Cross-cultural study the macro variables and its impact on exchange rate regimes

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Abstract

This is an empirical analysis of study simultaneously focus on examining the impact of macroeconomic variables, i.e., GDP growth, GDP per capita, inflation, foreign direct investment, exports, imports, interest rates, foreign debt and foreign reserves on the exchange rate regimes, using the sample of five countries from MSCI developed markets index, emerging markets index and frontier markets index each from 1970 to 2020. This study predicts and provides several essential contributions for markets, financial and economic, that fills the gaps in the markets economic and financial literacy of desired countries. The study identifies and evaluates the impact using the most advanced statistical frameworks. This study adopts ML—binary logit (quadratic hill climbing) and investigates the change in the exchange rate regimes due to macroeconomic variables. The empirical results confirm that Australia, Hong Kong, Japan, New Zealand and Singapore markets take timely correct exchange rate regimes decisions, which lead to developed markets. As emerging markets and frontier markets never adopt the exchange rate regimes three, four, and six, which is a significant impact factor that affects those markets never growth according develops markets. Foreign debts, inflation and foreign reserves are severe challenges for emerging and frontier markets.

Keywords Exchange rate regimes, Macroeconomic variables, MSCI markets index

Introduction

Background of the study

An exchange rate is a rate in which one country, like Pakistan currency, is exchanged for the other countries' currencies like US dollar, euro [1]. In twentieth century, most countries in the world currency determine with fixed exchange rates rather than specified by the marketplace. World War 1 countries currency set as gold worth. In World War 2, the select money mode again changed. Most countries' currency value is fixed as US dollar terms and equilibrium in exchange rate determined by the foreign exchange market as demand–supply currency equates [2].

As well as mostly countries' currencies followed the link through Bretton Woods's system with British Sterling Pound till 1970, but when failing of the Bretton woods system, the exchange rate of the regime changed across most world countries. Most countries adopted a floating exchange rate and did not allow them to freely move the nominal exchange rate until they feared floating [3]. The world's central bank was responsible for maintaining the exchange rate, where countries adopted the fixed exchange rate. The exchange rate was fixed by buying and selling currencies for maintains the demand and supply in currencies markets. In 1973, the floating exchange rate was made nominal, which investors discouraged due to risk exchange rate fluctuations. After World War 2, US influence increased in the international marketplace. In 1971, most countries linked currency with the US dollar. Political relationship and instability affected the currency devaluation [4].

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The empirical investigation suggests the existence of a large UGE can decrease the revenues (tax), depress the GDP and increase the social-economic problems. Tax evasion has a negative relationship fiscal and monetary policy of Pakistan, and an increase revenue (tax) audit ratio may minimize the size of countries' economies [5]. The impact of devaluation was experienced for the next seven years on financial factors like fiscal deficit, inflation, circular debt, taxes, interest rate and economy [6]. Exchange rate depreciation improves the balance of payment to reduce the growth rate of countries. Credit and fiscal policies to affect demand aggregate, authorities or government can influence the economic activity. Supply position determines the level and growth rate of employment and output. Eventually, the government will move to alter the domestic currency value of foreign exchange. Policies as the natural variables revert the economy to equilibrium Positions [7]. Past financial crisis major developed countries affected and remain weak as even nonexistent, exchange rate policies of some countries led as accentuating the imbalance of world and create hurdles against the recovery of the world economy [8].

The economic approach emphasizes the role of economic leverage undervaluation. It is still a powerful cyclical instrument and employed with precautionary to be internationally and globally consistent. The misalignment index plays a crucial role in reversing the growing trend. The undervaluation of their currency positively acts on their growth [9]. The change in the shadow economy size reflected the shift in monetary indicators. An increase in the shadow economy activity is likely to push up the currency demand of Pakistan [10]. The researcher found was the currency exchange rate had a positive impact on the economic growth of Pakistan. Exchange rate and inflation have a significant adverse effect on Pakistan economic growth. Decrease GDP will increase inflation as GDP reduces when the exchange rate increases. The result indicates that foreign direct investment, exchange rate and inflation have a significant effect on the economy as the capital stock has no significant impact on the economic growth of Pakistan. Direct foreign investments have a positive relationship with GDP [11].

The exchange rate on growth and domestic prices of all nominal variables (other than exchange rate) are endogenous and temporarily affect the equilibrium, as well as demand management policies, which can increase the growth rate of output and employment at the cost of domestic price and external deficits increases. There is no severe damage to growth during high inflation crises, and most countries recovery trend their actual growth rate [12]. Interest rates and inflation harm economic growth

[13]. The literature has evidence which not only evaluates the relationship between misalignment and development but also has a link with growth sources like foreign direct investment and growth, among others. The mostly world countries used currency to attempt foreign direct investment inflow influence from countries for using against the weak currency. Cash flows were led to the presence of countries foreign direct investments, and a study was found the negative impact of exchange rate volatility on direct investment [14].

Devaluation wills disfavor the trade balance, inflation in the cause of Pakistan and economic growth [15]. The relationship between gold prices represents commodity money system and fiat money as stability of economic indicators. Both approaches have no proper representations, not very significant against each other as inflation on macroeconomic variables. The commodity-based money system is not working free of inflation. The commodity money system is effective in the dynamic country's economic growth and, on the contrary, fiat money. The gold money base system is more reliable and creates high economic growth in the country [16]. The study result shows that currency redenomination is beneficial for country growth in Ghana [17]. The researcher analyzes and predicts the currency valuation factors. In Asia, only Pakistan exports are the suitable predictor of the currency valuation [18]. Researcher uses the monetary performance affected by exchange rate and inflation. Exchange rate was used policy in general, and currency devaluation like japan was most successful for stability [19]. This shows results that sustainable corporate social responsibility is the leading factor that enhances the firm performance [20]. Money supplies maintain the economic growth and stability of the fixed exchange rate [21]. Post-Bretton woods float exchange rate dynamics affected due to global prices [22]. Latest studies provide detail investigation relationship exchange rate regimes and macroeconomic variable GDP, trade and inflation [20, 23]. Exchange rate depreciation was a well anticipated in low inflation with reserve loss [24].

Statement of the problem

Empirical studied observed possible devaluation effect. Most developing countries used devaluation as a policy instruments. This study will investigate the devaluation (exchange rate effect and relationship on macroeconomic variables, i.e., GDP growth, GDP per capita, inflation, foreign direct investment, exports, imports, interest rates, foreign debt and foreign reserves for two reasons: First, the developing countries like Pakistan have currency short story of exchange rate usage adjustments as a policy tool to attract the

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external competitiveness. Since 1970, Pakistan devaluated its currency where continuously like other developing countries. ETB exchange rate is adjusted rather than sound judgments. Second, governments are heavily dependent on agricultural manufacturing industries and import goods that affect output. A large number of studies conducted on the impact of exchange rate on the economy mostly considered exchange rate channel while macroeconomic variables, i.e., GDP growth, GDP per capita, inflation, foreign direct investment, exports, imports, interest rates, foreign debt and foreign reserves implications of currency adjustments, are commonly overlooked. Production and exports are highly heterogeneous; export orientation dependency and import increase the dependence and liabilities of dollarization. The empirical evidence mixed effect of currency adjustments on economic growth (output) and government development approaches, as industries like manufacturing are the main engine of countries economic growth, is the best possible suggestion to guide policy directions. Early empirical studies used a simple method like ordinary least squares to measure the effects of exchange rate instability. Most popular cultural analysis has time-series econometrics [6]. However, the most recent evidence identifies the use of some macroeconomic in the present study which had nonlinear relationship found, which were generated by nonlinear processes. This study assumed the entire variable caused by a primarily linear process. The study will investigate which exchange rate regime is best fit and valuable for markets indexes and countries development. This study will therefore attempt to fill this research gap.

Objective of study

The general objectives of the study are to analyze the effect of macroeconomic variables, i.e., GDP growth, GDP per capita, inflation, foreign direct investment, exports, imports, interest rates, foreign debt and foreign reserves on exchange rate regimes spanning from 1970 to 2020, identify the significant impacting factor and suggest how to overcome negative impact. Data source by economic surveys, government progress reports, World Bank reports, IMF reports, central banks of countries and governments ministerial and financial websites.

The particular objective is as follows:

1. Review the trend of countries exchange rate regimes and macroeconomic variables, i.e., GDP growth, GDP per capita, inflation, foreign direct investment, exports, imports, interest rates, foreign debt and for-

eign reserves according to developed, emerging and frontier countries markets index (MSCI rank) for the period of 1970 to 2020.
2. To analyze the real effects of macroeconomic variables, i.e., GDP growth, GDP per capita, inflation, foreign direct investment, exports, imports, interest rates, foreign debt and foreign reserves on exchange rate regimes on the bases of the country by country as well as countries market indexes wise, developed market index, emerging market index and frontier market index countries (MSCI rank) for the period of 1970 to 2020.

Research questions

- What is the trend of exchange rates regimes and macroeconomic variables, i.e., GDP growth, GDP per capita, inflation, foreign direct investment, exports, imports, interest rates, foreign debt and foreign reserves in developed, emerging and frontier countries (MSCI rank)?
- Does the macroeconomic variables, i.e., GDP growth, GDP per capita, inflation, foreign direct investment, exports, imports, interest rates, foreign debt and foreign reserves, have an effect on exchange rate regimes on the bases of the country by country as well as countries market indexes wise, developed market index, emerging market index and frontier market index countries (MSCI rank)?

Literature review
A brief discussion on the exchange rate

IMF first time devaluation suggests Zambia, since the exchange rate is more practical use in works [25]. An exchange rate is when one country, like Pakistan currency, is exchanged for the other currencies like the British sterling pound and US dollar [1]. There are two types of exchange rate expressions: domestic currency per unit of the foreign currencies, and second the foreign currencies units are expressed as the domestic currency. This study takes data from the currency market, and the exchange rate was defined as the domestic currency per unit of the foreign currencies.

Exchange rate policies

Developing countries central banks of countries like Pakistan bank state of Pakistan determine exchange rate policies since 1990 like exchange rate regime in which

Pakistan rupees value vis-à-vis other world currencies is defined in the foreign exchange market as market forces of demand and supply. Demand and supply situation showing the country balance of payment position. Foreign exchange mainly comes from export, foreign direct investment, remittances and foreign loans and demand due to imports, payments of debt. If the order of the foreign currencies was higher than the supply of the foreign money, then domestic currency goes depreciate. As the supply of the foreign currencies is higher than the demand, the domestic currency value increases and vice versa. State bank of Pakistan made sure smooth operation of the foreign exchange market and was needed to intervene in the foreign exchange market. State Bank of Pakistan never predetermines the exchange rate of any currency (SBP). The LDC authorities' exchange rate problem management was varied, and there were issues such as economic stability, promotion of exports, limiting imported inflation and foreign direct investments [26, 27].

Exchange rate regimes

Exchange rate regimes classification (ranked according to the degree of flexibility arrangement basis) has widely literature used: E.R. regimes classified into four categories: (1) floating regimes, (2) intermediate regimes, (3) soft peg regimes and (4) hard peg regimes. Floating regimes subclassified independent (exchange rate determined according to the free market in the demand and supply. Monetary authorities cannot intervene in freely foreign markets and economic policies independently) and light managed floating (the exchange rate determined according to the free market in the demand and supply. Monetary authorities can intervene in free foreign exchange markets and economic policies). Intermediate regimes as managed float (the monetary authorities' can intervene in the foreign exchange markets without pre-committing or specifying a preannounced way for the exchange rate. Intervention may be direct or indirect as the change in interest rate, unannounced intervene) and crawling board band (the exchange rate adjusted and maintains within broadband around a central rate. Adjusted periodically and preannounced fixed rate (adjusted rule based on differentials between targets)), soft peg regimes described further crawling narrow band (the exchange rate maintained within crawling narrow band around a central rate. Adjusted periodically and preannounced fixed rate (adjusted rule based on differentials between targets)), pegged within bands (the exchange rate allows the fluctuating within a narrow band (around an official or de facto central fixed peg)—may its single currency and cooperative arrangements), (crawling peg (the exchange rate maintained adjustments periodically according to a set of indicators. The exchange rate adjusts preannounced fixed rates), and fixed peg (the exchange rate pegged significant currency with a fixed rate), hard peg regimes described as currency board (the monetary system is based on the fixed-rate legislative commitment to exchange domestic currency for other countries' currencies) and currency union dollarization like other countries used it as only a legal tender or a Union block by IMF, Frankel and Edwards.

Markets index and MSCI   MSCI is a world-leading service provider of critical decision support tools and global investment. MSCI world markets index ranking is very credible. This study follows the MSCI market index ranking; first, developed markets were ranked as Australia, Hong Kong, Singapore, Japan and New Zealand. Emerging markets were China, India, Pakistan, Malaysia, Korea and Indonesia. Third frontier markets rank index according to Bangladesh, Sri Lanka, Vietnam, Bahrain, Jordan and Oman.

Exchange rate regimes and developed markets   Developed markets exchange rate regimes were an exciting and timely decision made for the exchange rate that why his regimes very effective and markets growing very fast. Hong Kong was the oldest exchange rate regime from 1841 to February 2, 1895, peg with the silver standard of Mexican piaster's circulate. From February 2, 1895, to December 5, 1935, Hong Kong silver standard dollar was introduced and from December 5, 1935, to 1972, like other world countries peg with UK pound, from January 5, 1942, to September 14, 1946, during pegged with Yen and July 6, 1972, to 2020, peg with US dollar. In January 1900 to 1939, Australian dollar was pegged with gold and partial time by time with the UK pound when the temporary gold standard was suspended. Singapore from February 1906 to June 25, 1972, peg was UK pound, Malaysia and Brunei and on June 25, 1972, to 2020, officially currency was peg change to US dollar: as New Zealand since September 21, 1931, and Australia since August 28, 1939, to December 1971, peg with UK pound with the as active parallel market for US dollar and in December 1971 formally shift and peg with US dollar, Australia, November 1982, New Zealand, March 4, 1985, managed floating; as New Zealand, December 1989, and Australia June 1993, freely floating adopt as

targeting inflation framework. Japan currency peg with the UK pound since 1933 to September 1939, and on July 1, 1932, foreign exchange controls were introduced, on December 29, 1941, to August 1945 currency peg with Reich mark. August 1945 to June 1947 black market was skyrocketed. Officially, 15 Yen exchange to a dollar and in the black market, 875 Yen exchange to a dollar on February 1946 with Inflation rate was 513%. From July 1947 to 2020, reference currency was the US dollar with different bands and premiums.

Exchange rate regimes and emerging markets The exchange rate regimes of Asian countries are significant and impact markets. Malaysia has an emerging market and very effective regimes. From June 25, 1903, to February 1906, currency peg was silver and February 1906 to September 5, 1975, pegged with UK pound. From September 5, 1975, to 2020, currency officially pegged with the US dollar with different bands and premiums. Korea is an industrial hub and emerging market. Since1910 to October 1945, the currency peg was the Japanese Yen (Korean Yen) and from October 1945 to 2020 officially pegged with the US dollar with different bands and premiums. India has a crowded population country and emerging market. From August 1914 to March 22, 1927, currency peg was UK pound, and gold standard peg was March 22, 1927, to September 24, 1931. From September 24, 1931, to September 25, 1975, currency was again pegged with the UK pound. India rupees official peg with US dollar on August 23, 1971, to December 20, 1971, peg was US dollar and again December 20, 1971, to September 25, 1975, pegged with UK pound with as few years active parallel market US dollar. The Indian currency was officially pegged with the US dollar from 1979 to 2020 with different bands and premiums. China has a significant export share in the world economy and its regimes essential roles, especially in Asian markets. From November 3, 1935, to March 14, 1938, currency was pegged with the UK pound and abandoned the silver standard. On March 1, 1938, money was pegged with the Yen. From March 14, 1938, to 1939, dual markets capital controls tightened and was adopted and in 1939 to December 1973 (freely falling/dual market, managed floating/dual market/multiple exchange rates). From January 1974 to till 2020, currency was pegged US dollar with different bands and premiums. Pakistan has a primary emerging market and leading region role player. From the eighteenth century to April 1, 1948, exchange rate was the arrangement with no separate legal tender

of the Indian Rupee. It is pegged with British pound/parallel markets from April 1, 1948, to January 15, 1959, and pegged with British pound/parallel markets. Pakistan rupee was introduced in June 1954 with a parallel market premium of 103%. From January 15, 1959, to September 17, 1971, multiple exchange rates/parallel market was adopted, and the rupee was linked with the UK pound. From September 17, 1971, to December 2020, Pakistan rupees officially pegged US dollar/parallel markets with different bands and premiums.

Exchange rate regimes and frontier market index Bahrain exchange rate arrangement with no separate legal tender from 1862 to 1959 and circulate was Indian and UK pound. From 1959 to January 28, 1966, Persian Gulf rupee was issued and pegged with the UK pound. From January 28, 1966, to June 23, 1972, Bahrain Dinar introduced replaced Gulf rupee and pegged with the UK pound. From June 23, 1972, to December 2020were pegged with the US dollar. Jordan November 1, 1927, to September 21, 1931, pegged with gold and Palestine pound replace with Egyptian piaster. From September 21, 1931, to August 17, 1971, foreign exchange rate control was introduced; the Palestine pound was replaced with Dinar and pegged with the UK pound. From August 17, 1971, to December 2020, Dinar official pegged with US dollar/dual market band. Oman exchange rate was the arrangement with no separate legal tender from the eighteenth century to May 7, 1970. Indian rupees and Maria Therese Thaler and later on Persian Gulf rupee used as exchange. The US dollar and Saudi Rial were pegged from May 7, 1970, to December 2020. Sri Lanka is the neighborhood of India and an important country of Asian regain. From December 16, 1929, to June 1941, pegged Indian rupees under currency board and Indian rupees pegged with UK pound. July 1941 to November 8, 1971, currency pegged was Indian rupees (via UK pound) under currency board and November 8, 1971, to UK pond/dual market, on June 1, 1973, the Ceylon rupee of Sri Lanka rupee and re-pegged with UK pound/dual market. From November 15, 1977, to December 2020 Sri Lanka rupee officially pegged the US dollar with different bands premiums, and the parallel market remains active. Bangladesh has a frontier market and continuously increases the share of world markets. From January 1, 1972, to January 1992, the Bangladesh currency taka was introduced and pegged with the UK pound. From January 11, 1983, to December 2020, de facto crawling peg/dual market/multiple exchange rates pegged with

a basket of currencies different bands, premiums and intervention currency mode was US dollar.

Exchange rate and economic growth

Devaluation of the currency was expansionary effects on the country growth economically. Devaluation of the currencies led to cheaper goods and increased demand, as an increase in exports of the countries [28]. An expansionary devaluation effect on country output was evident, devaluation in-country currency improves direct investment, trade balance and balance of payment, expanding output and employment [29]. The exchange rate with economic growth as manufacturing production has positive but not insignificant, which does not support the position that shifting the exchange rate regimes or excessive instability has well-defined effects for manufacturing production. Exchange rate variability in Pakistan has no significant effect on Pakistan manufacturing products [30]. Developing countries like Pakistan have less flexible exchange rates (regimes) and have been associated with very slow growth and with greater output instability. As in the content of industrial countries, regimes have no significant impact on economic growth [31]. GARCH model applied exchange rate instability impact on macroeconomic variables of Pakistan. As exchange rate instability was positive effects on gross domestic product, trade opening and growth rate and negatively affected the FDI [32]. Empirical relations between the exchange rate instability and growth of exports and instability of the exchange rate was significant negative effects short run and long run with most trading countries like USA, UK and European Union [33]. Autoregressive conditional hetero-skedasti city-based measured, exchange rate and nominal were the negative impacts on economic growth as exchange rate instability effect depends on exchange rate regimes and financial trading opening. Instability is more harmful when developing countries adopt flexible exchange rate regimes and financial trading openings [34]. Bound testing approach, augmented dickey fuller (ADF and GARCH), the export of Pakistan, was negatively influenced by exchange rate instability.

On the other hand, prices were massively affected by the country foreign income [35]. The exchange rate was the main role player and affected the macroeconomics performance of the countries. There was a positive relationship between the exchange rate and foreign direct investment [36]. The empirical study has investigated the impact of domestic and foreign currency values, as exchange rate instability affected imports and export demand functions of developing countries.

GARCH-based model was used, when Pakistan worked with the US dollar as a medium currency with its trade partners, instability discouraged imports and exports. Exports demand function unaffected by instability distortions. When Pakistan was trading with developing countries, the bilateral exchange rate was valued in domestic currency. When Pakistan was traded with low-income countries, it then performed direct domestic currency [37].

Exchange rate and inflation

The estimates offered evidence that exchange rate instability persisted and was a negative and significant effect on the economic growth of Nigeria. There was a negative and significant relationship between inflation and the economic growth of Nigeria. Oil prices were useful as the positive and significant relationship among the money supply, government expenditure, financial opening and economic growth of Nigeria [38]. Foreign direct investment was positively linked with currency depreciation, and exchange rate instability deters foreign direct investment. Finance trade opening increases the foreign direct investment, and the basis for inflation was insignificant. Empirical study suggested the exchange rate instability granger causes FDI but not vice versa [39]. The impact of the devaluation of the currency as exchange rate fluctuation was experienced for the next seven years on financial factors like inflation, interest rate and economy [6]. Exchange rate and inflation have a significant but negative impact on developing countries like Pakistan economic growth. GDP decrease will increase inflation as GDP decreases when the exchange rate increase. The result indicates that exchange rate and inflation have a significant impact on the economic [11]. High damage effect to growth during the high inflation crises and most of the countries were recovery trend their precise growth rate [12]. Importantly, countries with similar economies radically choose multi-exchange rate regimes without looking at the substantive cost for macroeconomic indicator outcomes similar to the country's inflation and growth output (Rose, [40]).

Exchange rate and foreign direct investment

The exchange rate has mainly affected the macroeconomic performance of world countries. Important study based on secondary data and time-series data of 32 years for the period of 1982 to 2013 examined the impact of exchange rate on foreign direct investment. Correlation and regression analysis techniques adopted through SPSS software and check the relationship among exchange

rate and foreign direct investment. Research correlation analysis results showed the exchange rate and foreign direct investment have a positive relationship among others significantly [36]. The exchange rate impact on FDI was two different arguments. The first argument was a direct relationship between foreign direct investment and exchange rate, and in second argument there was a inverse relationship of instability of foreign direct investment and exchange rate. When facing the other side's the coin, foreign direct investment of the host country can appreciate the exchange rate output or input damping [41]. Currency of Yen appreciation against American and Asian currencies leads to an increase in the foreign direct investment by the manufacturing sector of Japan and other Asian sectors [42].

Exchange rate and interest rate

Interest rates and inflation have a negative effect on countries economic growth [13]. High exchange rate may cause low investment because the private sector borrows low credit, high risks level, higher interest rate, the demand for collateral by the world financial markets and economic agents to lend to the international and domestic investment due to exchange rate instability which can hinder world economic growth [43]. There is a negative relationship between interest rate and currency ratio. The high interest rate has an impact on the investment and economic growth of countries [44].

Exchange rate and foreign debt

Empirical studies observed that the level of account of countries foreign debt shows the ability of the country borrows power in its own domestic currency and foreign reserve for the exchange rate system selections. Empirical studies results were not robust in the selection of an exchange rate regime [45–47]. The central bank of countries maintains stabilized exchange rate because of most adverse effects of devaluation or depreciation on financial statements, especially when countries going to payable very high debt in foreign currencies [48]. The exchange rate regimes have an important role in determining external debt, debt service burden and sustainability of both. Firstly, direct effects on their size, secondly, effect on growth particularly and competitiveness of developing countries which mostly have a big amount of foreign debt denominate in a foreign currency [49, 50]. Large depreciations direct impact on growth in public sector debt and sustainability of the fiscal positioning. The empirical literature suggested when exchange rate

regimes were fixed provided more fiscal control as compared to flexible exchange regimes. Fiscal profligacies were overcome losses in risk of foreign reserves or as well as the build-up of public debt [51, 52].

Exchange rate and import

The researcher adopts the OLS technique to measure the relationship between exchange rate, GDP, inflation rate, import and export of Nigeria. There was a significant positive relationship between the explanatory variable (like exchange rate, import and export) and GDP [53].
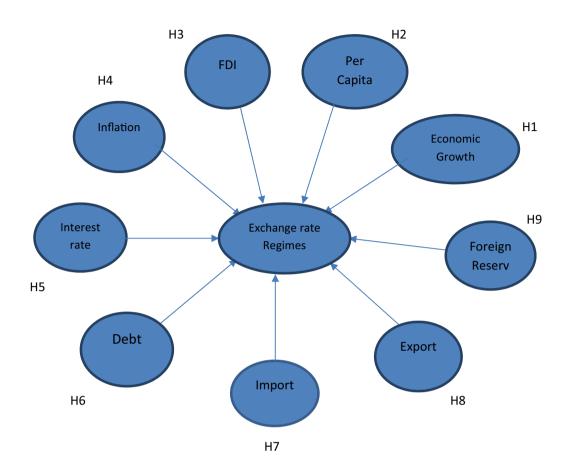
Exchange rate and export

System GMM was used to measure the effect of instability of real exchange rate on export; data were used 106 developed and emerging countries of the world. Investigation reveals the negative relationship between the instability of the real exchange rate with exports [54]. A similar study was conducted, and co-integration and VECM (vector error correction model) used to analyze the data of Pakistan, Sri Lanka and India for the period of 1960 to 2007; the estimation result was showed the significant negative relationship among the instability of real exchange rate to the export of Asian three countries of Pakistan, India and Sri Lanka; and similar result indicated the short run and the long run [55].

Exchange rate and foreign reserve

Cluster analysis applied on combined data of exchange rates and foreign reserves that why they can count for exchange rate movements as well as exchange market intervention [31]. In spite of the fact that we looked at the exchange rate regimes and economic performance linked with the evolution of exchange rate arrangements, it varies when studied with de facto schemes, and official regimes were not irrelevant even at all times it does not match with de facto regimes. Regimes were very helpful in the financial market's prospect on the development of exchange rate and their effect on global financial policy decisions. Interest rates and changes in gross foreign reserves are used as a proxy for interventions in the exchange rate market which has a drawback. Some countries' linked the action of central banks foreign reserves with reserve management strategies. Payments of bulky purchases or debt such as imports of oil are not essential to use for exchange rate stabilization motive. Most countries of the world interest rate were put administratively, and result statistics may deviate from the reality of data on the foreign exchange reserves [56, 57].

Data and methodology

Data and sample description

The main objective of this research is to examine the impact of macroeconomic variables, i.e., GDP growth, GDP per capita, inflation, foreign direct investment, exports, imports, interest rates, foreign debt and foreign reserves on the exchange rate regimes using the five countries sample from MSCI developed markets index, emerging markets index and frontier markets index each from 1970 to 2020. MSCI is a premier US-based finance firm to provide critical decisions support the tools and services for the global investment society. The core areas of functioning are providing investment data, performance analytics, stock indexes, and portfolio risk and governance tools for investors and funds. MSCI, based on the global investable market index (GIMI) by considering economic, development, size, liquidity and market accessibility framework, designs the developed, emerging and frontier markets indices. These classifications enabled investors to allocate their investments in various risk-returns equity market indices. We choose five countries from each MSCI markets index based on the criteria: (1) countries having complete data of all variables

during the sample period, and (2) countries having experience of different exchange rate regimes during the sample period. The data of all macroeconomic variables for each country have been collected from the DataStream of the World Bank and International Monetary Fund (IMF).

This study employs the methodology of foreign exchange rate regimes comparable with [58]. exchange rate regimes which were classified into fine and coarse arrangements, but this study only follows the coarse regimes. The coarse regimes arrangements scaled into 1 to 6 based on (1) the separate legal tender, the preannounced peg, the preannounced horizontal band and de facto peg; (2) the preannounced crawling peg, the preannounced crawling band, de facto crawling peg and de facto crawling band; (3) the preannounced crawling band, de facto crawling band, moving band, de facto moving band and managed floating; (4) freely floating; (5) freely falling; and (6) dual markets.

Model specification

We adopt ML—binary logit (quadratic hill climbing) to investigate the change in the exchange rate is due to change in the macroeconomic variables, i.e., GDP growth, interest rates, inflation, foreign direct

investment, exports, imports, foreign debt and foreign reserves. So the model is shown below with specification.

$$\text{EX} = \alpha + \beta X + \delta d + \varepsilon t \qquad (1)$$

Wang and Hsiao [59] and Di Giovanni and Shambaugh [60] examine the impact variables (1) i is for country and t for time (2) where ex denotes the exchange rate, x is the determinants of impact (Barro [61]), d is the dummy for the macroeconomic variables, i.e., GDP growth, GDP per capita, inflation, foreign direct investment, exports, imports, interest rates, foreign debt and foreign reserves and ε was denoted the zero term.

exchange rate regimes on domestic currencies, we are really measuring major trade partners like Asian specified countries according to the ranking of (MSCI indexes) developed market index, emerging market index and frontier market index. We use macroeconomic variables, i.e., GDP growth, per capita and interest rate as an annual rate, inflation, foreign direct investment, exports, imports, interest rates, foreign debt and foreign reserves as a percentage to GDP and GDP growth as a proxy for the economies.

Stationary unit root tests: Statistical parameters quality of the process mean and standard deviation do not

$$\begin{aligned}(\text{Exchange rate})i,t = \beta 0 &+ (\beta 1\,\text{RGDP})i,t + (\beta 2\,\text{FDI})\,i,t + (\beta 3\,\text{Inflation})i,t + (\beta 4\,\text{R})i,t + (\beta 5\,\text{Debt})i,t \\ &+ (\beta 6\,\text{Import})i,t + (\beta 7\,\text{Export})i,t + (\beta 8\,\text{Foreign Reserve})\,i,t \ldots\ldots \varepsilon t\end{aligned} \qquad (2)$$

RGDP = real gross domestic product (growth rate), exchange rate = real effective exchange rate. R = real interest rate, inflation = inflation rate, FDI = foreign direct investment, import = countries import, Export = countries export, foreign reserve: countries foreign reserve.

Variables discussed in the above model are stated of the natural logarithm. The natural logarithm of the variable getting reasons enables to correct skewed data convert into normal distribution which assumption of econometric estimation [62]. As a measurement for the exchange rate, we used multilateral real effective exchange rate regimes rather than bilateral real exchange rates from 1970 to 2020. In real effective of

change with the time [63]. Classical regression model assumption (dependent and independent) variables are stationary, and errors have a zero mean and variance in finite terms [64]. T ratio is not useful as T distribution, so it is impossible to validate undertake hypothesis tests about regression parameters [65]. We apply ML—binary logit (quadratic hill climbing) which is used to investigate the change in the exchange rate regimes due to change in the macroeconomic variables, i.e., GDP growth, GDP per capita, interest rates, inflation, foreign direct investment, exports, imports, foreign debt, foreign reserves. In this model, Z value and P value are used to analyze the hypothesis tests about regression parameters.

Results of statistical analysis
Descriptive statistic

	Debt	Export	Import	FDI	GDP growth	Inflation	Interest rate	Per capita growth	Foreign reserves
Panel A: Developed markets									
Mean	59.200	73.700	70.400	6.45	3.960	4.150	4.670	2.650	31.200
Median	40.500	28.300	28.000	2.61	3.520	2.880	4.250	2.340	9.930
S.D	53.200	71.900	67.400	9.72	3.670	5.000	4.070	3.340	34.700
Mini	9.680	8.970	6.940	− 3.81	− 6.100	− 6.010	− 0.100	− 6.670	0.000
Maxi	249.00	229.00	221.00	58.50	16.20	23.00	19.00	14.70	142.00
Obs	255	255	255	255	255	255	255	255	255.00
Panel B: Emerging markets									
Mean	43.500	29.800	29.300	1.61	6.350	6.360	6.210	4.500	15.100
Median	42.000	19.600	22.100	0.87	6.520	5.310	6.000	4.400	9.550
S.D	24.700	27.100	22.600	1.73	3.810	5.960	4.830	3.930	12.900
Mini	0.970	2.490	2.130	− 0.06	− 8.000	− 8.720	− 7.990	− 9.670	− 0.059
Maxi	109.00	121.00	101.00	8.76	19.30	38.50	23.00	16.10	53.20
Obs	255	255	255	255	255	255	255	255	255

	Debt	Export	Import	FDI	GDP growth	Inflation	Interest rate	Per capita growth	Foreign reserves
Panel C: Frontier markets									
Mean	49.600	45.100	48.800	1.49	4.670	7.640	9.230	3.090	17.400
Median	38.000	40.600	41.500	0.90	4.670	4.820	5.000	2.590	14.000
S.D	38.000	28.700	25.900	5.02	5.060	16.100	18.100	7.400	12.800
Mini	2.870	2.900	8.100	− 13.6	− 14.300	− 25.100	− 20.10	− 35.60	0.762
Maxi	220.00	132.00	120.00	33.6	30.50	201.00	95.20	36.30	52.60
Obs	255	255	255	255	255	255	255	255	255

Unit root test

	Augmented Dickey–Fuller			Phillips–Perron		
Variables	Developed markets	Emerging markets	Frontier markets	Developed markets	Emerging markets	Frontier markets
Debt	(− 13.44)***	− 2.60*	− 2.69*	(− 13.44)***	− 2.65*	− 2.90**
Export	(− 15.89)***	(− 14.69)***	− 3.0428**	(− 15.90)***	(− 14.67)***	− 2.76*
Import	(− 16.16)***	(− 14.78)***	− 2.75*	(− 16.16)***	(− 14.78)***	(− 18.31)***
FDI	(− 16.046)***	− 4.5263***	− 3.512***	− 3.5003***	− 4.2545***	− 7.1010***
GDP	− 5.2545***	− 5.3797***	− 12.33***	− 9.2367***	− 12.40***	− 12.37***
Inflation	− 6.06***	− 6.39***	− 12.86***	− 6.01***	− 9.06***	− 12.86***
Interest rate	− 3.37**	− 3.74***	− 4.37***	− 3.37**	− 6.55***	− 5.69***
P.CAP. GDP	− 6.28***	− 4.87***	− 9.17***	− 10.73***	− 11.47***	− 9.39***
Reserve	(− 15.07)***	(− 16.27)***	− 3.23**	− 23.04***	(− 16.28)***	− 3.13**

The statistical results of the macroeconomic variables, i.e., GDP growth, GDP per capita, interest rates, inflation, foreign direct investment, exports, imports, foreign debt and foreign reserves of developed, emerging and frontier markets in the table, indeed reflect the above scenario of stationary and long-run relationships between variables as expected; significant levels of *, **, ***showing each critical value of Mackinnon 1%, 5% and 10% of ADF and P.P. test are based on intercept, without() showing level and with () are showing the first difference.

Develop markets and regression

Variable	Coefficient (1)	Coefficient (2)	Coefficient (3)	Coefficient (4)	Coefficient (5)	Coefficient (6)
Intercept	−9.20*** (− 4.462)	1.253** (2.071)	0.702 (0.0618)	11.673*** (4.324)	− 4.993*** (− 4.308)	− 1.381** (− 1.974)
Debt	0.027*** (3.2827)	0.0008 (− 0.2184)	0.1316* (1.8442)	− 0.146*** (− 4.5526)	0.0018 (0.2582)	− 0.0.35*** (− 3.4448)
Export	0.0697 (1.5419)	− 0.07*** (− 4.3064)	− 1.393** (− 9953)	0.0815 (1.3982)	0.1236*** (3.5946)	0.1223*** (5.0129)
Import	− 0.164** (− 2.4836)	0.059*** (3.2258)	0.2087 (0.8030)	− 0.254*** (− 3.2793)	− 0.138*** (− 3.5482)	− 0.0564*** (− 2.6011)
FDI	0.0600 (0.7954)	0.0799** (2.3984)	− 0.2557 (− 0.4483)	0.7705*** (2.6478)	− 0.0502 (− 1.0561)	− 0.3315*** (− 5.5185)
GDP	1.844*** (3.9799)	− 0.509** (− 2.4079)	0.2812 (0.2398)	− 0.3893 (− 0.6661)	0.1771 (0.6326)	− 0.4120* (− 1.9404)
Inflation	0.1511* (1.7045)	− 0.101** (− 2.1188)	0.6936* (1.8403)	− 0.797*** (− 3.8789)	− 0.1670 (− 1.5483)	0.0813 (1.6336)
Interest rate	0.1203 (0.8737)	− 0.19*** (− 2.7036)	0.2216 (0.5744)	0.2435** (2.0634)	0.1842 (1.4506)	0.0.172 (0.2485)
PER capita	− 1.72*** (− 3.9101)	0.4001* (1.8566)	− 0.8124 (− 0.6460)	− 0.0091 (− 0.0160)	− 0.1068 (− 0.3868)	0.7074*** (3.1772)

Variable	Coefficient (1)	Coefficient (2)	Coefficient (3)	Coefficient (4)	Coefficient (5)	Coefficient (6)
Reserve	0.147*** 2.6846	0.0121 (0.7787)	− 0.1666 (− 0.3922)	− 0.5178** − 2.1952	0.0571* (1.9143)	− 0.687*** (− 3.4331)
McF. R-squared	0.4665	0.2401	0.8741	0.6799	0.3521	0.4893
S.D. dependent ver	0.2566	0.4547	0.2980	0.3606	0.2926	0.4565
Akaike info criterion	0.3507	0.9938	0.1592	0.3523	0.4827	0.6972
Schwarz criterion	0.4896	1.1327	0.2981	0.4911	0.6215	0.8361
H. Quinn criter	0.4066	1.0497	0.2151	0.4081	0.5385	0.7531
Restr. Deviance	130.1305	307.1868	163.5841	218.1663	159.1008	308.9567
LR statistic	60.70***	73.76***	142.98***	148.34***	56.02***	151.16***
N (Observations)	255	255	255	255	255	255

The statistical results of the ML—binary logit (quadratic hill climbing) for developed markets exchange rate regime one the above table reflect the scenario and coefficient results as estimation; its foreign debt, GDP, foreign reserve serve as the highest positively significant and GDP per capita as the highest negatively significant for long-run impacts variable on developed markets during exchange rate regimes 1 while imports stand negatively second and inflation positively is third significant important variable as exchange rate country regimes. Results showing exchange rate of developed markets countries highly depend on foreign debt expected to impact the foreign reserve and country growth. The estimate of long-run coefficients of the binary logit for the exchange rate regime two is presented in table; the imports serve as the highest positively significant, and exports and interest rate serve as the highest negatively significant for long-run impacts variable on the developed market from exchange rate regimes while foreign direct investment stands second positively as GDP and inflation negatively significant. GDP per capita positively is third, debt and foreign reserve less important significant variable as compared to import, export, inflation of developed markets from exchange rate regimes two time period. According to results of the binary logit of exchange rate regime three, the exports serve as the high negatively significant for long-run impacting variable on developed markets from exchange rate regimes while debt and inflation stand second place of positively significantly important for developed markets. Imports, GDP and interest rate serve as positively, and foreign direct investment, GDP per capita and foreign reserve are serve as negatively significant less important as compared to export, debt and inflation for developed markets in exchange rate regimes three time period. Exchange rate regime four shows the foreign direct investment serves as the highest positively significant, and imports, foreign debts and inflation serve as the highest negatively significant for long-run impacts variable on the developed market from exchange rate regimes while foreign reserve stands second positively and interest rate is negatively significantly important for developed markets during exchange rate regimes four time period. Exports are serve as positively and GDP, GDP per capita significant level at low means its less impact of exchange rate regime during exchange rate regime four time period. Exchange rate regime five table results show the exports positively and imports serve as the highest negatively significant impacting variables. Foreign reserves second important variable is positively significant and impact the exchange rate regimes in five time periods where GDP, foreign debt, interest rate and foreign reserve as positively and foreign direct investment, inflation, GDP per capita as negatively significant impact during the exchange rate regimes five time period. Exchange rate regime six results showing the exports, per capita positively and foreign debt, imports, foreign direct investment foreign reserve stand-level one highest significant most impacting variables during exchange rate regimes six time period. GDP negatively impacts significant second and inflation, interest rate placed third significant important variable for developed markets during exchange rate regimes six time period.

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Emerging markets and regression

Variable	Coefficient (1)	Coefficient (2)	Coefficient (5)
Intercept	4.3791*** (6.1868)	− 3.0114*** (− 4.8160)	− 6.5213*** (1.5877)
Debt	− 0.0041 (− 0.6183)	0.0022 (0.3129)	0.0274** (0.0129)
Export	0.1298*** (4.2762)	− 0.0017 (− 0.0642)	− 0.2242*** (0.0493)
Import	− 0.1581*** (− 4.6264)	0.0237 (0.7757)	0.2177*** (0.0511)
FDI	0.3660*** (3.2252)	− 0.1028 (− 0.9634)	− 0.0895 (− 0.1644)
GDP	− 1.2457*** (− 5.2158)	0.3187 (1.4828)	1.7226*** (0.4116)
Inflation	− 0.0115 (− 0.5589)	0.0244 (1.1477)	0.0038 (0.0339)
Interest rate	0.0684** (2.0712)	0.0196 (0.5710)	− 0.1740*** (0.0659)
Per capita	1.4169*** (5.5616)	− 0.4267* (− 1.8825)	− 1.8932*** (0.4422)
Foreign reserve	− 0.1042*** − 3.79120	0.0445* 1.8625	0.08912* 0.04867
Mc Fadden R-squared	0.4579	0.3462	0.5820
S.D. dependent var	0.4410	0.3644	0.3083
Akaike info. Criterion	0.7028	0.6465	0.3609
Schwarz criterion	0.8417	0.7854	0.4997
Hannan-Quinn criter	0.7587	0.7024	0.4167
Restr. Deviance	293.7134	221.5597	172.2876
LR statistic	134.5021***	76.6982***	100.2683***
N (total observations)	255	255	255

The statistical results of the ML—binary logit (quadratic hill climbing) for emerging markets exchange rate regimes on the above table reflect the scenario and coefficient results as estimation; its exports, foreign direct investment, GDP per capita serve as the highest positively significant and GDP, imports, foreign reserves serve as the highest negatively significant for long-run impacts variable on emerging markets during exchange rate regimes one time period. While interest rate stands positively significant important at second level and foreign debt, inflation serves negatively significant impacting variable on emerging markets during exchange rate regimes for the time period. Exchange rate regimes two foreign reserve is positively significant, and GDP per capita is most negatively significant impacting variable in emerging markets. GDP, foreign debt, imports, inflation, interest rate are second important positive significant variables as exports foreign direct investment are negatively significant variables in emerging markets during the exchange rate regime two time period. Exchange rate regimes five GDP and imports are highly positively significant impacting variables, while exports, interest rate and GDP per capita are the most negatively significant variables in emerging markets during exchange rate regimes five time period. Foreign debt that serves positively second and foreign reserve which serve positively third significant leave importance in emerging markets as inflation serves as positively and foreign direct investment negatively less important significant level as compared to other variables of emerging markets during exchange rate regimes five time period. Just for surprising results during the analysis of the emerging markets data, emerging markets were not followed by the exchange rate regimes 3, 4, 6 till 2020, which may leading impact factor of developed and emerging markets.

Frontier markets and regression

Variable	Coefficient (1)	Coefficient (2)	Coefficient (5)
Intercept	5.2506*** (3.7614)	− 9.1446 (− 1.4618)	− 5.3882*** (− 3.9538)
Debt	− 0.0437*** (− 4.3023)	0.0662 (1.2958)	0.0391*** (4.1773)
Export	0.0562 (1.5905)	− 0.3539 (− 1.1822)	− 0.0459 (− 1.4115)
Import	− 0.0070 (− 0.2002)	0.0468 (0.3911)	0.0174 (0.5091)
FDI	0.1358 (1.3494)	0.1759 (0.7067)	− 0.1216 (− 1.2355)
GDP	0.0870 (0.7957)	− 0.0808 (− 0.3214)	− 0.0735 (− 0.6662)
Inflation	0.2278*** (2.7587)	0.0231 (0.1037)	− 0.2021 (− 2.5531)
Interest rate	0.0996 (1.1976)	− 0.1311 (− 0.2171)	− 0.0668 (− 0.9143)
Per capita	− 0.0240 (− 0.3820)	− 0.0960 (− 0.7347)	0.0309 (0.4797)
Foreign reserve	− 0.1450*** (− 3.2670)	0.3087 (1.4512)	0.1024** 2.5776
Mc Fadden R-squared	0.5786	0.5430	0.4989
S.D. dependent var	0.2754	0.1080	0.2566
Akaike info. criterion	0.3182	0.1369	0.3342
Schwarz criterion	0.4571	0.2758	0.4730
Hannan-Quinn criter	0.3741	0.1928	0.3900
Restr. deviance	145.0842	32.6205	130.1305
LR statistic	83.940***	17.7134**	64.9170***
N (total observations)	255	255	255

The statistical results of the ML—binary logit (quadratic hill climbing) for frontier markets exchange rate regimes one inflation has positively significant at the highest

level and foreign debt; the foreign reserve has negatively highest significant major impacting variables in frontier marks during exchange rate regimes one time period while GDP, exports, foreign direct investment, interest rate are positively significant and imports and GDP per capita have a negatively significant impact on frontier markets during exchange rate regimes one time period. Exchange rate regimes two foreign debt, imports, foreign direct investment inflation and foreign reserve have positively significant and most impacting variables in frontier markets when frontier countries apply the exchange rate regimes two during the time period while GDP, exports, interest rate and GDP per capita have negatively significant impacts on frontier markets during exchange rate regimes two time periods. Exchange rate regimes five as results showing of frontier markets foreign debt on top is highly positive significant important variable and foreign reserves as second most useable and positively significant variable in frontier markets during exchange rate regimes five time period. Imports and GDP per capita positively and exports, foreign direct investment, GDP, inflation, interest rate have negative impact significant variables in frontier markets during exchange rate regimes five time period. As a result, frontier markets similar to emerging markets do not follow the exchange rate regimes of three, four, and six from 1970 to 2020, which is a real impacting and leading factor of emerging and frontier markets.

Discussion
Discuss the conclusion, implications and policy recommendations of the findings in context of existing research

This study examines the impact of macroeconomic variables, i.e., GDP growth, GDP per capita, interest rates, inflation, foreign direct investment, exports, imports, foreign debt and foreign reserves on the exchange rate regimes used the sample of five countries from MSCI developed markets index, emerging markets index and frontier markets index each from 1970 to 2020. The methodology and data used in the study are robust and most reliable. For the statistical consideration, the study explores the modern technology and methods to investigate the issues in contents of the exchange rate regimes of developed, emerging and frontier markets from microeconomic variables. The study investigates the microeconomic variable impacts on the six levels of exchange rate regimes. The statistical results of the ML—binary logit (quadratic hill climbing) are very interesting and valuable. Surprisingly results show emerging and frontier markets countries that did not follow the exchange rate regimes level three, four and six as followed by developed markets countries from 1970 to 2020, which is leading impact

factors that affect the markets of emerging and frontier countries. Countries markets that get timely exchange rate regimes decisions that boost their markets now its develop markets; those markets (emerging and frontier market) do not follow exchange rate regimes as develop markets causes of straggling markets. Developed markets and foreign debt in exchange rate regimes one were positively and four and six for negatively very impacting variable, which shows develops markets impressive growth during foreign debt increase and decline when foreign debt decrease. Exports of developed countries grow in exchange rate regimes level two negatively and level five and six positively, which mean exports increase during the described period. Imports of developed countries grow high point in exchange rate regimes level two negatively and in level four, five, and six positively. Foreign direct investment more favorable time of growth in developed markets exchange rate regimes level four is positively, and six are for negatively effecting markets sentiments. For GDP, more preferable is exchange rate regimes level one, which highly impact developed markets. Inflation raises highly in developed markets during exchange rate regime four, which is favorable for market growth but affects people's purchasing power in developed countries. As a result of interest rate is most effacing time is exchange rate regimes two when high-interest rate negatively impacts on developed markets, during high-interest rate markets growth slowdown. In developed markets, personal income (GDP per capita) is the highest negative in exchange rate regimes level two and highest positive during level six. Foreign reserves grow in exchange rate regimes level one highest positive and level six highest negative impact on developed markets. According to emerging markets, mostly positive variables like exports, foreign direct investment, GDP per capita, while GDP, import, foreign reserves tech highest negative and highly affect the markets during exchange rate regimes one time period. Exchange rate regimes level two are not favorable for emerging markets. Exchange rate regimes level five highly positively affecting variables of imports, GDP and exports, interest rate and GDP per capita negative affecting emerging markets. For Frontier markets, exchange rate regimes level two is not favorable as microeconomic indicators like emerging markets. Inflation was highly positive, and foreign debt foreign reserves were highly negative during exchange rate regimes level one and most affecting the frontier markets. Foreign debt and foreign reserve growth in exchange rate regimes level five highest positive impacting on frontier markets. For frontier markets, major variables are inflation, foreign debt and foreign reserve, which affect people of frontier markets and countries markets growth. Inflation raises, which is favorable for

market growth but affects people's purchasing power. When countries borrow foreign debt and foreign reserves, markets have a reasonable fund that attracts the local and foreign investors, leading to the impressive growth of markets.

The study is never limited, giving new opportunities and ideas to explore the research. First, this study used annual data to analyze the different variables with different periods because of mostly data availability as an annual form. The size of the sample may be extendable. Suppose data are available in the form of quarterly, monthly bases, which conclude more conclusive results. May others appropriate and related variables included in the model like the public and private investment, saving on REER, foreign trade and equity. Secondly, time-series data are collected invaluable and different ways; data are appropriate sources like World Bank, IMF and central banks sites, but every date its update and changes acquired, data collected by according (MSCI index rank) 15 countries due to different base years which may calculate affect value. Finally, this study analyzed the base of course line regimes. It is the more comprehensive view and may more conclusive results on the base of regimes lines (15), which conclude separate currency arrangements. Moreover, some studies indicate the time-series data macroeconomic variable used as the nonlinear relationship may affect. This study assumes and examines the variable linearly because of the 51 years of data available.

Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent to participate
All authors have given their consent to participate in submitting this manuscript to this journal.

Consent for publication
Not applicable.

Competing interests
The authors have no relevant financial or nonfinancial interests to disclose.

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