta(\text{TP}(-1))$	0.000	1.910	0.057
$\Delta(\text{TP}(-2))$	0.000	2.042	0.042
$\Delta(\text{TOPENNESS})$	-0.003	-0.631	0.528
$\Delta(\text{TOPENNESS}(-1))$	-0.005	-0.843	0.400
$\Delta(\text{TOPENNESS}(-2))$	0.013	2.214	0.027
<i>Beverages</i>			
$\Delta(\text{RER}(-1))$	0.195	2.741	0.006
$\Delta(\text{RER}(-2))$	-0.075	-1.057	0.291
$\Delta(\text{RER}(-3))$	0.168	2.431	0.015
$\Delta(\text{TOPENNESS})$	0.000	0.328	0.742
$\Delta(\text{TOPENNESS}(-1))$	0.004	1.966	0.050
$\Delta(\text{TP})$	-0.000	-2.716	0.007
$\Delta(\text{FER})$	-0.048	-3.166	0.001
$\Delta(\text{FER}(-1))$	-0.050	-3.269	0.001
$\Delta(\text{RGOVT})$	-0.000	-0.029	0.976
$\Delta(\text{GOVT}(1))$	-0.008	-0.464	0.642
$\Delta(\text{GOVT}(2))$	-0.029	-1.662	0.098
$\Delta(\text{GOVT}(3))$	-0.028	-1.419	0.157
$\Delta(\text{RIR})$	-0.000	-0.605	0.545
<i>Tobacco and Tobacco Products</i>			
$\Delta(\text{RER}(-1))$	-0.207	-3.008	0.001
$\Delta(\text{FER})$	-0.070	-2.377	0.018
$\Delta(\text{FER}(-1))$	-0.050	-1.746	0.082
$\Delta(\text{FER}(-2))$	-0.037	-1.286	0.199
$\Delta(\text{FER}(-3))$	-0.049	-1.703	0.090
$\Delta(\text{TP})$	0.000	3.420	0.000
$\Delta(\text{TP}(-1))$	-0.000	-2.490	0.013
<i>Textile</i>			
$\Delta(\text{RER}(-1))$	0.175	2.605	0.009
$\Delta(\text{RER}(-2))$	-0.057	-0.801	0.423
$\Delta(\text{RER}(-3))$	0.182	2.532	0.011
$\Delta(\text{RER}(-4))$	-0.030	-0.443	0.658
$\Delta(\text{RER}(-5))$	0.070	1.018	0.309

(Continued)

(Continued)			
Industry Variables	Coefficients	t-statistics	p-values
$\Delta(\text{RER}(-6))$	0.149	2.179	0.030
$\Delta(\text{RER}(-7))$	0.157	2.296	0.022
$\Delta(\text{RIR})$	0.002	1.994	0.047
$\Delta(\text{RIR}(-1))$	-0.000	-0.409	0.682
$\Delta(\text{RIR}(-2))$	-0.002	-2.096	0.037
$\Delta(\text{RIR}(-3))$	-0.001	-1.107	0.270
$\Delta(\text{RIR}(-4))$	-0.004	-3.274	0.001
$\Delta(\text{RIR}(-5))$	-0.002	-1.678	0.094
$\Delta(\text{RIR}(-6))$	-0.002	-2.524	0.012
$\Delta(\text{FER})$	-0.043	-2.952	0.003
$\Delta(\text{FER}(-1))$	-0.062	-4.205	0.000
Footwear			
$\Delta(\text{TP})$	0.000	2.243	0.026
$\Delta(\text{TOPENNESS})$	0.024	3.526	0.000
$\Delta(\text{TOPENNESS}(-1))$	0.031	3.499	0.000
$\Delta(\text{TOPENNESS}(-2))$	0.015	2.256	0.025
$\Delta(\text{TOPENNESS}(-3))$	0.012	2.340	0.020
$\Delta(\text{FER})$	-0.024	-1.192	0.234
$\Delta(\text{FER}(-1))$	-0.032	-1.699	0.090
$\Delta(\text{GOVT})$	-0.047	-2.180	0.030
$\Delta(\text{GOVT}(1))$	-0.002	-0.123	0.901
$\Delta(\text{GOVT}(2))$	0.075	3.078	0.024
Road Vehicles			
$\Delta(\text{RIR})$	0.000	0.035	0.971
$\Delta(\text{RIR}(-1))$	-0.002	-2.185	0.030
$\Delta(\text{RIR}(-2))$	-0.003	-2.415	0.016
$\Delta(\text{RIR}(-3))$	-0.003	-2.821	0.005
$\Delta(\text{RIR}(-4))$	-0.005	-3.932	0.000
$\Delta(\text{RIR}(-5))$	-0.003	-2.312	0.021
$\Delta(\text{RIR}(-6))$	-0.003	-2.401	0.017
$\Delta(\text{RIR}(-7))$	-0.003	-2.243	0.026
$\Delta(\text{RIR}(-8))$	-0.002	-1.985	0.048
$\Delta(\text{GOVT})$	-0.097	-3.024	0.002
$\Delta(\text{GOVT}(1))$	0.080	2.172	0.031
$\Delta(\text{GOVT}(2))$	0.052	1.469	0.143
$\Delta(\text{GOVT}(3))$	-0.092	-2.263	0.024
$\Delta(\text{GOVT}(4))$	0.029	0.675	0.500
$\Delta(\text{GOVT}(5))$	0.041	1.003	0.317

(Continued)

Industry Variables	Coefficients	t-statistics	p-values
$\Delta(\text{GOVT}(6))$	-0.051	-1.331	0.184
$\Delta(\text{GOVT}(7))$	0.036	0.884	0.377
$\Delta(\text{GOVT}(8))$	-0.020	-0.536	0.592
$\Delta(\text{GOVT}(9))$	-0.068	-2.033	0.043
$\Delta(\text{GOVT}(10))$	0.072	2.0175	0.045
$\Delta(\text{GOVT}(11))$	-0.068	-2.174	0.031
$\Delta(\text{FER})$	-0.032	-2.300	0.022
$\Delta(\text{FER}(-1))$	-0.045	-3.186	0.001
$\Delta(\text{TP})$	-0.000	-2.337	0.020
$\Delta(\text{TP}(-1))$	-0.000	-1.653	0.100
$\Delta(\text{TP}(-2))$	-0.000	-1.951	0.052
$\Delta(\text{TOPENNESS})$	-0.000	-0.117	0.906
$\Delta(\text{TOPENNESS}(-1))$	0.006	1.004	0.316
$\Delta(\text{TOPENNESS}(-2))$	0.016	3.12	0.002
<i>Motor Tyre</i>			
$\Delta(\text{RER}(-1))$	-0.206	-3.162	0.001
$\Delta(\text{TOPENESS})$	-0.004	-0.693	0.489
$\Delta(\text{TOPENESS}(1))$	0.010	1.595	0.112
$\Delta(\text{GOVT})$	-0.000	-0.031	0.974
$\Delta(\text{GOVT}(-1))$	-0.047	-2.743	0.006
$\Delta(\text{FER})$	-0.065	-4.796	0.000
$\Delta(\text{FER}(-1))$	-0.054	-3.953	0.000
<i>Medicines</i>			
$\Delta(\text{RER}(-1))$	0.129	1.879	0.061
$\Delta(\text{FER})$	-0.028	-1.813	0.071
$\Delta(\text{FER}(-1))$	-0.042	-2.782	0.005
$\Delta(\text{FER}(-2))$	-0.013	-0.827	0.408
$\Delta(\text{FER}(-3))$	0.010	0.667	0.505
$\Delta(\text{FER}(-4))$	0.028	1.842	0.066
$\Delta(\text{FER}(-5))$	0.019	1.246	0.214
$\Delta(\text{L FER}(-6))$	-0.022	-1.404	0.161
$\Delta(\text{GOVT})$	-0.005	-0.379	0.705
$\Delta(\text{GOVT}(-1))$	-0.023	-1.613	0.108

Note: Probabilities shows the significance level at 5% and 10%.



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