Examining the Impact of Intellectual Migration Dynamics Digitalization on Economic Well Being

Bakhtiyor Islamov
Tashkent branch of REU
International Economics
Tashkent, Uzbekistan
Tashkent State University of Economics
Tashkent, Uzbekistan
b.islamov@tsue.uz

Zulaykho Kadirova
Tashkent State University of Oriental Studies
Department of Foreign Economic Activity
Tashkent, Uzbekistan
zulayxo_kadirova@tsuos.uz

Sulkhiya Gazieva
Tashkent State University of Oriental Studies
Department of Foreign Economic Activity
Tashkent, Uzbekistan
sulxiya_gaziyeva@tsuos.uz

Abstract

This research analyzes the interaction of personal remittances with migration patterns and an array of technological variables to better understand their influence on the economy. It uses an OLS regression model on a dataset containing 11 entities to isolate the effects of selected variables, which include the natural log of personal remittances, the total count of people left in foreign countries, national internet servers, as well as mobile subscriptions. This study asserts that the increased incentive for remittances at the macroeconomic level leads to more economic development. However, as for the basic migration and technological variables, their contribution is minimal implying that technology accessibility is not sufficient to spur economic growth. The study forecasts the level of coherence in the measurement tools used through calculating a Cronbach's alpha which indicates adequate reliability but still calls for enhanced item relations due to the weak averages observed. The overall aim of the research study is to determine how policies can be used to increase remittance flows which would in turn stimulate economic growth. Such information will contribute to the existing frameworks of economic development in the context of migration policies and serve as a guide for practitioners.

CCS Concepts

• **CCS Concept: remittances, economic development, intellectual migration trends, technological indicators, scale reliability**;

ACM Reference Format:
Bakhtiyor Islamov, Zulaykho Kadirova, and Sulkhiya Gazieva. 2024. Examining the Impact of Intellectual Migration Dynamics Digitalization on Economic Well Being. In *The 8th International Conference on Future Networks & Distributed Systems (ICFNDS '24), December 11, 12, 2024, Marakech, Morocco.* ACM, New York, NY, USA, 8 pages. https://doi.org/10.1145/3726122.3726296

1 Introduction

Lately, the phenomenon of migration and its associated economic impacts has started to attract increasing attention on the part of scholars and policymakers as well. The economy of the home or the host country is greatly modified by migration in the form of cross border movement of labor. One of the crucial factors in this interplay topic is the remittance flow, – money lent by migrant employees to their home country – that has been shown to have an impact on household spending, savings and economic stability among other factors. In many lowincome countries, private remittances are among the most significant inflows of money, even higher than foreign direct investments and overseas developmental aid. It therefore follows that understanding the determinants of remittance flows and their economic impacts is key in designing interventions that would restrict the use of such flows in facilitating supernormal growth rates of economies. Technology itself is also expected to foster economic activity. The availability of internet services and mobile phones may ease financial transactions and access to information and therefore widen economic participation. The extent to which these technological aspects influence economic performance still requires debate. The purpose of this research is to analyze how personal remittances, migration patterns and technological factors are connected and their joint effect to economic outcomes. Such a blended dataset allows the authors to seek to illuminate certain econometric parameters of these variables that undermine or promote economic stability. Furthermore, the validity of the measurement scale will always be tested in order to make sure that the proper statistical evaluation underlies the findings. The results of this study will cover the gap in the existing literature on migration and economic development and repeatedly provide concrete recommendations for policymakers aimed at increasing the effects of remittances and technological development.

2 Literature review

Researcher Shelly V. Siar studied the causes of high-skilled migration using the example of Filipino migrants in New Zealand and Australia. Scholar J. Hunt examined the issue of immigrants who entered on educational or trainee visas [1]. American researcher J. Borjas analyzed the economic consequences of intellectual migration processes [2]. J. Peri, in his approach, studied the impact of immigrants on local wages [3]. According to the calculations of J. Bound, G. Khanna, and N. Morales, high-skilled immigration leads to an increase in population incomes in the United State [4]. Researchers N. Jaimovich and H. Siu proposed the idea that high-skilled migration contributes to reducing inequality in society [5]. Scholars J. Hunt and M. Gauthier analyzed the impact of highly

ICFNDS '24, Marakech, Morocco

ACM ISBN 979-8-4007-1170-1/2024/12
https://doi.org/10.1145/3726122.3726296

skilled personnel on innovation and entrepreneurship [6]. In the 21st century, based on the principle of "knowledge economy", it is especially important that countries pay more attention to their economic growth [7].

Scholar V. Wadva studied the impact of high-skilled migrants on the expansion of the recipient country's economy [8]. Researcher J. Hunt noted in his studies that the success rates of knowledgeable immigrants are significantly higher [9]. V. Kerr, meanwhile, investigated how entrepreneurial immigrants promote innovation and competitiveness in the country [10]. Artificial intelligence means an intelligent artificial system that performs the logical and creative functions of a person [11].

According to research by Hanson and Liu, the share of foreign workers in science, technology, engineering, and STEM fields increased from 6.6% to 28.1% between 1960 and 2012 [12].

Researcher S. Mahmud focused on the integration of intellectual migrants into new societies [15]. Ploger and Becker examined the relationship between the work environment and the integration of migrants [16]. M.Reimsdijk and S. Bassford studied the reasons for high-skilled migrants returning home. Research was also conducted by scholars Bailey and Baldassar on the adaptation of migrants from South Asian countries [17]. In order to achieve the status of developed countries, emerging economies must focus on achieving strong economic and financial development [18]. In today's globalized economy, the export of Information and Communication Technology (ICT) services plays a crucial role in the economic development of countries [19]. According to research by S.Mansurov and K.Abdurakhmanov it was concluded that the potential of artifcial intelligence in shaping the processes of modern labour migration has not yet been fully revealed in developing countries. Regulation of labor migration processes is of urgent importance in preventing such undesirable problems and situations. Digital tools and platforms are being used in all sectors, including labor migration and service management [21]. The research aimed to determine how important ICT is for workers' daily activity abroad in evidence from the 5 regions of Uzbekistan [22].

3 Methods

3.1 Data Collection and Participants

The study analyzed a dataset from world bank open source during 24 year of observation. The dataset includes variables such as personal remittances, migration status, savings, and technology usage, which are essential for understanding the economic dynamics within the studied population.

3.2 Descriptive statistics

Statistics that form a summary of a set of characteristics within the data were calculated as well. At this stage, all variables were averaged, standard deviations calculated and ranges computed in order to define the distribution of the data and possible outliers.

3.3 Two-Way Graphs

Two-way graphs were developed to visually illustrate the relationships among key variables. These graphs provided an initial examination of the connections between personal remittances, migration patterns, and technological influences, thereby enhancing the comprehension of the data trends.

3.4 Correlation test

Pearson correlation coefficients were calculated the strength and direction of the linear relationships between the continuous variables. This examination illuminated the cardinal correlations and also influenced potential multicollinearities before regression analysis execution.

3.5 Model using Ordinary Least Squares (OLS)

We used an Ordinary Least Squares (OLS) regression to investigate how personal remittances, the trends of migration, and technology indicators affect the dependent variable. The model accounted for pertinent covariates and made it possible to estimate the marginal impact of each independent variable on the outcome.

3.6 Shapiro–Wilk Test for Normality

For normality we used Shapiro-Wilk test. In this test that is integral to validating the assumptions of linear regression, ensuring that the data meets the criteria for normal distribution.

Evaluation of Multicollinearity

To check if there was too much overlap between the independent variables which could skew the results the Variance Inflation Factor or VIF got figured out. When the VIF figures went above 10 it raised a red flag showing these variables might be giving out pretty much the same info which could mess with the study's accuracy.

The Breusch-Pagan/Cook-Weisberg test serves as a method for detecting the presence of heteroskedasticity.

To evaluate if the regression model was experiencing uneven error variance the Breusch-Pagan/Cook-Weisberg test was put to use. This test's starting assumption suggests that the differences left unexplained by the model do not vary and remain steady. If one finds a significant p-value it points toward the necessity of incorporating robust standard errors in the analyses that follow.

Analysis of Reliability

To assess how consistently the measurement scale performed in the study they worked out Cronbach's alpha. They considered an alpha coefficient higher than 0.7 as good enough showing that the scale's items were effectively capturing the same basic idea. Furthermore, they looked into how closely linked the items were by checking the average connection between them.

Histograms are utilized.

To show how key variables spread out histograms were drawn up. Seeing the data's shape and spotting any unusual patterns became easier with this visual aid paving the way for a clearer understanding of further statistical analysis.

4 Results

Most investigations into the economic reasons behind skilled worker relocation perceive migration to be a collective decision made not just by people but also by their kin. In Filipino migrants to New Zealand and Australia, Shelly V. Siar indicated the "compulsion" and "attraction" elements that propel high-skilled migration.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Personal remittances	17	3.396e+08	1.495e+08	1.483e+08	6.768e+08
Internet servers	11	134.791	186.595	.07	468.684
Mobile subscriptions	28	39.605	39.452	.004	102.898
Labor force	28	11176450	1661152	8390470	13779051
Unemployment	28	7.37	2.807	4.86	13.3
left abroad	24	122294.54	102741.49	15233	361775

The "impetus" factors comprise inadequate compensation, uncompensated extended labor hours, insufficient medical care, excessive job demands, and instability in the home nation's economy or sociopolitical sphere. However, the items that attract people are more pay, extra perks, chances to get better at work, and access to new tech.

The summarizing data reveals major significant factors associated with financial and communal circumstances. Typically, nations get around 339.6 million in remittances, and there's quite a bit of difference between them, as shown by a standard deviation of 149.5 million. The least recorded sum stands at 148.3 million, with the most being 676.8 million, suggesting a significant disparity in monetary inflows among nations or across different periods. 'The mean count of web servers shows notable fluctuation at 134,791 servers, yet the high standard deviation (186.595) indicates that certain countries or areas have much greater quantities of servers compared to others. The minimal tally stands at triflingly at 7/100, suggesting that several regions are devoid of any digital hosting facilities, whereas the zenith count reaches 468.684 units, signifying vast network facilities within particular localities. The table 1 shows the rates of mobile subscriptions demonstrate extreme variations, with a typical average of 39.605 per 100 people, but the standard deviation (39.452) suggests that in some areas, predominantly all residents are subscribed, whereas in other areas, only a few are. The highest value is 102.898, signifying that some countries have more than one mobile subscription per person, whereas the lowest is just 0.004.

The workforce comprises roughly 11.2 million persons, though this tally indicates moderate fluctuation, with an average deviation of near 1.66 million. The tiniest measured workforce equals 8.39 million, whereas the biggest measures at 13.78 million. This suggests variability in population quantity or involvement in work activities in various locales or timeframes. The mean jobless rate is 7.37%, fluctuating between 4.86% and 13.3%, showcasing notable disparities in joblessness degrees across diverse areas or periods. Some places have about the same jobless rate most of the time, but some places have jobless rates that change a lot. Average number of individuals emigrating annually fluctuates widely, around 122,294, with a deviation of 102,741. The smallest documented emigration is 15,233 individuals, contrasted with a peak of 361,775, suggesting some areas witness substantial departures overseas, possibly motivated by financial or governmental factors. The initial measure demonstrates considerable fluctuation with elevations in the early 2000s and once more circa 2015. The oscillations hint at intervals of augmented migration succeeded by steep declines, likely attributable to fiscal transformations, administrative amendments, or prominent communal happenings influencing movement.

The second statistic exhibits a steadily increasing trajectory commencing in the early 2000s, marked by a significant acceleration circa 2010, maintaining its ascent subsequently. The world is getting more connected because of the spread of mobile phones and better phone signals.

The third metric shows significant volatility, with two notable peaks—one occurring in the mid-2000s and another in the 2020s. These variations could be influenced by economic conditions in both the sending and receiving countries, migration patterns, and changes in foreign policy or global financial markets.

The fourth metric remained fairly stable and low until around 2015, when it began to rise sharply and exponentially. This increase in the number of internet servers can likely be linked to a surge in digital transformation, investments in IT infrastructure, and the overall growth of the internet economy.

If we analyze the specifics of the pairwise correlations and their coefficients to better understand the relationships between the variables:

The coefficient shows in figure 1 an extremely weak positive correlation that is not statistically significant, indicating that the relationship between emigration rates and personal remittances is minimal in this dataset. Internet servers is moderate negative correlation, which is close to being significant, suggests that higher emigration may be linked to a lower number of internet servers, possibly reflecting reduced technological infrastructure or investment in areas with greater emigration rates. Mobile Subscriptions (0.403, p=0.063) is although moderate positive correlation is not statistically significant, it hints that regions with more emigrants might see higher mobile subscription rates, potentially indicating a demand for improved communication technologies. While Labor Force (0.430, p=0.046) is positive correlation is statistically significant, underscoring a notable connection between larger labor forces and increased emigration rates, which could suggest a surplus of labor or economic conditions that encourage migration.

Unemployment (-0.485, p=0.022) can be found negative correlation with statistically significant, indicating that rising unemployment rates are often associated with higher emigration levels, likely reflecting a lack of local job opportunities that drives individuals to seek work elsewhere.

The table 2 shows that Internet Servers (-0.369, p=0.264) is weak negative correlation with not statistically significant, indicating that the presence of internet servers does not have a meaningful

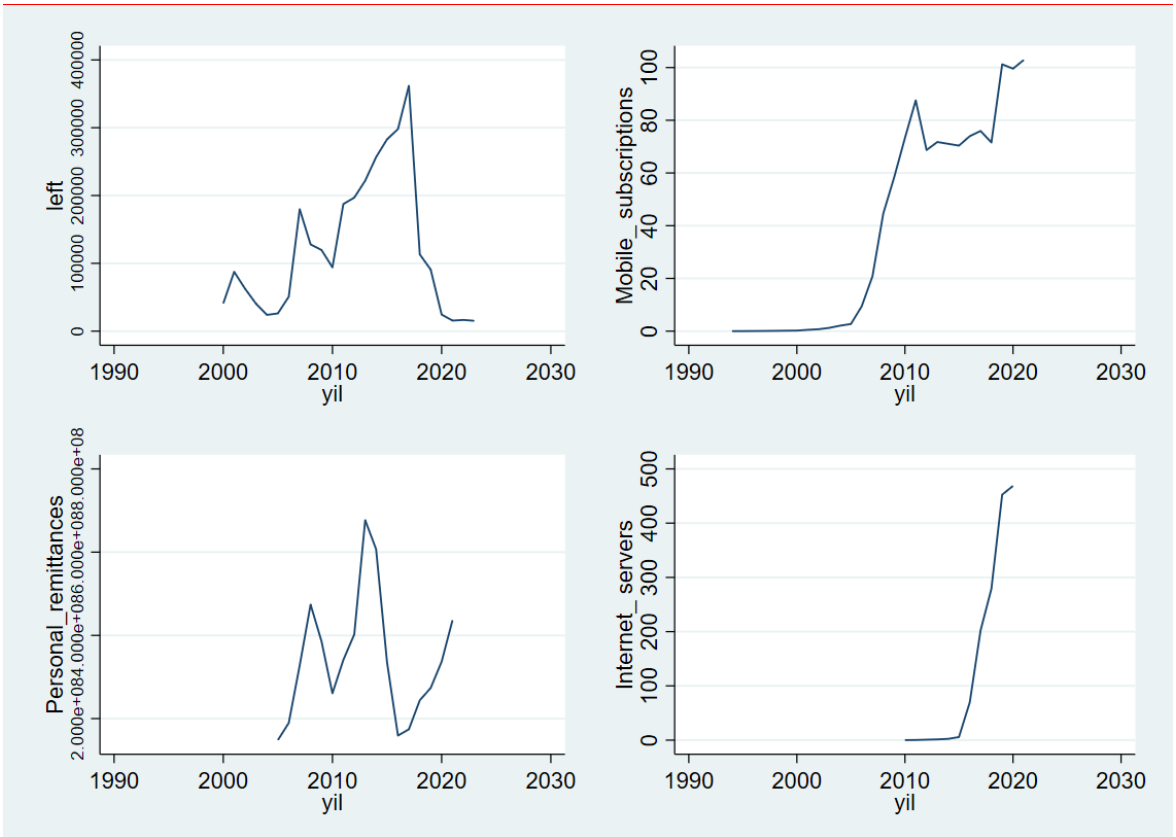

Figure 1: The four main indicators

Table 2: Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) left_abroad	1.000					
(2) Personal_remit~s	0.107	1.000				
	(0.684)					
(3) Internet_servers	-0.548	-0.369	1.000			
	(0.081)	(0.264)				
(4) Mobile_subscri~s	0.403	0.257	0.773*	1.000		
	(0.063)	(0.319)	(0.005)			
(5) Labor_force	0.430*	0.109	0.834*	0.930*	1.000	
	(0.046)	(0.677)	(0.001)	(0.000)		
(6) Unemployment	-0.485*	-0.580*	0.696*	-0.741*	-0.737*	1.000
	(0.022)	(0.015)	(0.017)	(0.000)	(0.000)	

*** p <0.01, ** p <0.05, * p <0.1

impact on the flow of remittances in the regions examined. Coming to unemployment (-0.580, p=0.015) it has found moderate negative correlation with higher remittance levels typically experience lower unemployment rates, likely due to the economic boost from incoming funds. Mobile Subscriptions (0.773, p=0.005) is a strong and statistically significant positive correlation highlights a notable link between internet infrastructure and mobile subscription rates, emphasizing the interdependent growth of these technologies. Labor Force (0.834, p=0.001) can be recorded strong positive correlation is also statistically significant, indicating that regions with a larger labor force tend to have more internet servers, probably due to increased demand and better economic conditions. Unemployment

Table 3: Linear regression

lnGross_savings	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
lnLife_expectancy	2.126	6.073	0.35	.741	-13.484	17.736	
lnPersonal_remitta~s	.135	.052	2.62	.047	.003	.268	**
Internet_servers	-.001	0	-3.32	.021	-.002	0	**
Mobile_subscriptions	.006	.003	1.95	.108	-.002	.014	
Labor_force	0	0	2.14	.086	0	0	*
Constant	8.014	24.89	0.32	.76	-55.967	71.995	

Mean dependent var	23.745	SD dependent var	0.112
R-squared	0.850	Number of obs	11
F-test	5.678	Prob > F	0.040
Akaike crit. (AIC)	-26.934	Bayesian crit. (BIC)	-24.547

*** p <.01, ** p <.05, * p <.1

Table 4: Shapiro "Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
yhat	11	0.900	1.617	0.895	0.185
ehat	11	0.909	1.475	0.717	0.237

has a significant strong positive correlation is particularly interesting, suggesting that regions with more internet servers might also face higher unemployment rates, a relationship that deserves further exploration to understand causality or underlying factors.

After finding relationship we would like analyze regression based on OLS model. This linear regression model investigates the impact of various factors, including life expectancy, personal remittances, internet servers, and mobile subscriptions, on gross savings, represented here through the logarithm of gross savings. Below is a summary of the model's coefficients and their implications:

According to the table 3 in the model, a decrease in life expectancy and savings is not strongly linked to corresponding savings, as evidenced by the high p-value that indicates statistical significance. Accordingly, we cannot assert with certainty that life expectancy has a significant impact on savings through this study. Personal remittances, which are funds sent home by expatriates, increase by approximately 0.135% when these funds are added to the gross savings. The outcome is statistically meaningful, suggesting that remittances have a positive correlation with savings. Gross savings can be slightly reduced by increasing the number of internet servers, which is statistically significant. However, there is another interesting point to remember. While this might appear unusual, it may indicate that areas of the globe that allocate substantial amounts to technology may focus on different economic policies that impact savings. Additional mobile subscriptions could lead to a small boost in savings, but its statistical significance is uncertain and cannot be determined using current data. The magnitude of the labor force's influence on savings is insignificant when compared to other datasets, but the findings are not sufficiently robust to establish their similarity. The model suggests that personal remittances consistently lead to increased savings, while the presence of internet servers appears to have an adverse effect. However, the effects of life expectancy and mobile subscriptions are not strong enough to reliably consider whether they have any impact on savings in areas where it has been done. You've provided yourself with data that is derived from a VIF analysis that detects multicollinearity among the independent variables in regressive models. To summarize, the labor force has a VIF of 14.98, which is indicative to significant multicollinearity.

The table 4 shows that the results of Shapiro-Wilk test from for normality tests on two data sets, yhat and ehat were estimated. By using this statistic in conjunction with the test, one can understand how closely the distribution of yhat matches that of normal. A minimum of 1 indicates normality. If we can reject the null hypothesis, which states that the data conforms to a normal distribution, this statistic provides an answer. We don't reject the null hypothesis because 0.185 is above 0.05. Therefore, we do not have robust evidence to indicate that the predicted values (yhat) are not normally distributed. We also don't reject the null hypothesis here, as for the residuals we get a p-value of 0.237—also well above 0.05. This implies that the residuals will probably be evenly distributed. Hence, Although the W statistics for both yhat and ehat are below 1, suggesting some deviation from normality, the p-values for these two variables are above 0.05, indicating no significant deviation. Therefore, we can treat the expected values and residuals as normally distributed for our analysis.

The errors in our regression model should be assessed as either homoskedastic. The null hypothesis (H0) indicates that the error terms exhibit a consistent pattern of variation (homoskedasticity). For the chi-squared analysis, Chi2(1) is the test statistic. 0.00 is the value of minimum proof against the null hypothesis shows that the p-value is 0.9715. The null hypothesis can be rejected if this value is reached. The absence of strong evidence of heteroskedasticity

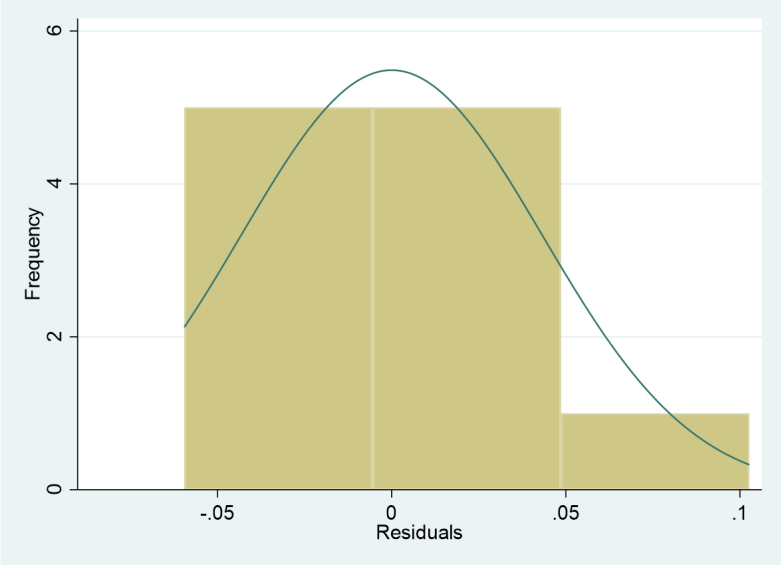

Figure 2: The Breusch-Pagan/Cook-Weisberg test for heteroskedasticity

means that a p-value greater than 0.05 (0.9715) doesn't make us invalidate the null hypothesis.

The analysis derived from the Breusch-Pagan/Cook-Weisberg test for heteroskedasticity is used to determine whether the variance remains consistent. The figure 2 shows that, finding results lead us to conclude that your model doesn't display heteroskedasticity. The assumption of uniform variance is still valid, indicating that the errors are evenly distributed among all fitted values for lnGross_savings. Although heteroskedasticity may cause inefficient estimation, it is a positive sign for the improvement as this could potentially invalidate hypothesis tests and improve regression analysis. That information comes from a regression that shows how many independent variables conditionally marginalize essentially one dependent variable. The marginal effects from figure 3 demonstrate the degree of change in the dependent variable, which could be related to migration or labor mobility, with a one-unit increase in each independent variable at its mean values.

The dependent variable is not statistically significant when the left abroad increases by only one unit, resulting in minimal change in the dependent factor. Natural logarithm of Gross_savings shows a statistically significant increase of approximately 0.144 when the amount sent as lnPersonal remittances is raised by one unit. It is slightly less when the number of Internet servers increases, but this effect is not statistically significant. This change in the dependent variable is not statistically significant, but it increases one unit in Mobile subscriptions. While outcome variable increases slightly when the Labor force is increased by only one unit. Although it is almost crucial, this does not fall below the usual minimum of 0.05.' The use of Cronbach's alpha indicates internal consistency, indicating the relative proximity or similarity of these objects as a group. A reliability level of 0.7 or higher is generally considered to be good. Your 0.7865 indicates that the scale is dependable. This means that the scale is very reliable (alpha = 0.7865) and therefore can reliably measure its intended construct. The low average interterm correlation (0.0627) suggests that the scale may not be a good match, despite its reliability.

5 Discussion

The purpose of this research was to evaluate the connections between key variables, such as lnPersonal remittance flows, foreign funds left, gross savings, and multiple technological indicators like internet servers and mobile subscriptions. These studies offered valuable insights, especially in demonstrating that the dependent variable is positively associated with personal remittances, which supports previous research exploring how monetary flows can contribute to economic development and stability within the recipient country. Additionally, the significant positive impact of lnPersonal remittances (dy/dx = 0.1438, p = 0.042) suggests that higher incoming monetary shipments are associated with better outcomes in the study context. Previous research has indicated that remittances have a positive impact on household consumption, savings, and investments in education and health. The outcomes have significant implications for policymakers who aim to utilize remittances for economic development. Conversely the dependent variable had weaker or negligible associations with variables left abroad, internet servers and mobile subscriptions. The limited or negligible impact of internet servers and mobile subscriptions on economic activities implies that technology may not fully benefit economic activity without effective utilization in the socio-economic context.

A Cronbach's alpha of 0.7865 indicated that the measurement scale was dependable and had reasonable internal consistency. Even though there is some inconsistency among items, the low average interitem correlation (0.0627) suggests that the scale may not fully reflect this fundamental concept. The scale may be refined in future studies by incorporating qualitative techniques to identify more pertinent indicators, which would enhance coherence. The

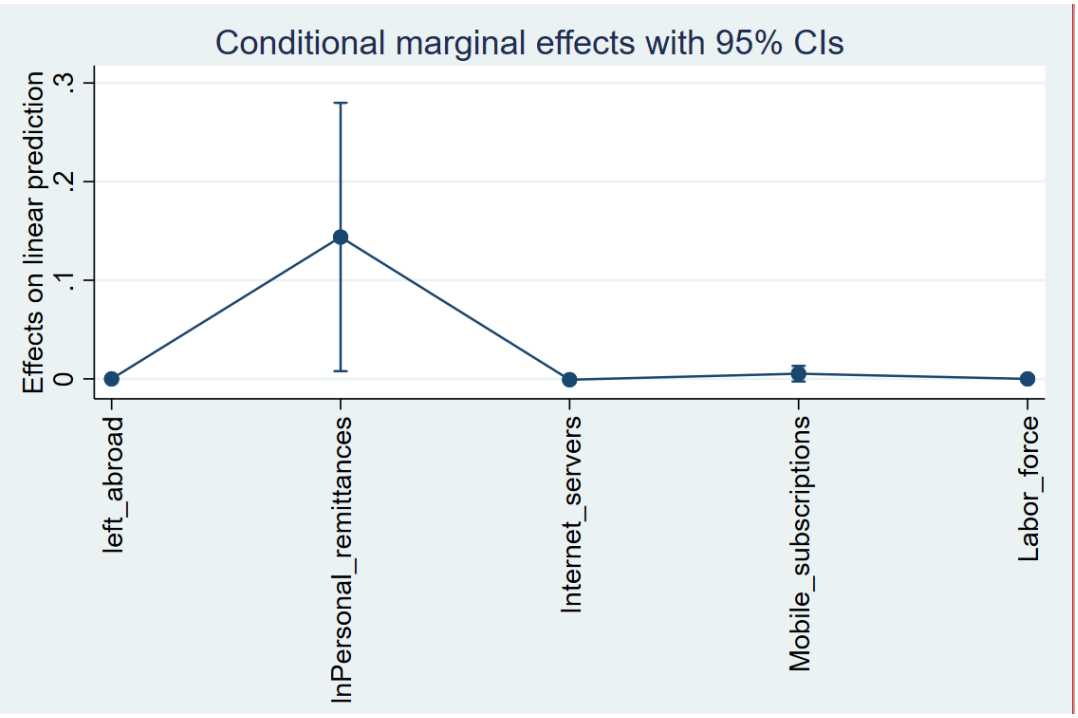

Figure 3: The marginal effects

outcomes highlight the necessity of policies that promote and support remittance flows. Through the reduction of transaction costs and enhanced access to financial services, policymakers and financial institutions can promote financial inclusion and create a more conducive environment for remittance transfers. In addition, efforts to train migrant workers on the economic benefits of sending funds overseas can increase these positive outcomes. However, the study has its limitations. The small sample size of 11 does not allow for generalizations in the findings, and the data is cross-sectional, which limits causal interpretations. Larger, longitudinal datasets are more suitable for investigating these relationships in future research. Additional variables such as social networks, policy changes, and economic conditions could be utilized to enhance the comprehension of the factors that shape remittances and their economic effects. Besides the quantitative analysis, qualitative studies could yield more comprehensive information on the motivations and utilization of remittances. According to the study, there is a strong positive association between personal remittances and the dependent variable, which highlights the crucial role of household contributions in elevating consumption, savings, and economic stability. Left abroad, Internet servers and Mobile subscriptions also showed weaker or minuscule effects that suggest other factors may have less direct impact on economic outcomes. Standard measurement scale is dependable, but they need to refine it even more to ensure item coherence. The outcomes highlight the necessity of implementing policies that encourage remittance flows, which could lead to sustainable economic development by using their full potential.

6 Conclusion

Current research has provided valuable information on the impact of personal remittances, migration patterns, and technological factors on economic development. It stated personal remittances are crucial and advantageous for economic development, as they provide significant financial benefits to individuals in developing nations. This finding is consistent with earlier research showing the transformative role of remittances in improving household welfare, increasing savings and encouraging investment in health and education. However, the analysis of variables like left abroad, Internet servers, and Mobile subscriptions demonstrated minimal or negligible effects on the dependent variable. Although it is commonly thought that technological access is linked to economic growth, the actual benefits may depend on various contextual factors such as the implementation of technology within local economies. There are doubts about the effectiveness of enhancing technology access without guaranteeing that individuals possess the necessary skills and resources to leverage these tools for economic development. This raises important questions.

Reliability analysis showed good internal consistency of the measurement scale used in this study (Cronbach's alpha 0.7865). Even though the average inter-item correlation is low, it suggests that some items may not align and represent the same underlying construct. The scale may need to be refined in future research, with the possibility of incorporating qualitative methods to better capture the complexity of the constructs being measured. Policymakers must consider the implications of these findings. Given the proven effects of remittances on economic conditions, it's imperative to

create policies that facilitate their flow. This could entail reducing transaction costs, improving the regulatory environment for financial transfers, and increasing financial literacy among migrant workers and their families. The local economy can be stimulated and sustainable development can result from the optimal utilization of remittance benefits by policymakers.

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