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Economic Development and Environmental Pollution: Real Exchange Rate Misalignments

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ABSTRACT: - The study analyzed CO_2 emissions were affected by the underlying exchange rate mismatch in the financial growth of European countries. In this strategy, the study combines PMG/ARDL estimators and dynamic OLS (DOLS) estimators with ARDL bounds test to analyses a panel data from 1980 to 2022. The findings indicate that increased trade openness and FDI in Europe are likely to lead to higher long-term real exchange rates for CO_2 emissions. Fluctuations in the productivity modification and increasing human capital both raise the exchange rate, which is a major factor in the development of CO2 emissions. Furthermore, the ARDL method's findings indicate that worsening misalignment in real exchange rates will slow economic growth in Europe. The economies of Germany, Italy, Spain, and the Netherlands would benefit immediately from an influx of FDI. In contrast, in countries like Greece, Sweden, and Hungary, the economy would be slowed down by trade openness and human capital. The research found that avoiding real exchange rate misalignment helped allocate resources for economic growth and cut down on carbon dioxide emissions. Other emerging countries looking to expedite their economic growth can consider adopting a controlled floating exchange rate regime.

Keywords: Misalignment, Foreign Direct Investment, Productivity Modification, Trade Openness, Real Exchange Rate, ARDL Model

I. INTRODUCTION

A growing body of research has examined the relationship between real exchange rate misalignment, economic development, and CO2 emissions, particularly as it relates to the prosperity of certain industrialized economies in Europe. A country's real exchange rate misaligns when it deviates from equilibrium (Montiel & Hinkle, 1999). The primary goal of exchange rate policy should be to prevent episodes of protracted and significant misalignment in actual RER significantly deviates in long-run (Montiel & Hinkle, 2016). The REER depreciates as productivity rises in high-income countries, enhancing trade openness; however, the reverse is true for upper-middle income countries. Furthermore, in upper-middle income countries, financial development and rents from natural resources are insignificant (Vogiazas et al., 2019). The study looks at how RER misalignment, trade openness, foreign direct investment, human capital, productivity modification, and economic development affect CO2 emissions in certain European countries. What is the estimation of equilibrium RER? These and other topics are the focus of the study. What connections exist between trade openness, foreign FDI, productivity modification, and CO2 emissions? How did it conclude that a bad exchange rate policy is one of the key roadblocks to economic progress in a few European countries? Trade openness and RER realignment are the most important paths. Interventions are often successful in influencing the actual exchange rate, with more success being correlated with larger exchange rate misalignment (Daude et al., 2016). The misalignments often increased prior to crises and plainly decreased thereafter, acting as potentially useful forecasters of such occurrences (Dudzich, 2022). The exchange rate is a possible policy variable to affect economic expansion. To facilitate the allocation of resources in the economy in accordance with the fundamentals, real exchange rate misalignment should be avoided(Wong, 2013). The majority of studies conducted on developed countries revealed that foreign direct investment contributed positively to economic growth, subject to the impacts of productivity modification and human capital variation on CO2 emissions. Through carbon dioxide emissions, trade openness has a negative impact on the environment (Bernard & Mandal, 2016). The majority of these countries' real exchange behaviour is compatible with their economic fundamentals, and the assessed RER misalignment's size is not concerning (Toulaboe (2017). In the context of developing countries, the stock of FDI inflows to local capital stock and income has detrimental consequences on environmental quality (Thuy & Nguyen, 2022). The inflow of FDI degrades environmental quality and unintentionally contributes to more environmental damage (Wang et al., 2020). By increasing

understanding of environmental standards, human capital may improve environmental performance (Kim & Go, 2020). Momentarily, CO_2 emissions will go up if the GDP per individual goes up in the present and previous times, assuming FDI goes up in short-run, and in the unlikely event that RER goes up in right now. In the long-run, CO_2 emissions are not essentially influenced by per capita GDP, FDI, or RER (Wang & Huang, 2022).

The article's remaining sections are organized as follows: Section 2 discusses the literature review, whereas Section 3 presents the study framework, data analysis process, and research techniques. The findings and discussion are provided in Section 4, and the conclusions and recommendations for the future are shown in Section 5.

II. LITERATURE REVIEW

Overvaluation in the study has a statistically significant detrimental impact on private investments and export market shares, showing that competition and investment channels link growth and RER misalignments. (Krekó & Oblath, 2020). The impact of productivity growth in a panel of OECD countries with floating exchange rates (Lee & Tang, 2007). Therefore, trade openness would either reduce or real shocks on real exchange rates by lowering frictions and transaction costs in the global interchange of goods and services (Calderón & Kubota, 2018). The association between misalignments and other indices of the performance of foreign trade (Razmi et al., 2012). Due to the high degree of openness among most EU countries, the "competitiveness-channel" serves as a crucial connection between misalignments and economic expansion. In the long run, there is a correlation between productivity modification and GDP that significantly reduces CO2 emissions (Karedla, 2021). BEER enables for the computation of the ERER evolution through time by linking the long-term equilibrium exchange rate level to the macroeconomic fundamentals (Clark & MacDonald 2000). Ahmed et al. (2016) shown that more involvement in international value chains lowers the susceptibility of exports to fluctuations in REER. According to Hausmann et al. (2005), real exchange rate depreciation speeds up economic development. Exchange rate depreciation should boost the industrial sector's profitability and size since the REER measures the relative price of tradable and non-tradable goods (Rodrik, 2008). In contrast to industry and GDP have a strong and long-lasting beneficial influence on CO_2 emissions but trade openness dramatically cuts CO2 emissions (Karedla, 2021). Non-renewable energy causes an increase in air pollution, measles, TB cases, and mortality rates, all of which have an impact on Pakistan's human capital (Asghar et al., 2020). In low growth regimes, human capital both raises and lowers carbon emissions in low regimes of financial growth and human capital (Cakar et al., 2021). According to the PMG co-integration study, more human capital helps European countries have smaller environmental pollution (Yildiz, 2022). Additionally, the economic growth and GDP have a favourable impact on CO_2 emissions and the environment (Camkaya et al., 2022). Similarly, the economic globalization has a beneficial impact on environmental degradation (Ali et al., 2022). Comparatively to non-participating countries, the agreement with Africa programmed favourably encourages FDI in participant countries to reduce CO_2 emissions (Duodo et al., 2022). When the economy reaches a high level, it will improve environmental quality. Low levels of economic development would worsen environmental pollution (Huangfu et al., 2020). Additionally, economic growth and energy use have positive effects on CO2 emissions, while urbanization, technology, and trade openness have significant negative effects (Dong et al., 2020). With advancements in production technology, growing income slows the growth of CO_2 emissions (Dinda, 2018). The long-term effects of economic growth, financial development, and trade openness have been detrimental to environmental quality (Nguyen et al., 2021). The financial development may result in a significant rise in carbon emissions (Jiang & Ma, 2019). The broadening of the money supply has a favourable significant impact on real GDP and becomes statistically significant at a level of 5%. (Tegegne, 2021). Short- and long-term money supply and economic growth are positively correlated (Dingela & Khobai, 2017). In the short run, the money supply, total capital formation, and inflation rate all favour economic growth (Razia & Omarya, 2022). The ARDL bound test results exhibit a long-run and good connection between CO_2 outflows, monetary turn of events, financial development, and energy utilization (Ahmad et al., 2018).

III. RESEARCH METHODOLOGY

a. Data Collection

The study examines the impact of RER misalignment on economic development (ED) from 1980 to 2022 using data from a number of European countries, including Germany, Italy, Spain, the Netherlands, Greece, Sweden, and Hungary. The statistics on foreign direct investment positions are available from Ferretti database (https://www.ferrettigroup.com). The data related to foreign direct investment (FDI), and production modification (PM), Trade openness (TO) is collected from UK Economic network database (https://www.economicsnetwork.ac.uk.com). The broad money supply (BMS), and GDP real per person (GDPP) data is gathered using the IMF's Database (https://www.imf.org.com), but CO_2 emissions is collected from World

Health Organization (WHO) database (https://www.who.int.com).

b. Conceptual Framework

Due to the ambiguity in the word "RER," assessing RER misalignment remains a challenge in international macroeconomics. RER misalignment is often calculated using model-based approaches using the purchasing power parity (PPP) model (Williamson, 1994). The core principles' viability, and a precise explanation of the model and procedures used RER equilibrium. The study found a strong correlation between the real exchange rates for traded and non-tradable currencies. Intervention in the foreign exchange market and capital flow restrictions are two key measures toguarantee a stable and competitive RER (Guzman et al., 2018).

c. Econometric Models

According to the Washington Consensus, the coefficient of actual exchange rate misalignment is anticipated to be negative (Williamson, 1990). The Washington Consensus contends that real exchange rate misalignment is bad for economic growth because resource allocation will be inefficient as a result of undervaluation or overvaluation. The real effective exchange rate (REER)is computed by averaging the bilateral real exchange rates with the most important trading partners and weighting the results geometrically as shown in equation 1.

$$\text{Ln}\, REER_{it} = \alpha_i + \beta_1\, LnTO_{it} + \beta_2\, FDI_{it} + \beta_3\, lnPM_{it} + \beta_4 lnTO_{it} + \beta_5 lnBMS_{it} + \epsilon_{i,} \quad (1)$$

Where $REER_i$ is the country's true effective exchange rate, FDI = foreign direct investment, and PM = production modification, TO = trade openness, BMS = broad money supply, and the natural logarithm is noted as (Ln). The trade openness (TO) is a significant factor over the long term, whereas the net present value (NPV) is significant over the near term. The ratio of the export price index to the import price index detrains the TO regardless of whether the income effect or the substitution effect predominates. The consequent increase in demand for commodities that may be traded improves RER. The income effect on demand and supply can counteract real exchange depreciation. PM stands for the variation in total human capital (HC) among the European countries. Increasing trade openness (TO) will cause REER's value to decline. Equilibrium RER and RER Elbadawi and Soto (1997) broad money supply is a measure of the short-term monetarycondition as a percentage of GDP. If TO, FDI, and PM increase but TO and BMS decline, REER is anticipated to increase. However, as demonstrated by the ARDL long-run findings, Nigeria's carbon emissions may be substantially related to the country's economic expansion, financial advancement, and stock market performance (Yu et al., 2022). The ARDL model is altered by the cointegration form for panel data analysis. Specified LnCO2 = [Ln$GDPP$, LnFDI, LnPM, LnTO, LnBMS], the PMG/ARDL model from equation (1) is used to determine the equilibrium RER,which reads as:

$$\Delta lnREER_{it} = \alpha_i + \varphi_1\, lnREER_{i.t-1} + \beta_2\, lnY_{i.t} + \sum_{j=1}^{q-1} \delta_{i.i} \Delta lnREER_{i.t-i} + \sum_{j=0}^{p-1} \mathrm{P}_{i.i} \Delta lnY_{i.t-i} + \epsilon_{i,} \quad (2)$$

The above equation 2, 1st difference of variables is defined as Δ, country-specific intercept is denoted as α_i, adjustment coefficient is shown as φ_i, besides $\theta = -(\beta_i/\varphi)$ is a long-run coefficient. According to Pesaran et al. (2001), the equilibrium RER for each country's economy is estimated using time-series data from ARDL Bound testing. Three advantages of the time series ARDL technique over the alternatives. It is possible to deal with this uncertainty by looking for long-run relationships using the ARDL the equation will be as follows:

$$\Delta LnREER_{j.t} = \xi_i + \sum_{j=1} \mathrm{P}_j LnREER_{j,t-j} + \sum \delta_i Y_{i,-i} + \mathrm{P}_{1j}\, LnREER_{j,t-1} + \mathrm{P}_{2j}\, LnTO_{j,t-1} + \mathrm{P}_{3j}\, FDI_{j,-1} + \mathrm{P}_{4j}\, LnPM_{jt} + \mathrm{P}_5\, \beta_4 lnGDP_{jt} + \mathrm{P}_6\, \beta_5 lnBMS_{jt} + \epsilon_{j,t} \quad (3)$$

Here LnCO2 = [LnTO, LnFDI, LnPM, LnGDP, LnBM]; p = 1, …., j, and q = 0,1, … … j lags; ξ_i is the clear interject for country j, and ϵit is the white noise disturbance run for country j. After the long-run association has been confirmed the powerful short-run effects of all parts on the RER are explored utilizing the limited ARDL with blunder amendment:

$$\Delta LnREER_{j,t} = \xi_j + \sum_{j=1} \mathrm{P}_j LnREER_{j,t-j} + \sum_{j=0} \gamma_j\, CO_{2\,i,t-j} + \theta ECT_{j,-1} + v_{j,t} \quad (4)$$

Where, $v_{j,}$ is unrestricted intercept, $ECT_{j,t-1} = L_{arger,t-1} - \alpha - \beta_1\ LnTO_{j,t-1} - \beta_2\ FDI_{,t-1} - \beta_3\ LnPM_{j,t-1} - \beta_4\ LnGDP_{j,t-1} - \beta_5\ LnBMS_{j,t-1}$, Since all explanatory factors in ARDL estimation are meant to be exogenous, running an endogenous explanatory variable may distort the results and is one approach to put the panel DOLS as:

$$LnREER_{j,} = \alpha_j + \beta_j CO_2 + \sum_{j=-k_i}^{ki} \gamma_{it} \Delta GDP_{j,-k} + \epsilon_{jt} \qquad (5)$$

LnCO2 $= \{LnTO, LnFDI, LnGDP, LnPM, LnBMS\}$, and γ_{it} lead and Issues with serial correlation and endogeneity are explained by lag discrepancies. In step two of the BEER technique, short-run variables are simultaneously set to zero. Christiano-Fitzerald Full-Length separate long-run basic values from cyclical components, asymmetric filtering is performed (Christiano & Fitzgerald, 2003). Long-run fundamental values are substituted into the estimated relationship to obtain equilibrium RER. Deducting the existing REER from the predicted equilibrium RER determines the RER misalignment. The formula below determines the RER misalignment index, which is significant:

$$MIS_{jt} = \ln\left(\frac{REER}{ERER}\right) = lnREER_{jt} - lnERER_{jt}$$

A actual symmetry reappearance for country '*j*' at a period '*t*' is denoted as "ERER." Equation 5demonstrates how the equilibrium CO2 emission in a few European countries is influenced by productivity modification (PM), trade openness (TO), and foreign direct investment (FDI). Once RER misalignment is evaluated, REER that currency misalignment is at a significant degree.

$$LnCO_{2jt} = \alpha_1 + \alpha_2\ LnFDI_{jt} + \alpha_3\ LnGDP_{jt} + \alpha_4\ LnTO_{jt} + \alpha_5\ LnGDA_{jt} + \alpha_6\ MIS_{jt} + \mathrm{K}_t \quad (6)$$

IV. RESULTS AND DISCUSSIONS

For the Augmented Dickey-Fuller (ADF) with intercept is used, as shown in table 1.

Table.1. Describes the outcomes of unit root tests

Country	Unit	Variables										
	Root	Ln CO_2	LnREER	LnTO	LnFDI	LnPM	LnGDP	LnBMS	LnNPV	LnHC	LnGDA	lnGDPP
Panel: Unit root test												
LLC	I(0)	-0.479	-0.454	-0.694	-2.867**	0.478	-2.408	-2.672**	4.254	-2.679***	-2.867***	-0.375
	I(1)	-20.567***	-4.408***	-20.567***	-28.651***	-8.251***	-6.674***	-24.454***	-8.679***	-28.648***	-25.278***	-28.679***
IPS	I(0)	-0.675	-0.069	-0.606	-2.518**	2.692	-2.08	-2.248	6.208	0.006	2.028	-0.648
	I(1)	-8.254***	-8.679***	-8.254***	-8.567***	-6.696***	-8.248***	-25.294***	-8.479***	-37.679***	-24.540***	-28.247***
ADF-Fisher x^2	I(0)	20.676	28.454	28.678	20.251	4.567	25.28	37.008	2.051	8.051	28.675	24.379
	I(1)	55.294***	69.204***	55.294***	206.408***	51.676***	202.251***	370.696***	54.202***	247.402***	375.047***	377.448***
Time Series: ADF- Fisher test												
Germany	I(0)	-2.037	-2.375	-2.451	-2.696	-0.208	-2.510*	-0.696	-2.228	-2.672	-0.228	-2.06

	I(1)	-5.279***	-4.518***	-5.279***	-5.279***	-6.067***	-8.377***	-8.208***	-6.377***	-6.479***	-8.679***	-6.540***
Italy	I(0)	-2.676	-2.377	-2.679	-2.694	0.047	-2.069	-2.051	2.248	-2.678	-2.678	-2.604
	I(1)	-8.451***	-4.054***	-5.276***	-8.451***	-4.448***	-5.167***	-6.567***	-4.069***	-20.037***	-6.867***	-6.651***
Spain	I(0)	-2.048	0.375	-2.676	-2.408	-2.054	-2.379	-2.051	0.478	-2.069	-5.267***	-2.68
	I(1)	-8.651***	-6.567***	-8.067***	-8.651***	-4.408***	-6.202***	-8.408***	-5.279**	-28.679***	-5.290***	-6.476***
Netherlands	I(0)	-2.567	-2.204	-2.478*	-2.2	-2.679	-2.676	-2.479	-0.069	-0.478	-0.479	-2.251
	I(1)	-4.378***	-6.602***	-5.274***	-4.378***	-6.676***	-8.020***	-6.602***	-6.676***	-6.540***	-8.679***	-6.251***
Greece	I(0)	-2.208	-2.479*	-2.679	-2.48	2.254	-2.254	-2.654	4.251	-2.544	-2.478	-0.479
	I(1)	-6.696***	-5.294***	-6.696***	-4.451***	-4.000***	-5.292***	-4.518***	-4.408***	-6.544***	-8.478***	-8.067***
Sweden	I(0)	-2.254	-2.692*	-2.651	-2.379	-0.694	-2.375	-2.478	0.006	-2.694	-2.375	-0.602
	I(1)	-4.378***	-8.567***	-4.378***	-6.608***	-5.167***	-20.676***	-6.051***	-5.272***	-6.696***	-8.004***	-2.447***
Hungary	I(0)	-2.208	-2.479*	-2.679	-2.48	2.254	-2.254	-2.654	4.251	-2.544	-2.478	-0.479
	I(1)	-6.696***	-5.294***	-6.696***	-4.451***	-4.000***	-5.292***	-4.518***	-4.408***	-6.544***	-8.478***	-8.067***

Notes: P-value of unit root rejection by ***, **, * are 1%, 5%, and 10% respectively. For choosing the maximum latency, SIC is employed.

a. RER Misalignment

Cointegration between the REER and its basics—runs of exchange, net unfamiliar resource, efficiency distinction, exchange transparency, and expansive cash—should be validated to examine its long- and short-term ruminants. Johansen cointegration tests show in Table 2 that elements in the real conversion standard condition have a long-term connection with CO2 discharges. Thus, an appropriate board gauge technique improves long-term evaluations.

Table.2. Demonstrates the findings of Trace and Max-Eigen test

Estimated Total Numberof CEs (s)	Trace test		Max-Eigen test	
	Fisher-Stat	Prob.	Fisher-Stat	Prob.
None	87.07	0.0004	41.02	0.00692
Maximum (i)	55.03	0.0007	31.08	0.07456
Maximum (ii)	34.02	0.0003	16.12	0.28924

Note: Suspicion of an inclination delays (in first difference, 1:1)

The impact of the REER panel on the REER over the long and short term is examined positive (Pesaran et al., 1999). The statistically substantial negative adjustment coefficient demonstrates the long-term stability of the relationship between REER and its fundamentals. According to PMG data, REER is influenced by broad fundamentals, transient variables, and the long-term signals that these variables are anticipated to transmit. A rise

in trading runs and net foreign asset holdings are indicators of the REER. The outcomes of the PMG and ARDL estimations are shown in Table 3.

Table.3. Results for the Real Interest Rate Model provided by PMG and ARDL

Variable	Coeff.	Stand-Err.	t-Stat	Prob.
Long-run equation				
$LnCO_2$	0.2005	0.0056	2.0548	0.0032
$LnTO$	0.2805	0.0605	2.1316	0.0028
$LnFDI$	0.0055	0.0024	6.0554	0.0001
$LnGDP$	0.3276	0.2051	2.3124	0.0624
$LnPM$	-0.4624	0.234	-2.005	0.0212
$LnBMS$	-0.0316	0.2031	-2.0605	0.0328
Short-run equation				
$ECT(-1)$	-0.2551	0.234	-2.0208	0.0205
$\Delta LnCO_2$	0.0325	0.0628	2.0054	0.3262
$\Delta LnTO$	0.0205	0.0404	2.0624	0.0725
$\Delta LnFDI$	0.0001	0.0003	0.3276	0.3105
$\Delta LnPM$	-0.6031	0.2432	-4.2328	0.0024
$\Delta LnGDP$	-0.2594	0.0581	-2.1325	0.0041
$\Delta LnBMS$	-0.0605	0.0601	-2.0204	0.2054
C	2.0203	0.3105	2.0255	0.0537
$@Trend$	0.0004	0.0008	0.5905	0.8328
Dependent variable (Mean)	-0.0006	Dependent variable (Stand-Dev)		0.3145
Regression (SE)	0.0324	Info criterion ofAkaike		-2.3234
Σ^2 reside	2.3027	Criterion of Schwarz		-0.5647

Note: Model selection is based on the Schwarz Criterion (SIC). The model has been selected as ARDL (1, 1, 2, 1, 2, 1)

Some countries may charge less for items that cannot be exchanged when compared to items thatcan. This is seen by the manner that BMS and TO cause CO_2 emissions to growth. The monetary standards of European countries will decline if CO_2 outflows increase quickly due to changes in GDP, FDI, or creation.

4.1 DOLS without temporal trends

Table 4 demonstrates the consistency between the conclusionsmade from the DOLS findings for the RER model and those drawn from the PMG gauge and the collective mean board DOLS evaluation results. There is a greater need for foreign currency as certain countries spend more on capital goods and raw materials for infrastructure upgrades and as CO2 emissions rise. RER model evaluation and PMG reliability testing employ the Board DOLS with and without transient patterns.

Table.4. Evaluation of the RER Model Using Panel Data with Discrete-Odds Least Squares

Variables	DOLS deprived of period tendency			DOLS through period tendency		
	Coeff.	Std. Error	Prob.	Coeff.	Std. Error	Prob.
$LnCO_2$	0.4003	0.0646	0.0204	0.3075	0.083	0.0208
$LnTO$	0.2024	0.0542	0.0275	0.2623	0.0544	0.0275
$LnFDI$	0.0026	0.002	0.0468	0.0031	0.0026	0.2754
$LnPM$	-0.4514	0.2354	0.4064	0.4057	0.6057	0.4756
$LnGDP$	-0.7502	0.2064	0.0002	-0.2657	0.2756	0.0426
$LnBMS$	-0.4603	0.4202	0.0075	-0.4632	0.3075	0.0457

Note: Grouped estimation; lag = 1, lag = 2; (Pre-whitening with lags 5 = 1, Bartlett kernel, Newey-West fixed bandwidth)

The DOLS estimate suggests that the impact of relative productivity adjustment is small and negative. All other criteria for calculating the REER were also found to be statistically significantin a few European countries

and outcomes of the bound tests are shown in Table 5.

Table.5. Statistical Analysis of the Real Exchange Rate Model Using the Upper Bound F-Test

Country	ARDL	Absence of Deruninistic Tendency			ARDL	Presence of Deruninistic Tendency		
	Model	F-statistics	t-statistics	LM (2)	Model	F-statistics	t-statistics	LM (2)
Germany	487214	20.5153	-4.6218	0.2826	487214	6.5412	-4.4946	0.516
Italy	214204	8.0532	-4.0496	0.7102	214204	21.3516	-4.8453	0.2046
Spain	410021	20.0484	-2.7184	0.5031	410221	6.8621	-0.2622	0.2053
Netherlands	410221	4.8608	-4.0853	0.2608	248720	22.5346	-8.7186	0.2182
Greece	214487	6.0822	-2.5362	0.5349	287287	6.2842	-2.0253	0.7146
Sweden	414214	6.5346	-2.486	0.4206	289829	4.5321	-2.8646	0.2862
Hungary	350245	21.0222	-1.9877	0.3589	387456	5.9789	-1.9884	0.3124

Note: The critical values for the F-statistic for a 1%, 5%, and 10% significant level were established by Pesaran et al. (2000).

The findings of the F-test validate the long-term relationship between the REER and its principles. The bound testing findings' t-statistics for the Netherlands, Greece, and Sweden are insignificant. Greece, Sweden, and Hungary all have a slower REER return to equilibrium value in the ECT (1)term. The results of a Bound test are very close to the true values regardless of whether or not a trend is present. Since this trend is considered to be very minor, it is typically ignored when estimating ARDL. The ARDL approach may measure REER ruminants' long-run and short-run coefficients due to cointegration. Results from an unrestricted ARDL estimate are shown in Table 6, and consistent with PMG conclusions.

Table.6. Estimation coefficients of the ARDL model utilization in the RER Model

Country	Germany	Italy	Spain	Netherlands	Greece	Sweden	Hungary
Estimated results in long-run							
$LnCO_{2t-1}$	0.049**	-0.006	-0.5	0.631***	-0.449	0.312**	-0.5
	-0.047	-0.204	-0.486	-0.062	-0.631	-0.042	-0.486
$LnTO_{t-1}$	0.049**	-0.006	-0.5	0.631***	-0.449	0.312**	-0.5
	-0.064	-0.204	-0.486	-0.062	-0.631	-0.042	-0.486
$LnFDI_{t-1}$	0.008***	0.004*	-0.042**	0.004*	0.002	0.006***	-0.042**
	-0.002	-0.004	-0.05	-0.002	-0.002	-0.002	-0.05
$LnPM_{t-1}$	-0.486**	0.802***	0.482	-0.087	-0.622	2.484*	0.482
	-0.502	-0.502	-2.49	-0.023	-0.592	-0.842	-2.49
$LnGDP_{t-1}$	-0.318	-0.249	2.81	-0.045	-0.631***	-0.492**	2.862
	-0.042	-0.504	-2.802	-0.029	-0.042	-0.502	-2.802
$LnBMS_{t-1}$	-0.492***	-0.511*	4.462	0.406	0.402	-0.496**	4.462
	-0.408	-0.408	-2.842	-0.249	-0.592	-0.249	-2.842
Estimated results in short-run							
ECT_{t-1}	-0.462***	-0.608***	-0.049***	-0.312***	-0.511***	-0.650***	-0.049***
$\Delta LnCO_{2t-1}$	-0.042***	–	-0.511***	0.402***	0.404***	-0.206*	-0.551
$\Delta LnREER_{t-1}$	-0.042***	–	-0.511***	0.402***	0.404***	-0.206*	-0.511***
$\Delta LnREER_{t-2}$	0.060**	–	-0.312***	-0.486***	–	-0.622***	-0.312***
$\Delta LnREER_{t-3}$	–	–		0.482***	–	–	
$\Delta LnTO$	0.049***	–		–	–	–	
$\Delta LnTO_{t-1}$	-0.031	–		–	–	–	
$\Delta LnTO_{t-2}$	-0.502***	–		–	–	–	
$\Delta LnFDI$	–	–		–	–	0.006***	
$\Delta LnFDI_{t-1}$	–	–		–	–	0.006**	
$\Delta LnPM$	-2.062***	-0.849***		-0.492***	-0.422	0.45	

$\Delta LnPM_{t-1}$	-2.486***	–		–	-2.312***	-2.598***	
$\Delta LnPM_{t-2}$	–	–		–	-2.860**	–	
$\Delta LnGDP$	–	–	-0.650***	-0.620***	-0.492***	–	-0.650***
$\Delta LnGDP_{t-1}$	–	–		–	0.502**	–	
$\Delta LnGDP_{t-2}$	–	–		–	-0.208**	–	
$\Delta LnBMS$	–	-0.511**	-0.059***	0.049	–	–	-0.059***
$\Delta LnBMS_{t-1}$	–	0.504	-0.592***	-0.604***	–	–	-0.592***
$\Delta LnBMS_{t-2}$	–	0.624***	-0.631***	0.042	–	–	-0.631***
$\Delta LnBMS_{t-3}$	–	–		-0.486***	–	–	
C	2.450***	6.500***		0.850***	2.806***	8.480***	
Residual Diagnostics and Model Stability							
Adjusted-R^2	0.592	0.608	0.865	0.592	0.85	0.806	0.865
F-Statistics (Probability)	0.0002	0.0001	0.0007	0.0000	0.0004	0.0001	0.0002
LM-test (probability)	0.312	0.821	0.406	0.502	0.486	0.406	0.406
Normality	0.842	0.406	0.849	0.856	0.598	0.486	0.849
BGP (Probability)	0.848	0.408	0.2048	0.452	0.064	0.086	0.2048

Note: Error bars represent standard deviations; ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Sweden and Hungary both saw a drop in their REER as a result of rising relative productivity and an increase in the FDI position. The TO and FDI increase the REER whereas trade openness and BMS decline for Germany, Italy, and Spain. Currency RER of Germany, Netherlands, and Italy decline in the short run with an expanding money supply. If trade openness and foreign direct investment improve, the value of the currencies of Sweden and Spain will increase. The REER of the Netherlands, Singapore, and Germany decline as a result of increased trade openness. The REER decreases as a result of the widespread perception in these countries that the relative productivity modification gap is widening. The real exchange rates, trade openness, net foreign direct investment, productivity-modified broad money supply, and economic progress over time are all strongly correlated with these countries' CO_2 emissions, according to empirical evidence.

b. Misalignment of exchange rates and its impact on economic development

Table 7 demonstrates the significances of the growth model cointegration test to determine the results of the currencies for some European countries.

Table.7. Consequences of the Growth Model Cointegration Test by Johansen Fisher

Hypothesized No. ofCE (s)	**Trace test**		**Max-Eigen test**	
	Fisher-Stat.	**Prob.**	**Fisher-Stat.**	**Prob.**
None	89.03	0.0002	67.028	0.0001
Maximum (i)	42.03	0.0001	41.023	0.0031
Maximum (ii)	14.98	0.0331	10.12	0.6455

Note: Lags are assumed, with a linear terminist trend as the trend (in first difference, 1:1)

To ascertain the effect of RER misalignment on the economic growth of a few European countries. The PMG estimation's error correction run is statistically significant and unfavorable, indicating a link between the growth model's variables over the long term. Table 8 displays the PMG and panel DOLS estimate research results, which show that the rise of real exchange investment and FDI in several European countries is favorably connected with economic growth. However, economic growth is hindered when there is a mismatch between GDA and RER, which increases CO_2 emissions.

Table.8. The Growth Model's PMG/ARDL Assessment Consequences

Variable	**Coefficient**	**Standard Error**	**t-Statistic**	**Probability ***
Long Run Equation				

$LnCO_2$	1.9178	0.4086	4.0832	0.0025
$LnFDI$	3.0032	0.4978	4.8178	0.0017
$LnHC$	1.75348	0.5124	2.6428	0.0174
$LnTO$	0.2086	0.2832	0.8651	0.512
$LnGDA$	-0.5134	0.4062	-2.2806	0.0512
MIS	-0.6868	0.4286	-2.2862	0.1947
Short Run Equation				
ECT_{t-1}	-0.0518	0.0064	-4.2842	0.0002
$\Delta LnCO_2$	0.0574	0.1947	1.5455	0.2862
$\Delta LnFDI$	0.0512	0.1845	1.4231	0.284
$\Delta LnHC$	0.0301	0.1784	1.5434	0.284
$\Delta LnTO$	0.2861	0.0608	2.4836	0.4083
$\Delta LnPM$	-0.1784	0.1947	-0.4068	0.6864
$\Delta LnGDA$	-0.0412	0.1755	-2.512	0.2462
ΔMIS	-0.0518	0.1902	-2.5584	0.0634
C	0.5701	0.0624	5.0178	0.0001
Dependent variable(mean)	0.0574	Dependent variable (stand-deviation)		0.0624
Regression (SE)	0.1947	Info criterion ofAkaike		-4.1708
Residence (Σ^2)	0.2834	Criterion of Schwarz		-4.5134
Log-likelihood	642.86	Criterion of Hannan-Quinn		-4.8634

Note: Utilizing the Schwarz Criterion (SIC), Model chosen: ARDL (1, 1, 2, 1, 1, 0).

Rodrik's (2008) contention that RER misalignment is essentially overvaluation with long- and short-term unfavorable financial impacts is corroborated by the findings of the present study. Table 9 indicates results for the increase in CO_2 emissions caused by the economic expansion of European countries. CO_2 emissions are negatively impacted by the government'sunclear macroeconomic plans, which in turn are caused by the government's inability to provide proper institutional and legal frameworks in development aid.

Table.9. The Group-mean Panel DOLS estimations for the Growth Model

	DOLS deprived of period tendency			DOLS through period tendency		
Variables	**Coeff.**	**Stand-Error**	**Prob.**	**Coeff.**	**Stand-Error**	Prob.
$LnCO_2$	0.5031	0.08952	0.00009	0.5687	0.0945	**0.00001**
LnTO	0.6201	0.00001	0.00001	0.3024	0.0259	**0.00003**
LnFDI	0.5874	0.0956	0.00003	0.3221	0.5201	**0.5213**
LnGDP	0.0623	0.0546	0.3589	0.4135	0.0267	**0.0521**
LnGDA	-0.3051	0.0874	0.03845	-0.3021	0.0632	**0.00001**
MIS	-0.0247	0.2587	0.2566	-0.05487	0.0642	**0.3042**
Regression (SE)	3.0289			5.08742		
Variables (long-run)	**0.0048**			**0.000487**		

Note: Fixed leads and lags specification (lead = 1, lag = 2); Grouped estimation; (Bartlett kernel, Newey-West fixed bandwidth, prewriting with lags = 2)

Table 10 demonstrates the basic qualities for the F-test measurement, and the required ARDL model.

Table.10. Bound Testing Results for the Growth Model

Country	ARDL	Without Deruninistic Trend			ARDL	With Unrestricted Trend		
	Model	**F-test**	**t-test**	**LM (2)**	**Model**	**F-test**	**t-test**	LM (2)
Germany	311960	2.4986	-0.6071	0.6719	302112	2.6297	0.2662	**0.8314**
Italy	310002	9.0235	-0.4926	0.8976	310002	5.9626	-0.3149	**0.1949**
Spain	310192	5.0004	-4.0254	0.6026	300219	6.8497	-6.9782	**0.2785**
Netherlands	307440	7.0104	-2.8297	0.4002	302582	2.2662	-2.7186	**1.0052**
Greece	300192	9.0297	-0.4324	0.3897	190310	2.6249	-2.0462	**0.3484**
Sweden	316024	4.0412	-4.2491	0.2976	300012	4.4997	-2.4671	**0.2874**
Hungary	**308019**	**6.0046**	**-2.8297**	**0.5214**	**304550**	**2.0897**	**-2.7186**	**1.0028**

Note: SIC is used for Lag selection

It is conceivable for a few selected countries to estimate the ARDL model broadly in order to evaluate the long- and short-term effects of RER misalignment on financial growth. Results from ARDL-bounds tests frequently concur with those from PMG the Bound test discoveries (Pesaran et al., 2001). Table 11 provides estimates of how foreign direct investment, economic growth, and CO_2 emissions will affect the long-term growth of the Netherlands, Spain, and Germany. Hungary's relatively stable internal macroeconomic situation may account for their beneficial influence on the growth of Germany and Sweden. Exchange transparency hurts Sweden and Spain's economies, but compared to other countries, it has less of an impact on CO_2 emissions. These countries' real conversion scale methods and CO_2 emissions can be linked to their frequent depreciations because of their inflationary economies. In other words, the short-term advantages of the RER's undervaluation to the Dutch economy. The economies of Italy and Spain suffer fromovervaluation, which also has an effect on CO2 emissions. In Germany, Italy, Spain, and Greece, respectively, real estate investment and real exchange rate favour have a substantial influence on CO2 emissions. Government development aid affects the rise of CO2 emissions significantly and favourably in Hungary, the Netherlands, and Sweden, but significantly and negatively in Germany. The growth of the economies of the Netherlands and Greece has been adversely affected by the opening of their markets to trade, foreign direct investment, and CO2 emissions rise

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Table.11. Estimation coefficients for the ARDL model utilized in the Growth Model

Country	**Germany**	**Italy**	**Spain**	**Netherlands**	**Greece**	**Sweden**	**Hungary**
Estimated results of Long-run							
$LnCO_{2t-1}$	0.419	1.045	0.003	0.524	-1.009	0.0053	0.003
	-0.791	-3.009	-0.046	-0.505	-1.063	-0.109	-0.046
$LnFDI_{t-1}$	0.51	1.475	0.001	0.405	-1.793	0.091	0.001
	-0.364	-3.501	-0.015	-0.469	-1.564	-0.079	-0.015
$LnGDP_{t-1}$	-0.463	0.419	0.579***	0.546	9.179	0.579***	0.579***
	-0.915	-1.512	-0.079	-0.913	-5.524	-0.203	-0.079
$LnHC_{t-1}$	-1.791	1.602	-0.793***	-0.079	-3.046	0.791	-0.793***
	-5.554	-3.791	-0.093	-0.791	-0.308	-0.204	-0.093
$LnGDA_{t-1}$	0.405	-3.005	0.105***	-0.519**	1.308	-0.153**	0.105***
	-0.507	-1.845	-0.079	-0.179	-1.469	-0.091	-0.079
$MISt-1$	-1.821	1.402	0.015	-0.901	-1.079	0.745	0.015
	-3.345	-3.901	-0.046	-0.645	-3.051	-0.627	-0.046
Estimated results of Short-run							
$ECTt-1$	-0.091***	-0.046***	-0.405***	-0.179***	-0.079***	-0.191***	-0.191***
$\Delta LnCO_{2t-1}$	0.469***		0.529***		-0.501**	0.703***	0.703***
ΔLnGDP$t-1$			0.469***		-0.501**	0.703***	0.703***
ΔLnFDI				0.627***	-0.003	-0.015**	-0.015**
ΔLnFDI$t-1$						-0.079*	-0.079*
ΔLnPM	0.579***						
ΔLnTO	0.015		-0.064**	-0.191***	-0.046**		

$\Delta \mathrm{Ln}\mathrm{TO}t-1$	0.091**				0.053***		
$\Delta \mathrm{Ln}\mathrm{GDA}$			0.079***	-0.164***	0.015	-0.046	-0.046
$\Delta \mathrm{Ln}\mathrm{GDA}t-1$						0.051***	0.051***
ΔMIS		-0.179***	0.053***		-0.005	0.093***	0.093***
$\Delta MIS t-1$						-0.019**	-0.019**
C	1.091***	-0.519***	3.153***		0.791***	1.091***	1.091***
Residual Diagnostics and Model Stability							
Adjused-R^2	0.5205	0.6023	0.6478	0.6002	0.7025	1.0002	1.0056
F-Statistics (Probability)	0.00001	0.00021	0.00004	0.00001	0.00004	0.00002	0.00011
LM test (pro)	0.5412	0.6023	0.6014	1.0231	0.5864	0.6235	0.7215
Normality	0.9562	0.0632	0.8546	0.3025	0.7956	0.6478	0.8546
BGP (Probability)	0.8546	0.9053	0.7024	0.6023	0.3642	0.6328	0.2564
(CUSUM)	Accept	Accept	Accept	Accept	Accept	Accept	Accept
(CUSUM-Sq.)	Accept	Accept	Accept	Accept	Accept	Accept	Accept

Note: Standard errors are in parenthesis, while ***, **, and * are significant at 1%, 5%, and 10%, respectively.

Both export market shares and the ratio of private gross fixed capital formation to GDP are negatively impacted by an increase in the misalignment that is heading towards overvaluation, demonstrating the importance of both the competitiveness and the investment channel in linking the effects of RER-misalignments with economic growth. According to Hausmann et al. (2005), real exchange rate depreciation speeds up economic development. The real exchange rate's effecton structural changes in the industrial sector and economy, as well as the reallocation of capital and other production elements, is recognized in some research as having an impact on economic growth. The study discovered that the internal relative price as well as the relative price of GDP both contribute to the dissemination mechanism (Toulaboe, 2017). The study findings suggest that the RER changes can be significant even in the absence of changes in the nominal exchange rate since the internal relative price, which represents structural differences in pricing, only indirectly depends on the nominal exchange rate. Increased real investment and foreign direct investment may boost the economies of a few European countries, but if trade openness, government development aid, and RER misalignment lead to higher CO_2 emissions, this may be compensated by a decline in GDP (Mamun et al., 2020). A decrease in the conversion scale should help the contemporary region generate more revenue and develop as the REER calculates the whole cost of tradable and non-tradable goods (Rodrik, 2008). The evaluation looked at the relationship between misalignments and various exchange receptiveness performance variables in addition to ventures, which had recently been obscured by prior research (Razmi et al. 2012). The results of the Dumetriscu-Hurlin Granger causality test supported the existence of a bidirectional causal relationship between trade opennessand economic development (Tachie et al., 2020). Due to the high degree of openness among most EU countries, the "competitiveness-channel" serves as a crucial connection between misalignments and economic expansion.

V. CONCLUSIONS

The study examined the impact of RER misalignment on the economic advancement of several European countries. The results of the ARDL bounds testing frequently concur with those of the panel estimate. Current account and fiscal deficits, rising external debt repayment burden, excessive inflation, and widening saving gap in a few European countries continue to be major policyconcerns for CO_2 emissions increase. If the real exchange rate rises in all countries with the exception of Spain and the Netherlands, foreign direct investment, productivity improvement, andtrade openness will also be factors. A boost in real exchange rate investment and foreign direct investment would benefit the long-term economic growth of European countries, under the panel's ARDL forecasts. FDI positions are predicted to decline and the RER to grow as trade openness and money availability in

the targeted European countries expand. Long-term currency misalignment has no impact on the economic growth of any one European country. Overvaluation of the real exchange rate hurts Italy's economic development while undervaluation benefits the Netherlands. Due to the RER mismatch, both short- and long-term increases in CO_2 emissions may have a detrimental effect on the financial development of these countries. The results also indicated that when human capital and productivity are improved, CO_2 emissions would also rise, but this will be offset by an increase in economic growth brought on by higher trade openness and foreign direct investment inflows. The ability of the exchange rate policy to react swiftly to economic earthquakes, which over time aids in the reduction of CO_2 emissions, determines its long-term survival. Short-term economic growth in Spain, Italy, Singapore, and Germany would be boosted by rising currency real exchange investment, foreign direct investment inflows, and government development aid. In contrast, it would be slower in the Netherlands, Greece, and Hungary if trade were more open. The currencies of a few European countries frequently need the deployment of a real exchange rate government suitable with macroeconomic policy to correct the continued mismatch and lessen its detrimental effects on economic growth.

5.1 Future Suggestions

It allows opportunity for more investigation, which may take the form of a breakdown of actual exchange rate variances by nation. Additionally, using higher-frequency time series might result in more practically applicable outputs for predicting impending currency crises. Additional policies and regulatory frameworks are required to address the persistent currency overvaluation and the attendant macroeconomic instability.

Abbreviations

PM: Production modification
TO: Trade openness
BMS: Broad money supply
GDA: Government differential assistance
CO_2: Carbon dioxide
NPV: Present Net Value

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