The Causal Relationship between International Private Transfers and Macroeconomics in India: Vector Error Correction Mechanism Estimation

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Abstract: The flow of international private transfers to India is substantial and has a strong causal relationship with macroeconomic variables in India and with international variables. This paper examines the long-run causal relationship between international private transfers and six macroeconomic variables viz. private transfers, GDP, consumer price index, exchange rate, GDP of the US and international crude oil price for the period 1975 to 2022. The vector error correction model estimates show that an increase in the GDP of the US increases private transfers to India by 4.5%, whereas an increase in international crude oil price decreases private transfers to India by almost 1%. An increase in the GDP of India influences private transfers to India positively, while an increase in the consumer price index and exchange rate reduces private transfers to India. The negative error correction mechanism reveals that about 23.3% of short-run deviations in private transfers to India are adjusted in the long-run equilibrium.

Keywords: International private transfers, macroeconomics, causality, VECM estimation

INTRODUCTION

The volume of private transfers from people working abroad to the home country is substantial and has been increasing over time. With liberalisation and globalisation and free movements of labour across countries, private transfers to developing countries are a significant factor in the international flow of funds and are a source of capital investment for the capital-scarce and labour-surplus economies. The size of private transfers varies from one-fifth to half of the economy for different developing countries. Addison (2004) argues that private remittances can create a positive impact on the economy through various channels. The remittances can impact savings, investments,

growth, consumption, poverty and income distribution. Private remittances help in raising the national income by providing foreign exchange and raising national savings and investments as well by providing hard currency to finance essential imports thereby curtailing any BOP crisis. Remittances also carry some positive effects on investments in developing countries, particularly raising enough and cheap capital to finance investment activities. The remittances are used to finance several social projects including school buildings, clinics and other infrastructure. International migration and private remittances significantly reduce the level, depth and severity of poverty in the developing world. Adams and Page (2005) find a significant impact of international migration and remittances on poverty in many developing countries.

Private cash transfers are an important source of income for many households in various developing countries. At the household level, the two principal motives of the private transfers are altruism and self-interested exchange (Cox, Hansen and Jimenez, 2004). The amounts received are large, especially in poor households. Such large private transfers influence poor households and boost their well-being and living standards. Private transfers are also for household economic status, education of children and better health-seeking of poor families in developing countries. The private transfers are important for policy as they also provide social and economic benefits similar to those of public programmes. The private transfers could crowd out public transfers in many ways.

India is the highest recipient of world private transfers, which is growing at an average of 15% every year. Much of India's private transfers come from the Indian migrants of skilled labour to countries like the USA and Middle Eastern countries in search of high earnings. Private transfers arise due to many factors ranging from cash transferred through 'formal' institutions like banks, non-bank financial institutions and money transfer operators. Gold and silver bought through baggage and gifts towards persons in India are gauged under the current account of private transfers as they represent one-sided transfers. With sizable private transfers to India, the private transfers, migration, economic growth and some of the macroeconomic variables of not only India but also the destination of the migrant Indians are interlinked.

This paper aims to identify the macroeconomic determinants of private transfers to India, not only that of India but also those of host countries. Specifically, this paper analyses the relationship between private transfers to India, the gross domestic product of India and the US, exchange rate, inflation, and crude oil price. Further, this paper also examines the short and long-run nature of the relationship between the private transfers and these macroeconomic variables. For this purpose, the paper uses time series data for the period from 1975 to 2022. In the empirical analysis, the time series methodologies of the stationarity test, cointegration test and vector error correction model are applied.

The economic literature on international private transfers is scanty. Cox, Hansen and Jimenez (2004) argue that private transfers are widespread in developing countries and are highly important for household resources. The private transfers at the household level are consistent with altruistic behavior and there exists a strong transfer derivative in poor households. In an attempt to understand the inference between private transfers and public transfers, the authors check for the crowding out hypothesis i.e. whether private transfers reduce public transfers. The spline regression results of changes in private transfers on changes that have occurred in public transfers suggest that the potential for crowding out is large for the public transfers targeted towards those in the lower reaches of the income distribution.

Eozenov (2008) analyse the determinants of private transfers in rural Vietnam using the Vietnam Living Standards Survey applying parametric and semi-parametric methods of estimation of LPM and logit models. The estimated empirical results show that private transfers helped in income smoothing over the life cycle. Among other factors, the age and gender of the household head are the major determinants of transfer inflows and outflows. The pre-transfer income is positively related to the net donor and negatively related to net recipient status, especially for low levels of income. This result suggests that the private transfers just crowd out the redistributive public transfers targeted towards the rural poor at the family level.

In India, Trivedi and Panda (2014) examines the behaviour of private transfers to India. He notes that private transfers to India are significantly influenced by both home and host country macroeconomic factors, especially the oil price hikes. Private transfers to India have become a major source for reducing the magnitude of current account deficits and are used for consumption and investment purposes. The relationship between private transfers and the macroeconomic variables is examined with unit root test and cointegration tests and the vector error correction model is estimated.

DATA AND METHODOLOGY

In order to examine the relationship between private transfers and macroeconomic variables in India, this paper considers a time series data for the period 1975 to 2022 for six variables viz. private transfers, GDP, consumer price index, exchange rate of India, GDP of the US and international crude oil price. The data on private transfers to India have been collected from the Reserve Bank of India Handbook of Statistics, and the data on the GDP of India and the US, the consumer price index of India, international crude oil price and the exchange rate of India have been collected from the World Bank sources. The GDP of India and the consumer price index are taken as proxies for the home country's macroeconomic factors while the GDP of the US and international crude oil price are used as host country macroeconomic variables as more than 65% of

migrant workers of India work in USA and the Middle East. The exchange rate weighs up the valuation of the Indian rupee with respect to the US dollar in the given span of time. All the monetary variables are expressed in terms of US for the ease of comparison. Table 1 presents the definition and descriptive statistics of the variables used in the empirical analysis of private transfers to India and macroeconomic determinants.

Table 1: Descriptive Statistics of Variables

Variable	Description	Mean	Std. dev.
$lnPTS_{IN}$	All current transfers and remittances in cash or in kind received from all non-resident individuals by residents of India and total remittances and transfers to non-profit institutions (US$)	22.730	1.456
$lnGDP_{IN}$	Gross domestic product of India (US$)	26.803	0.872
$lnCPI_{IN}$	Consumer price index of India at 2010 constant price	3.520	0.902
$lnER_{INR}$	The price for which US dollars are exchanged for Indian rupee (US$)	3.203	0.725
$lnGDP_{US}$	Gross domestic product of US (US$)	29.583	0.688
$lnCOP_{IT}$	OPEC crude oil price per barrel (US$)	3.405	0.685

VECTOR ERROR CORRECTION MODEL

The estimating equation of international private transfers to India is specified as:

$$lnPTS_t = \beta_0 + \beta_1 GDP_{Int} + \beta_2 CPI_{INt} + \beta_3 ER_{INt} + \beta_4 GDP_{USt} + \beta_5 COP_{ITt} + u_t \quad (1)$$

As the data used is time-series, the stationarity test, cointegration between the variables and the existence of long-run equilibrium in the macroeconomic variables are to be checked. The stationarity is the state where the mean, variance and covariance are constant over a period of time; the alternate condition is the non-stationarity of the series. The hypothesis for testing the stationarity is the presence of a unit root in the system. If there is a unit root in the system, spurious regression may result in wrong results. The Augmented Dickey-Fuller test for stationarity of the series is specified as:

$$\Delta y_t = \beta_0 + \delta y_{t-1} + \sum_{i=1}^{P} \alpha_i \Delta x_{t-i} + u_t \quad (2)$$

where u is a pure white noise error term and the order of autoregression is determined by the Schwarz information criterion to optimal lag length.

The Johansen cointegration test is used to check for the cointegration among the variables with possible combinations among the data in the given model. The cointegrating equation can be specified as:

$$u_{t-1} = y_{t-1} + \beta_0 + \beta_1 x_{t-1} \quad (3)$$

The Johansen test approaches the testing for cointegration examining the number of linearly independent combinations (k) for an (m) time series variables. The number of independent linear combinations (k) is related to the assumed number of non-

stationary underlying autoregressive processes (p): p=m-k. There are three possible outcomes: (i) if k=0, p=m, implying that the time series variables are not cointegrated, (ii) if 0<k< m, 1<p<m, implying that the time series variables are cointegrated, and (iii) if k=m, p=0, implying that all the time-series variables are stationary.

The Johansen test has two forms, trace test and maximum eigenvalue test. The trace test tests the hypothesis that the number of linear combinations i.e. k is equal to a given value (k^0) and the alternative hypothesis that k>k^0: H_0: k=k^0, H_1: k>k^0. To test for the existence of cointegration using the trace test, k^0 is set to equal to 0 i.e. no cointegration, and if the null hypothesis is rejected, then there is at least one cointegration relationship. The difference of the maximum eigenvalue is the alternate hypothesis: H_0: k=k^0, H_1: k=k^0+1. Hence, starting with k^0=0 and rejecting the null hypothesis implies that there is only one possible combination of the nonstationary variables to yield a stationary process.

If there is cointegration in the non-stationary time series data, the Vector Error Correction Model (VECM) examines the long-run behaviour of the series by including the cointegration term as an Error Correction Mechanism (ECM), which allows for long-run equilibrium relationship of cointegrating variables by partially correcting for the short-run adjustments. The VECM can be specified as:

$$\Delta y_t = \alpha_0 + \alpha_1 \Delta x_t + \alpha_2 u_{t-1} + \varepsilon_t \tag{4}$$

$$\Delta y_t = \alpha_0 + \alpha_1 \Delta x_t + \alpha_2(y_{t-1} + \beta_0 + \beta_1 x_{t-1}) + \varepsilon_t \tag{5}$$

where Δy_t is the short-run effect. Equation (5) explains the relationship between the cointegration equation and the vector error correction mechanism. If the coefficient value of α_2 is negative and statistically significant, then the long-run equilibrium is possible. The negative and significant coefficient of the error correction term indicates that any short-term fluctuations between the independent variables and the dependent variable will be adjusted and give rise to a stable long-run relationship between the variables. If cointegration is detected between the series then there exists a long-term relationship between the variables.

EMPIRICAL RESULTS

The Augmented Dickey-Fuller test results for unit root at levels and at first difference are presented in Table 2. The test hypothesis is: Ho: presence of unit root, and H_1: no unit root. At levels, the calculated test value is lesser than the critical value at 95% confidence interval, and hence the null hypothesis that there is a unit root in the system is accepted. At first difference, the estimated values are greater than the critical values, and hence the null hypothesis is rejected and the alternative hypothesis that there is no unit root in the system is accepted.

Table 2: ADF Unit Root Test of Stationarity

Variable	Model with	At level		At first difference	
		τ-value	p-value	τ-value	p-value
Private transfers	Intercept	-1.401	00572	-6.706	0.000
	Intercept and trend	-2.374	0,386	-6.675	0.000
	None	4.161	0.000	-2.151	0.032
GDP of India	Intercept	0.084	0.960	-5.700	0.000
	Intercept and trend	-1.199	0,897	-5.620	0.000
	None	6.268	0.000	-2.100	0.044
Exchange rate of rupee	Intercept	-0.651	0.847	-4.200	0.002
	Intercept and trend	-1.350	0.857	-4.154	0.011
	None	2.147	0.991	-1.989	0.045
CPI of India	Intercept	-1.150	0.685	-6.600	0.000
	Intercept and trend	-1.719	0,723	-6.438	0.000
	None	4.092	0.000	-1.690	0.085
GDP of US	Intercept	-8.088	0.000	-2.962	0.048
	Intercept and trend	-2.870	0.182	-4.700	0.002
	None	2.318	0.994	-1.533	0.115
International crude oil price	Intercept	-1.563	0.491	-5.604	0.000
	Intercept and trend	-1.836	0.667	-5.515	0.000
	None	0.530	0.826	-5.597	0.000

The Johansen cointegration test results for the existence of the number of cointegration relationships between the macroeconomic variables are presented in Table 3. The test hypothesis is: Ho: no cointegration, and H_1: there exists cointegration. The Johansen test rejects the null hypothesis of no cointegration between the variables. The trace statistic and the maximum eigenvalue statistic values are greater than critical values showing cointegration between the variables.

Table 3: Johansen Cointegration Test

Hypothesised no. of CEs	Trace statistic	p-value	Maximum eigenvalue	p-value
None*	154.525	0.000	49.952	0.002
At most 1*	104.573	0.000	36.430	0.024
At most 2*	68.113	0.012	29.932	0.024
At most 3*	38.130	0.004	26.029	0.009
At most 4	12.150	0.149	10.828	0.163
At most 5	1.321	0.250	1.321	0.250

Note: * Rejection of null hypothesis at 5% level.

Since the variables are cointegrated the vector error correction model can be estimated. The cointegration equation gives the basis of the cointegration among the variables. The estimated cointegrating equation is presented in Table 4.

Table 4: Cointegrating Equation of International Private Transfers to India
Dependent variable: lnPTS$_{IN}$

Variable	Coefficient	t-value
lnPTS$_{IN}$(-1)	1.000	-
lnGDP$_{IN}$(-1)	0.604	0.521
lnCPI$_{IN}$(-1)	-2.810	-1.373
lnER$_{INR}$(-1)	-2.053	-1.506
lnGDP$_{US}$(-1)	4.474*	7.428
lnCOP$_{IT}$(-1)	-0.949*	-4.525
Constant	-15.168	-

Note: * significant at 1% level.

The cointegration result shows that there is a negative relationship between private transfers and exchange rate, crude oil price and consumer price index. The economic growth of India and the US, measured by their GDP, is positively associated with private transfers to India. An increase in the GDP of the US will increase the private transfers to India by 4.5% whereas an increase in the international crude oil price will decrease the private transfers to India by almost 1%, both of which are statistically highly significant. Though not statistically significant, an increase in the GDP of India will boost private transfers to India, whereas an increase in inflation and exchange rate will dampen the private transfers to India.

The vector error correction model (VECM) is applied to find if there is any long-run equilibrium condition in the model. The lag length of 2 has been identified by the Schwarz Information Criterion (SIC). The estimated vector error correction results are presented in Table 5. In the estimated VECM, the error correction term is negative and statistically significant showing that 23.3% of the variation in the short-run deviations of private transfers is adjusted to attain the long-run equilibrium value. There exists a long-run causality between private transfers and the macroeconomic variables.

Table 5 VECM Estimates of International Private Transfers to India

Variable	Coefficient	Absolute t-value	p-value
ECT	-0.233*	2.60	0.013
D(lnPTS$_{IN}$(-1))	-0.484**	2.522	0.018
D(lnPTS$_{IN}$(-2))	0.086	0.411	0.684
D(lnGDP$_{IN}$(-1))	1.785*	1.840	0.078

Variable	Coefficient	Absolute t-value	p-value
D(lnGDP$_{IN}$(-2))	1.934**	2.200	0.037
D(lnCPI$_{IN}$(-1))	-1.482	1.115	0.275
D(lnCPI$_{IN}$(-2))	-0.821	-0.878	0.388
D(lnER$_{INR}$(-1))	1.161	0.986	0.333
D(lnER$_{INR}$(-2))	0.898	0.958	0.347
D(lnGDP$_{US}$(-1))	-4.016**	2.300	0.030
D(lnGDP$_{US}$(-2))	1.394	0.898	0.378
D(lnCOP$_{IT}$(-1))	0.157	1.197	0.243
D(lnCOP$_{IT}$(-2))	-0.063	0.470	0.643
Constant	0.088	0.462	0.647
R-square	0.456		
F-value	4.62		

Note: *, ** significant at 1, 5% levels.

The long-run equilibrium condition is thus:

D(lnPTS$_{IN}$): -0.233*[(lnPTS$_{IN}$(-l))+0.604*(lnGDP$_{IN}$(-1))-2.810*(lnCPI$_{IN}$(-1))
-2.053*(lnER$_{INR}$(-1))+4.474*(lnGDP$_{US}$(-1))-0.949*(lnCOP$_{IT}$(-l))-15.168]
-0.484*[D(lnPTS$_{IN}$(-1))]+0.086*[D(lnPTS$_{IN}$(-2)]+1.785*[D(lnGDP$_{IN}$(-1))]
+1.934* [D(lnGDP$_{IN}$(-2))]+1.161*[D(lnER$_{INR}$(-l))]+0.898*[D(lnER$_{INR}$(-2))]
-1.482*[D(lnCPI$_{IN}$(-1))]-0.821*[D(lnCPI$_{IN}$(-2))]-4.016)*[D(lnGDP$_{US}$(-1))]
+1.394*[D(lnGDP$_{US}$(-2))]+ 0.157*[D(lnCOP$_{IT}$(-l))]
-0.063*[D(lnCOP$_{IT}$(-2))]+0.088

(6)

CONCLUSION

The international private transfers to India have been the highest compared among the transfer-receiving countries in the world. Moreover, it has been growing at an annual rate of 15% over the years. Most of these private transfers come from the US and the Middle East, largely as remittances sent by migrants for family maintenance in India. Such private transfers also help in reducing poverty, and investments, and to some extent crowd out public transfers. The private transfers have also a strong causal relationship with macroeconomic variables and international variables. Especially the size of transfers is influenced by the GDP of host countries and international prices such as oil prices and exchange rates. To examine the long-run relationship between private transfers to India and other such macro variables, this paper has considered six variables over a long period from 1975 to 2022. As the data used is time series, various tests of data and relations among the variables are checked and the appropriate model

is estimated. The explanatory variables considered are the GDP of India and the US, the exchange rate, the consumer price index of India, and international crude oil prices.

The ADF stationarity test shows that there is no unit root at the first difference of the time series data. The Johansen cointegration test shows the presence of cointegrating equations in the system. The estimated vector error correction model shows that the GDP of the US has a significantly high impact on private transfers to India. An increase in the GDP of the US increases private transfers to India by 4.5% whereas an increase in international crude oil price decreases private transfers to India by almost 1%, both of which are statistically highly significant. The increase in GDP of India influences private transfers to India positively, while an increase in the consumer price index and exchange rate reduces the private transfers to India. The error correction term is statistically significant and negative showing that 23.3% of short-run deviations in private transfers to India are adjusted in the long-run equilibrium. Given the size and significance of international private transfers to India, efficient policy measures are needed to channel the private transfers to India for development and infrastructure building of the country which could also contribute to building social overheads and reduce poverty and unemployment problems in India.

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