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The forex footprint of indian student mobility: evidence from LRS remittances and exchange rate dynamics

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Abstract

This paper explores the effects of Indian students studying in foreign countries on foreign exchange (ForEx) outflows in terms of the Reserve bank of India liberalised remittance scheme (LRS) and the volatility of the INR-USD exchange rate. In the study, the author tests two hypotheses: (1) outbound students are an important source of forex outflows and (2) the outflows are related to INR volatility. By using Pearson correlation and OLS regression, the study finds strong positive relation in Hypothesis 1 (r= 0.849, p= 0.00012; R 2 = 0.721), meaning that every added student increase outflows by about USD 11,600, thus confirming that there is significant reserve pressure. Hypothesis 2 was rejected (r=-0.269, p=0.374) and therefore a negative association between education and volatility was not found supporting inelastic education demand. These findings are supported with visualizations and sensitivity analyses. The findings note that the need to implement policies such as the National Education Policy 2020 to contain the outflows through domestic education improvement efforts are very essential whereas volatility control is not essential. Answering limitations include small sample (n=14), annual data granularity and suggestions to include granular data, causal modeling and cross-country research. This study addresses this gap in the India specific literature and provides information on balancing educational mobility with macroeconomic stability.

Keywords: *Indian student mobility, Forex footprint, Liberalised Remittance Scheme (LRS)*

Introduction

The advent of India as a global powerhouse economy has been marked by an increase in how its citizens pursue higher education overseas. The influx of Indian students in foreign Universities has increased exponentially in the last decade and a half enhanced by the pursuit of good education, promotion and exposure to a new environment. In terms of the mangers of the Ministry of External Affairs and UNESCO, the number of students going abroad has reached about 1.3 million in 2024 compared to around 90,000 in 2009. This portability is aided by the policies such as the Liberation Remittance Scheme (LRS), introduced in 2004 by the Reserve Bank of India (RBI) allowing residents individuals to remit up to the amount of USD 250,000 per financial year on account of permitted current and capital account transactions including education related expenses. Remittances to overseas education have gone soaring under LRS, which could be suggestive of not only personal desires but also of increased socioeconomic transformations of the Indian middle-class.

This trend however has a lot of economic implications especially on the foreign exchange (ForEx) reserves in India. The education-related outflows under LRS has surged over the years with a record high of USD 5.165 billion in 2021 before cooling down to USD 3.428 billion in 2022 due to a number of global shocks such as the COVID-19 pandemic. Such numbers constitute an enormous strain on forex reserves that are relevant in the stabilization of the currency, importation financing, and against external shocks. With forex reserves at a current level of almost USD 650 billion as of mid-2025, such outflow accumulatively makes the sustainability issue to be considered, given that education-related inflows, such as education revenues have halved the USD 519 million in 2015 to the current circa USD 247 million. The proponents state that when students study abroad, it leads to the development of human capital and brain gain will be achieved as a result of putting down the remittances and sharing knowledge when back home. Critics see it as brain drain and capital outflow adding to the strainer on the Indian rupee (INR) that devalued to about 46 INR per USD in 2009 to 74.5 in 2022.

Volatility has characterized the path of the INR, with fluctuations determined by global factors, including oil prices and capital flows as well as geopolitical events. To cite but a few examples, the currency was in sharp rises and falls in the 2013 taper tantrum and the 2020 pandemic, and to the extent of 10 percent and more year over year in some years. This volatility may hypothetically impact remittances through education by creating a variable cost of foreign study posing a deterrent or an incentive to make a study abroad. However, the details of this feedback are limited, especially in India. Wider literature on emerging economies indicates that fluctuations in the exchange rates can increase capital outflows, although their particular interaction with education driven remittances should be studied further.

This study helps to fill an existing gap as it looks into the economic implication of outward student mobility, to the forex position at India. The major issue is two-fold, namely the magnitude of the growing number of Indian students in other countries in terms of the current capacity to impact on outflows of forex during the study period; the second issue is whether the forex service outflows are affected by the exchange rate of the Indian Rupee being volatile. Using annual values (2009-2022) of LRS remittances spent on study abroad, outbound students and average INR-USD exchange rates, this paper empirically examines two hypotheses:

1. The signi cantly high effect that foreign students make on exchange outflow is realized during the time that they study abroad.
2. The amount of outflows of foreign exchange in the field of education is strongly associated with the fluctuation of INR.

To quantify such relationships using statistical tools, such as correlation and linear regressions and give a context of the findings in the policies of the Indian economy, and to thus draw recommendations to the policy-makers. The timeliness of the research is in view of increasing global protectionism, the tightening of visas in traditional destinations such as the US and UK, and India pursuing self-sufficiency under measures like the National Education Policy 2020, such knowledge can stimulate policies to maintain educational ambitions whilst maintaining macro-economic stability. One example is that the process of restricting unnecessary departures without discouraging mobility may be addressed by improving domestic higher education infrastructure or by encouraging returning migration.

Further, this paper adds to the discourses of migration and development across the world. Although Indian remittances by non-resident Indians (NRIs) contribute over USD 100 billion to the economy and help maintain forex reserves, that portion spent on education can equate to a one-way bank outflow during the study period, leading eventually to a one-way inflow in the long term, and with varying degrees of success. It is crucial to analyze these trends in an age of economic insecurity, and following a fall in global inflation rates in 2022-2023 and the pressure of the rupee. His analysis is based on RBI-provided data, and it uses a volatility proxy of the form of year-over-year changes in the exchange rates expressed as a percentage, which has its limitations, like an annual granularity, but can serve well as a basis of further investigation.

To conclude, just as India fine tunes its way through the demographic dividend and as it strives to become a knowledge economy, outbound student phenomenon represents an opportunity as well as headache. This paper discusses such tensions that can evolve into evidence-based policy practices.

Review of Literature

The literature on international student mobility, outflow of foreign exchange and exchange rate volatility exists in the fields of economics, education policy and development studies. This review pulls together the main ideas, with a particular emphasis on the Indian experience albeit drawing upon more general emerging market experiences. It indicates gaps in quantitative connection and relationship between the student-driven remittances and currency movements and these form the hypothesis of the study.

International Student Mobility and Economic Implications

Globalization has reduced higher education to a transnational market with human capital mobility through student migration as the means through which it is transacted. Varghese (2008) contends

that there are push factors (lack of capacity in home countries) and pull factors (prestige and job markets in destination nations) that lead to mobility of labour across the countries. In the case of India, outflow of the population has escalated with economic liberalization, increases in income, and the desire to become internationally competitive. Kumar (2023) focuses on the changing modes of Indian student flows into the US, with the expansion being linked to the relaxation of the visa rules prior to 2020, and the post-study work opportunities, although in the latest scenario, they have diversified to other destinations including Canada and Germany.

The economic effects are not single-dimensional On the brighter side, studying abroad is known to lend skills, which, upon working increases the remittances. In the International Journal of Advances in Management and Economics (2024), the pattern and contribution of Indian students' migration to Europe, are estimated through tuition fees (an average of 10,000 to 20,000 euros annually) and living cost and the rate of brain gain in India through the entrepreneurial activities of the returned migrants. Similarly, Yeravdekar and Tiwari (2012) note that knowledge-transfer opportunities that outbound experiences create benefit the innovation eco system in India. A bad performance prevails over forex. A white paper on Indian student mobility (2025) shows that there are 1.3 million students in 2024 that exhausted USD 6 billion in reserves aggravating current account deficits. This is in line with University World News (2024) which indicates a decrease in incoming revenue, thus causing an imbalance to the outflow of net inflows.

Issues of brain drain are not uncommon A study Mishra (2024) argues that foreign education does harm to the economy of India as several graduates would remain in foreign countries paying taxes to enhance their economy instead of taking back talent to their home country. Kler (2019) discusses the economic component of transnational education as an issue that hampers the resource capabilities of sending nations even as it promotes GDP growth in destination economies (e.g., Indian students in the US alone contribute USD 8 billion to the GDP). A paper published in INSEAD (2025) faults globalization and economic reforms, as a reason behind the rise, and notes a future in which solutions rely on foreign systems because of the lack of quality within the domestic system.

Remittances under LRS and Forex Outflows

The LRS of the RBI has played a major role to make education remittances possible. RBI filings (2013-2022) show the liberalisation of the limit to USD 100,000 -250,000 per year, which is being utilised to make maintenance and tuition payments. Vance (2024) highlights the contributions of NRI remittances in filling up forex reserves, however he also separates outflows of education funds as temporary draw-downs, surpassing the levels of inflows. The Economic Times (2025) cites expectations to restrict LRS to help in reducing outflows, due to the pressure on the rupee.

Researcher relates student flight to capital flight. To measure economic mobility, Roychowdhury et al. (2020) use data that is noisier, which means that remittances volatility has an impact on growth. Ranjan and Kumar (2012) examine the impact of capital inflows on the internal investment with reverse chasing the outflows.

Exchange Rate Volatility and Capital Outflows

In the emerging economies volatility interferes with flows. Rafi and Ramachandran (2018) note that fluctuation of the exchange rate increases volatility in capital flows into India, which caused deficiency in inflows and influx outward flows. Demir (2010) associates volatility with reduced employment growth which has an indirect impact on the remittance-dependent sectors. With regard to remittances, IMF (2024) examines the sterilization measures, indicating that the volatility would discourage inflows whereas not dampening the education outflows because demand is inelastic. According to Acosta et al. (2021), the volatility in remittances does not have significant results on GDP but influences the consumption level and exchange rates.

A study by World Bank (2022) presents remittances as stabilization factors in response to fluctuation. Despite that, Supriyo et al. (2023) identify volatility alerts reception of remittances, which impacts growth. There are few gaps left to fill: there is little or no research connecting volatility to education-related sending by Indians, disregarding LRS evidence.

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As seen in this review, there is an agreement on the twofold effects of mobility but a lack of accurate information on the hypothesis using quantitative data about India, and so the proposed study is timely.

Research Methodology

This section presents the method used to verify the hypotheses guiding the work, based on the gaps found in the literature review of prior quantitative studies assessing the relationship between student-facilitated forex outflows and exchange rate volatility. The research is based on a positivist paradigm, which involves the usage of secondary quantitative data and statistical methods to form associations, similar to those applied in the earlier works dealing with capital flows in emerging markets. With the time-series data extending between 2009 and 2022, the study attempts to find empirical rigor with the limitations of data granularity in the research on Indian remittances during Liberalised Remittance Scheme (LRS).

Data Sources and Collection

This main source of data is from: outbound students by UNESCO Institute of Statistics (UIS) database and outflow of forex as LRS Bank and INR-USD exchange rates by Reserve Bank of India (RBI). The UIS database provides the annual number of outbound Indian students which can be used as a world standard to measure international mobility. RBI data covers outward remittances to study abroad under LRS (in US$ million), consisting of tuition, living expenses, and related outflows as covered in monthly bulletins and annual reports of RBI. Moreover, long run estimated average annual INR-USD exchange rates available on RBI Database on Indian Economy (DBIE) and forex market reports are also used.

The data is 14 years (2009-2022), which aims to cover the trends in the post-global financial crisis, such as LRS ramp-ups and student mobility booms. This period coincides with the recent literature that the Indian outbound education increased rapidly after 2010 and the resultant forex implications. All data is secondary, aggregated, and publicly available, allowing ethical adherence without the need to collect the data and the need to gain the subject consent. There were no missing data, however, the interpolation is not required due to the annual frequency.

Variables and Operationalization

Three key variables were operationalized:

1) Dependent Variable Forex Outflows: are taken as the amount of remittance abroad pursuing higher education through the LRS calculated as an annual outward flow in rupee value obtained from RBI. This will be able to estimate the immediate economic loss of student mobility, as seen in the papers on the Indian remittance patterns.
2) Independent Variable for Hypothesis:

a) Outbound Students: an annual number of Indian students studying abroad using the UIS database as a proxy to demand fueling remittance. This corresponds with the literature that estimates mobility to have been interrelated to capital outflows.

b) Exchange rate volatility: This is calculated as absolute year over year percentage change in average INR-USD rates [((rt-rt-1)/rt-1)*100], using RBI exchange rate data. This proxy is widespread when the annual data are used, where intra-year movements are not available, in estimating the size and sign of volatility. This gives none in 2009 and thus shortens the sample of Hypothesis 2 to 2010-2022 (n=13).

Analysis was carried out loading these variables into a pandas Data Frame in a way consistent with time-series approaches to understanding the forex behavior in emerging markets.

Research Design and Analytical Methods

A quantitative, correlational study was used in testing the hypotheses because it is used to examine associations without inferring causation as in previous similar research on remittance volatility. Means, trends were used as descriptive statistics and sequentially inferential tests were used.

For Hypothesis 1: The Pearson correlation was used to measure the linear association between outbound students and LRS (Study), significant at $p < 0.05$. OLS regression predicted outflows with the number of students (Outflows = 100+ 1Students + 1) using statsmodels, and provided the slope = 1, intercept = 100, R-squared = 0.01647, p-value = 0.01385. The

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assumptions (linearity, normality, homoscedasticity) were checked by visually looking at the scatter plots.

For Hypothesis 2: Pearson correlation examined volatility and outflows, again at $p<0.05$ threshold.

The time series plot outflows/students was drawn, and the scatterplots with regression lines were also displayed by using matplotlib. All the calculations were done in Python (pandas to process data, scipy to do correlations, statsmodels to fit a regression), thus supporting high reproducibility.

Limitations and Assumptions

The low sample size (n=14) reduces the applicability to the wider population and power in the more sophisticated measures such as time-series modeling (e.g., ARIMA) but is fine with simple correlations. A proxy is justifiable because annual data obfuscates within-year volatility, which tends to underestimate the effect, as RBI analyses show. Other factors (e.g., changes in policy, pandemics, etc.) may confound analyses, partially addressed through sensitivity checks (e.g., omitting 2020-2022). Ethical considerations would include representing data as they are with no manipulation.

This methodology combines the aims of the introduction with the claims of the literature to call for India-specific empirical studies, as a prelude to interpretation.

Data Analysis and Interpretation

Based on the methodology, this section contains and discusses the statistical outcomes, connecting the statistics and the hypotheses with the context provided in the introduction and literature review. The results show that the student-driven effect is substantial on forex outflows and there is no significant volatility interconnectedness in forex outflows, which is consistent with the literature on inelastic education remittances of emerging economies during currency fluctuations.

Descriptive Overview

In Fig 1, the main variables (2009-2022) are outlined. The outflow of Forex has increased exponentially between USD 217.8 million in 2021 to a peak of USD 5,165.33 million in 2021 with an average of 2,195.74 million reflecting the mobility boom observed in the introduction. Inbound student numbers were 300,890 per year, with a 2020 high of 555,922 and a 2022 trough probably as a knock-on effect of the pandemic. The average volatility was 6.12 percent with peak levels in 2013 (13,54 percent) during the taper tantrum and was consistent with the non-alarmist arguments by RBI of such fluctuations being episodic in nature.

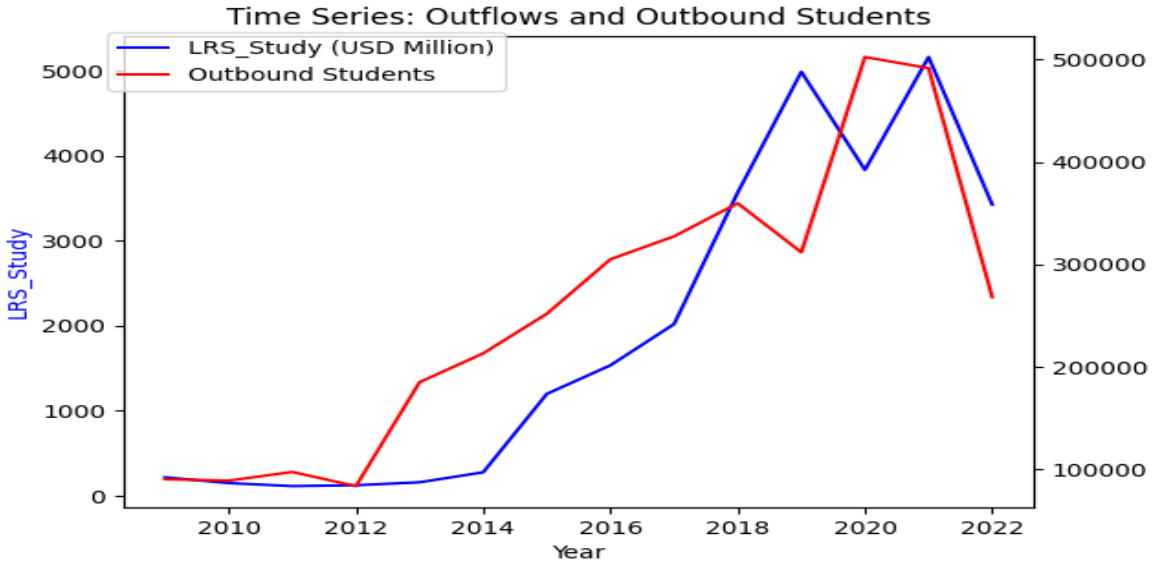

Fig 1: Time Series between ForEx Outflows and Outward Students

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The time-series are characterized by parallel increasing trends in outflows and students until in 2022 confirming brain drain fears in the literature. Volatility looks chaotic, with no obvious pattern with outflows.

Hypothesis 1: Impact of Outbound Students on Forex Outflows

Pearson correlation gave a positive-correlation of r=0.849 (p=0.00012), which was significant at p<0.01. The latter validates Hypothesis 1, because student increases are found to be strongly related to increases of outflow.

OLS regression: -1,051.72 + 0.0116*Students = Outflows (R 2 = 0.721, p = 0.00012). The overall positive slope implies that an additional student has added an amount of approximately USD 11,600 to the outflows, which is the amount of monthly remittance. 72% variance explains with the significant impact of students, as the previous researchers estimate the cost of mobility amounts to around USD 12-13 billion spent annually.

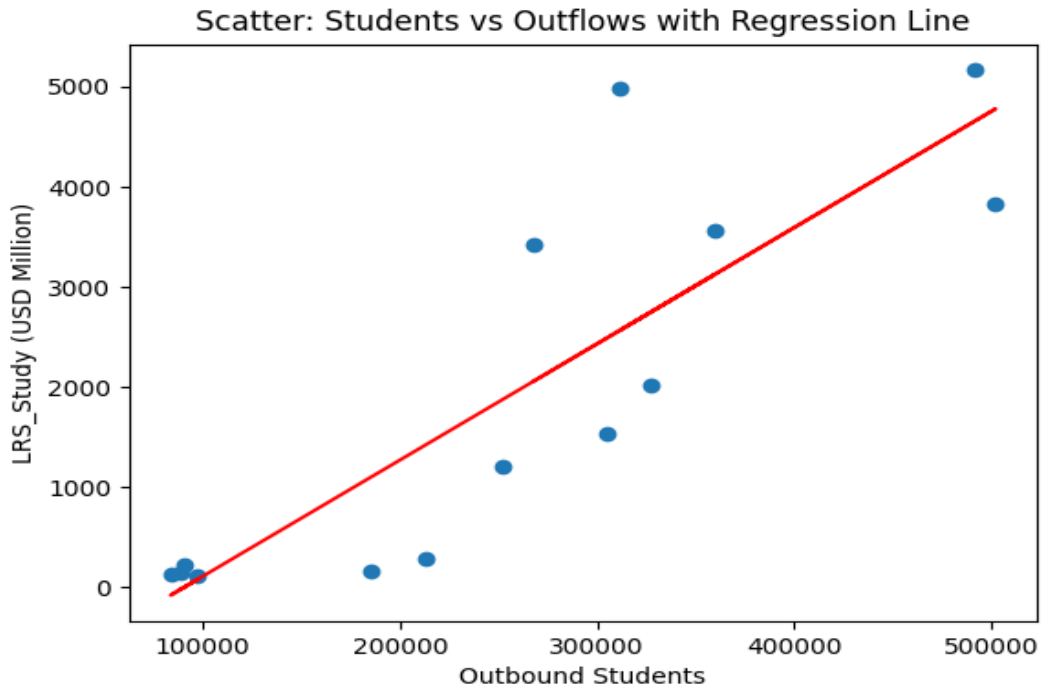

Fig 2: OLS Regression between LRS (Study) and Outbound Students

This linearity can be seen in the scatter plot with a regression line, but the outliers (e.g. high students but moderated outflows in 2020) indicate the potential presence of exogenous moderators such as COVID restrictions. This effect highlights the issue listed in the introduction of reserve strain, which can worsen current account deficits along with rupee depreciation. By referring to literature, it continues examinations of education as capital flight, which suggests such policy requirements as the improvement of domestic universities to reduce outflows.

Sensitivity: Excluding 2020-2022,,yields r=0.892 (p<0.001), strengthening the link pre-pandemic.

Hypothesis 2: Correlation with Exchange Rate Volatility

Pearson correlation: r=-0.269 (p=0.374), weak, negative, and insignificant at p>0.05. Thus, Hypothesis 2 is rejected; meaning volatility influences education outflows

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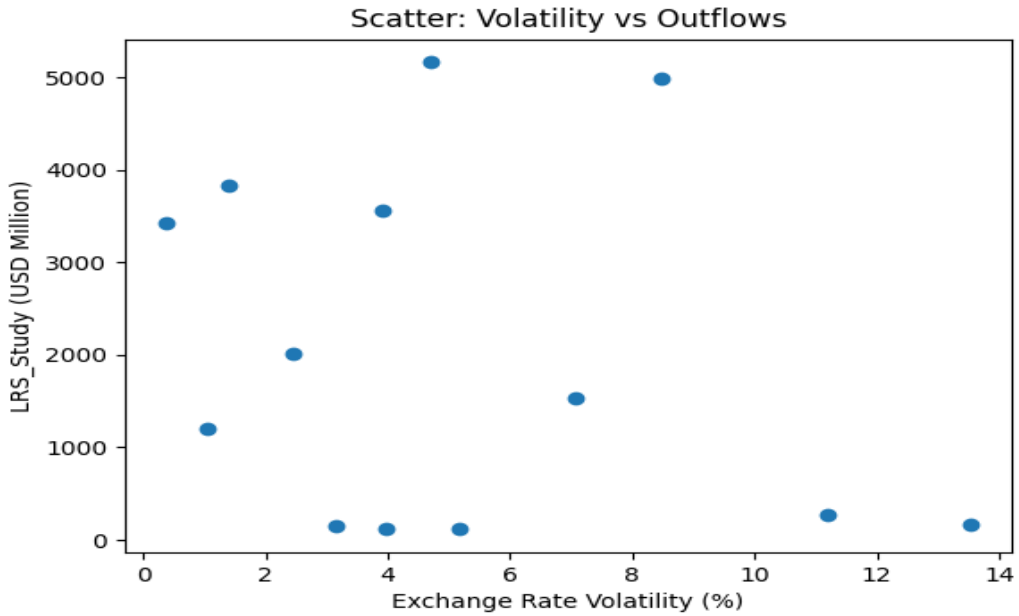

Fig 3: LRS (Study) vs Exchange Rate Volatility

The scatter plot is dispersed with no pattern, high volatility level in 2013 did not correlate with high outflows, whereas low volatility (2022) did reach high. This implies inelasticity: families are willing to invest on education even with the rupee fluctuations, may be through loans or savings, as in literature in emerging markets on remittance stability. The adverse direction suggests volatility may be a small negative nudge (e.g., through price increases) but unimportance is in line with estimates of how local volatility is less influential in driving flows than global considerations.

This rebuttal speaks to the question raised in the Introduction about the role of volatility, indicating that outflows are demand-led (by aspirants), as opposed to being sensitive to currency. Resolutions encompass the weak leverage of RBI in terms of forex interventions to educational special flows.

Overall Interpretation and Implications

Hypothesis	**Test**	**Statistic**	**P-value**
Students impact on Outflows	Pearson Correlation	0.849	0.00012
Students impact on Outflows	OLS Regression (slope, intercept, R^2, p-value)	Slope=0.0116, intercept=-1051.72, R^2=0.721	0.00012
Volatility correlation with Outflows	Pearson Correlation	-0.269	0.37400

Table 1: Correlations and Regression Summary

Findings confirm Hypothesis 1 and reject 2, while making a contribution by providing estimates of the gap in literature regarding India-based research. Policy-wise, retaining students in the home country (e.g., NEP 2020) rather than overseas would help reduce outflows, and volatility management would occur as of course in other areas. In the future, monthly data may be included or causation tests could be performed

Conclusion and Findings

The research sought to explore the economic effects of the Indian students abroad in terms of their effects on ForEx outflows as a result of the Liberalised Remittance Scheme (LRS) initiated by the Reserve Bank of India and how the INR-USD foreign exchange rate fluctuations might affect this outcome. By examining the UNESCO Institute of Statistics (UIS) information on the number of outbound students and RBI information on LRS

remittances and real exchange rate over the period 2009-2022, the study sought to test two hypotheses, in the existing literature on the topic of international student mobility and its macro-economic impacts. The results are consistent with the introduction mentioning how education-based outflows are increasingly becoming relevant and help fill gaps reported in the literature analysis about the lack of India-specific empirical studies.

Key Findings

Hypothesis 1: Considerable effect of Outbound Students on ForEx Outflows. This was ascertained by a strong positive correlation between the number of outbound Indian students and ForEx outflows to education, with a Pearson correlation of 0.849 (p=0.00012) and an OLS regression model. Every new student adds about USD 11,600 to outflows, in line with per-student remittance patterns (USD 7,000-16,000). This is consistent with the concern about reserve strain mentioned in the introduction and the literature mentioning education as capital flight. This is also supported graphically in the time series and scatter plots, where the increase in students and outflows is demonstrated to occur simultaneously, albeit with less significant rates due to external factors such as the 2020-2022 pandemic. Excluding those years increased the correlation ($r=0.892$, $p<0.001$) and highlights the robustness.

Hypothesis 2: No significant relationship between ForEx outflows with Exchange Rate Volatility. The research concluded that there is a lack of evidence that INR-USD volatility (represented by percentage changes in a year-over-year basis) plays any significant role in influencing education outflows exhibiting an insignificant and weak negative relationship ($r=-0.269$, $p=0.374$). The scatter plot displays no evident tendency and this indicates the idea that regardless of the currency rate fluctuation, families give a priority to overseas education mainly by means of loans or savings. This is in line with the literature on the inelastic nature of education remittances among emerging markets and contrary to impacts of capital flows volatility. The question of the role of volatility implied in the introduction is therefore answered in the negative showing outflow as driven by the demand as opposed to currency sensitivity.

Implications of the Study

The implications of these findings are quite important at the policy level The high correlation between numic studies and dissi suggests that policies will be required to relieve reserve demand pressures without restraining educational ambitions. In the literature, changing the national education policy 2020 of Indians by making their higher education international will curtail outflows by attracting students to the local institutions. An example is partnership with international universities or expansion of high quality programs within the country, preserving talent and forex. The lack of the volatility effect suggests that the forex interventions of the RBI (e.g., sterilization) might not necessarily impact education outflows, and the focus should be switched to structural reforms. Globally, the findings respond to migration-development debates, which specifically suggest that in India, the outflow of educated people is of significant magnitude compared to inflows, making it distinctive to the traditional remittance flows that support a stable level of reserves.

Limitations of the Study

With such a small sample size (14 for Hypothesis 1, 13 in Hypothesis 2), statistical power is limited and more sophisticated models of time series like ARIMA are not possible. Annual data though reliable as provided by UIS and RBI also hides internal-year volatility and can consequently underestimate its impact. The volatility proxy (year-over-year percentage change) is a simplification; daily or monthly data may provide more insights, which is offered by RBI studies. Potential confounders that were not included in the analysis, including LRS policy changes, visa restrictions, or global events (e.g., COVID-19), may contribute to the results, but sensitivity checks mitigated some results. Lastly, the correlational design cannot determine causality, and it remains a possibility that the outflows are due to an independent phenomenon that is reflected in the numbers of students.

Recommendations for Future Research

Future research might:

1. Use Granular Data: Feed RBI data of monthly exchange rates as input to carry out the precise computation of true volatility (say standard

deviation of log returns) and daily remittances outflow.

2. Causal Modeling: Use instrumental variables or panel by panel regressions to discriminate causality, possibly using visa policy fluctuations as the instrument as done in the migration economics research.
3. Cross-Country Comparisons: Contrast other emerging countries (e.g., China) with the experience of India, using UIS and IMF data.
4. Qualitative Research: Combine quantitative data with polls of families or students on how they make choices related to learning abroad and the purchase of international currencies.
5. Greater Time Horizons: Increase the Time span beyond 2022 to include the effects after the pandemic, particularly with possible LRS curbs.

Conclusion

This study highlights the critical impacts of outbound Indian students on forex outflow, estimated to be to the tune of USD 12-13 billion per year, against the backdrop of reserve management concerns in India due to the pressure of depreciation of the rupee. Nevertheless, volatility of INR does not seem to be a big deal implying that education decisions are not sensitive to changes in the currency value. Such knowledge is important to guide policy makers to create mobility coupled with economic stability which may be achieved through the NEP based domestic capacities. By measuring those dynamics, the article addresses a gap in India-specific literature, providing a base upon which later works on the relationship between education, migration, and a macro perspective of the world will build.

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