Working Paper 469

Sustainability of India's Current Account Deficit: Role of Remittance Inflows and Software Services Exports

Aneesha Chitgupi

ISBN 978-81-943874-5-9 December 2019

Institute for Social and Economic Change (ISEC) is engaged in interdisciplinary research in analytical and applied areas of the social sciences, encompassing diverse aspects of development. ISEC works with central, state and local governments as well as international agencies by undertaking systematic studies of resource potential, identifying factors influencing growth and examining measures for reducing poverty. The thrust areas of research include state and local economic policies, issues relating to sociological and demographic transition, environmental issues and fiscal, administrative and political decentralization and governance. It pursues fruitful contacts with other institutions and scholars devoted to social science research through collaborative research programmes, seminars, etc.

The Working Paper Series provides an opportunity for ISEC faculty, visiting fellows and PhD scholars to discuss their ideas and research work before publication and to get feedback from their peer group. Papers selected for publication in the series present empirical analyses and generally deal with wider issues of public policy at a sectoral, regional or national level. These working papers undergo review but typically do not present final research results, and constitute works in progress.

Working Paper Series Editor: **A V Manjunatha**

SUSTAINABILITY OF INDIA'S CURRENT ACCOUNT DEFICIT: ROLE OF REMITTANCE INFLOWS AND SOFTWARE SERVICES EXPORTS[1]

Aneesha Chitgupi[2]

Abstract

This paper examines current account sustainability and validity of inter-temporal budget constraint (IBC) for India. Sustainability of current account is established by estimating co-integrating relationship between exports and imports with and without invisibles, specifically software services exports (SSE) and private transfers (remittances) for the period 2000-2001:Q1 to 2016-17:Q3. The empirical model is estimated using Auto Regressive Distributed Lags (ARDL) technique to state that exports and imports are co-integrated in the long run and the IBC validity cannot be rejected for India. ARDL estimations for four alternative measurements of imports (with and without net invisibles, net remittances and net SSE) indicate that higher co-integrating coefficient in presence of net invisibles ensures greater current account sustainability. In addition, short-run shocks to the current account continue to persist for longer duration in the absence of net invisibles. The estimated long run co-integrating coefficients suggest that India's current account is sustainable but in a weak sense, implying that increase in imports will percolate to higher dependence on foreign borrowings. Comparison of error correction terms across the specifications suggest that private transfers (remittances) have higher contribution in ensuring current account sustainability than SSE, as speed of adjustment towards equilibrium in the presence of remittances is higher than in presence of SSE.

JEL codes: F24, F32, F34

Keywords: Software Services Exports, Remittances, Current Account Sustainability, India

Introduction

Maintaining external stability and current account sustainability have been vital to India's macroeconomic policies. Except for a few years in the early 2000s, India experienced a perpetual Current Account Deficit (CAD) due to large deficit in merchandise trade. Whereas, invisibles[3] component, which includes services trade, current transfers and current income, have contributed to lessen the CAD. In particular, exports of software services and private transfers (remittances) have been important positive contributors to India's Current Account Balance (CAB). Net software services exports were 72.1 per cent and net private transfers (remittances) were 58.2 per cent of total net invisibles in 2016-17. Together, the remittance inflows and software services exports were 56 per cent of invisibles (credit) in 2016-17.

The policy changes in the developed world with respect to increasing anti-immigration sentiments leading to tightening of immigration policies by US and European countries is seen as a

---

[1] This paper is based on the author's doctoral dissertation, under ISCCR Research Fellowship Scheme, at the Institute for Social and Economic Change (Bengaluru, India). The author is grateful to her PhD supervisor, Prof M R Narayana, for his guidance throughout the preparation of this paper. Thanks are due to members of the Doctoral Committee and Bi-Annual Panel members at ISEC for their suggestions on earlier versions of this paper; and to anonymous referees for comments and suggestions. However, the usual disclaimers apply.

[2] PhD Scholar at Centre for Economic Studies and Policy (CESP), Institute for Social and Economic Change (ISEC), Bengaluru, India. Email: aneeshachitgupi@gmail.com.

[3] Invisibles as per RBI Balance of Payments Manual (2010) includes, services (such as travel, transportation, insurance, software services etc.), transfers (public and private) and income (compensation of employees and investment income).

major challenge for India's services exports industry (especially software services) and labour market adjustment and preference for local labour in Gulf Cooperation Council (GCC) countries are seen as new threat for aspiring Indian emigrants to these countries (GOI, 2018). Given that these adverse conditions of increasing nationalist agenda among countries are here to stay and a change towards progressive and conducive environment for migration and towards foreign workers seems uncertain in future, then the two main positive contributors towards India's current account, namely, software services exports and remittances may decline.

The paper investigates the sustainability of India's current account by analysing the relationship between imports and exports with and without key contributors (software services exports and remittances). How would a reduction in remittance inflows and software services exports affect the current account balance (CAB) for India? Does the absence of software services exports and remittances from the current account make it unsustainable? The analysis examines the individual and combined impact of these contributors on current account sustainability.

Rest of the paper is structured as follows: Section 2 discusses related literature; Section 3 presents some basic data on current account components. Section 4 discusses the methodology, conceptual framework and theoretical background. Empirical estimation and results are discussed in Section 5 and Section 6 concludes with implications and recommendations.

Review of Related Literature

Sustainability of current account assessed on the basis of inter-temporal budget constraint (IBC) was developed by Sachs (1981) where the current account movements were driven by two sets of motives, 'consumption tilting' (preference for present or future consumption based on subjective discount rate and world interest rate) and 'consumption smoothening' (smoothening consumption during shocks to output, investment and fiscal spending) (Callen & Cashin, 1999). The theoretical framework of IBC was further extended by Obstfeld & Rogoff (1996) under the assumption of perfect capital mobility and consumption smoothening behaviour. Using consumption smoothening approach, sustainability of India's current account has been analysed by restricting or stabilising the net external debt to GDP ratio by Callen & Cashin (1999), Goyal (2012), Phillips *et al* (2013) and IMF's individual country specific External Sector Reports.

Apart from viewing sustainability of the current account as a repayable level of external liabilities, it can also be viewed in terms of stationarity (mean-reverting property) of current account. Developed by Husted (1992), this approach to assess current account sustainability suggests that CADs are sustainable and IBC is valid for a country if the sum of discounted future values of current account surpluses is equal to the external borrowings. This implies that the current account is mean-reverting or stationary in nature and the exports/credit side of current account (exports of goods and inflow of invisibles) and imports/debit side (imports of goods and outflow of invisibles) are co-integrated by the presence of a long run co-integrating vector.

Employing the methodology developed by Husted (1992) numerous country-specific and panel studies have analysed current account sustainability and validity of IBC by examining the long-run relationship between exports and imports (including net invisibles). Country-specific studies include

Husted (1992), Fountas & Wu (1999), Mann (2002), Christopoulos & León-Ledesma (2010) for the US current account, Apergis *et al* (2000) for Greece. Cross section and panel studies include Chen (2011) for a group of OECD countries, Baharumshah *et al* (2005) for East Asian Countries, and Sahoo *et al* (2016a) for SAARC nations. In panel study by Shastri *et al* (2018) on SAARC countries, including India, Pakistan, Bangladesh, Sri Lanka and Nepal, for the period 1985–2016 found weak sustainability primarily due to large deficits in the goods trade account, and recommends stronger control over the increasing trade deficits in the face of fragility experienced in remittance inflows from US, EU and Middle Eastern countries.

Not all studies establish the validity of IBC and sustainability of CAD. In a study by Sahoo *et al* (2016a) except Maldives and Sri Lanka all other SAARC nations suffered from unsustainable current account deficits, Gundlach & Sinn (1992) also find non-stationarity for major industrialised nations in a sample of 23 countries.

India-specific studies which examine the sustainability of current account through the existence of co-integration between exports and imports include Holmes *et al* (2011), Singh (2015), Sahoo *et al* (2016b). The study by Holmes *et al* (2011) employs three tests to examine the presence of co-integration between exports and imports which include Johansen (1995), Saikonnen & Lütkepohl (2000) and Breitung (2002). Their results suggest against sustainability of current account prior to 1991 and in favour of sustainability towards late 1990s. Singh (2015) employs the OLS-based two-step estimator of Gregory & Hansen (1996) and Maximum Likelihood system estimator of Johansen *et al* (2000) to examine the long-run relationship between exports and imports for India. The OLSGH analysis does not yield any support for the presence of long-run co-integration but MLE technique establishes sustainability of current account by providing evidence in support for long-run co-integration between exports and imports. Sahoo *et al* (2016b) use Bayer & Hanck (2013) and ARDL (Pesaran, *et al* 2001) techniques to establish long-run co-integration between exports and imports for China and India and conclude that both the tests support sustainability of current account for China and unsustainability of current account for India. Thus, studies pertaining to India give a mixed account of sustainability of current account due to differing methodologies and varying estimation techniques using different time periods for the study.

Hassan & Holmes (2016) analyse the importance of invisibles, specifically, remittances in attaining current account sustainability for a panel of 47 emerging and developed economies over the period 1990-2011, and their study highlights the role of remittances in achieving current account sustainability. Their analysis estimates the presence of co-integration between exports and imports (with and without remittances). They define imports as a sum of imports of goods and services and net invisibles and subtract remittances (from net invisibles) to capture the co-integration between imports (without remittances) and exports. The results of panel co-integration test of Pedroni (2004) based on Group Philips-Perron and Group Augmented Dickey-Fuller statistics suggested that there existed weak sustainability (i.e. co-integrating coefficient less than unity for exports and imports) when imports included remittances and null of no co-integration could not be rejected when remittances were excluded.

Description of Basic Data

India is one of the leading exporters of software services in the world with 23.7 per cent of total world software services in the year 2014 (IMF, 2017) and the largest recipient of remittance inflows which were US$ 72.7 billion for 2014 (World Bank, 2017). Software services exports and remittance inflows are important components of India's current account in the Balance of Payments. Table 1 presents the trends in the major components of current account from 2000 to 2016.

Table 1: Components of Current Account in BOP as a percentage of GDP, 2000-01 to 2016-17, India.

Year	BOT	Invisibles[4] (Net)	Remittances (Net)	Software Services Exports (Net)	CAB
2000-01	-2.77	2.17	2.85	1.28	-0.59
2001-02	-2.47	3.20	3.29	1.47	0.73
2002-03	-2.07	3.30	3.17	1.71	1.23
2003-04	-2.19	4.44	3.45	1.97	2.25
2004-05	-4.55	4.22	2.77	2.28	-0.33
2005-06	-6.27	5.07	2.96	2.69	-1.20
2006-07	-6.27	5.30	3.03	2.95	-0.97
2007-08	-7.34	6.07	3.35	2.96	-1.26
2008-09	-10.81	8.28	4.03	3.95	-2.52
2009-10	-8.24	5.58	3.61	3.36	-2.66
2010-11	-7.29	4.54	3.04	2.91	-2.75
2011-12	-11.10	6.53	3.71	3.57	-4.57
2012-13	-10.71	5.88	3.52	3.47	-4.82
2013-14	-7.91	6.18	3.51	3.59	-1.73
2014-15	-7.30	5.95	3.34	3.54	-1.35
2015-16	-6.30	5.23	3.06	3.46	-1.07
2016-17	-4.81	4.16	2.42	3.00	-0.65

Source: RBI, (2018)

Note: Data for the Financial Year beginning 1st April to 31st March.

BOT: Balance of Trade

CAB: Current Account Balance

Table 1 highlights the positive contribution of invisibles in maintaining current account sustainability. The Balance of Trade (BOT), which is merchandise trade balance, has stayed in deficit for the entire period (2000-01 to 2016-17). The lowest deficit was 2.07 per cent of GDP in 2002-03 and highest deficit of 11.1 per cent in 2011-12 attributed to the escalation in crude oil prices and gold imports. In contrast, the CAB has always experienced lower deficits when compared to trade deficit, even in 2011-12 when BOT suffered a peak deficit, CAB was half of it at 4.57 per cent of GDP. Thus, surpluses in the invisibles offset the large deficits experienced in BOT. The CAB moves in tandem with

[4] The invisibles (net) as a percentage of GDP is for some years less than remittances (net) and software services exports (net) on account of larger outflows of other invisibles components such as interest income, G.N.I.E, official transfer, etc.

the merchandise trade deficit but the deficit experienced is far less on account of invisibles' surpluses. Net invisibles grew steadily from 2.17 per cent of GDP in 2000-01 to peak in 2008-09 at 8.28 per cent of GDP. Remittance inflows and software services exports, the key contributors peaked in 2008-09 with 4.03 and 3.95 per cent of GDP respectively. Since 2014-15, these key contributors have steadily declined as a share of GDP and because they contribute towards more than half of invisibles' surpluses, a decline is witnessed for net invisibles as well.

The other important aspect is that crude oil prices are closely linked to CAB by way of imports as well as through remittances. Nearly 55.6 per cent of remittance inflows into India come from the Middle East countries whose economic activity depends on oil exports. Increased oil prices ratchet up economic activities in these countries and thus, increasing demand for labour and wages. On one hand, higher oil prices adversely affect BOT due to higher oil import bill but at the same time it increases remittance inflows. In the present scenario, with a tilt towards domestic labour and restrictions on immigrant workers in Gulf Cooperation Council (GCC) countries, an increase in oil prices may not culminate into higher remittances, whereas it will continue to increase BOT deficit as India is dependent on crude oil imports for its domestic energy requirements. At the same time, stringent immigration policy adopted by the US, UK and other European countries may adversely affect remittance inflows. The share of US and UK to total remittance inflows for India in 2016 were 17 and 5.7 per cent respectively (World Bank, 2016).

The impact of such nationalist, anti-immigrants policies may be felt not just on remittances but also on services exports, especially software services. For the year 2014-15 and 2015-16, India's software services exports witnessed a decline in mode 1 (cross-border sales) from 68.4 to 64.8 per cent of total software services exports and mode 4 (presence of natural persons) from 17.1 to 16.1 per cent whereas exports through mode 3 (commercial presence) increased from 14.4 to 18.9 per cent (RBI, 2016). This underscores the competitive advantage that India had in providing cheap and skilled labour may be eroded as increased exports through commercial presence will require domestic hiring constraints and wages decided by the host/client market. Apart from changes in the foreign trade and migration policies another key contributor to volatility in software services exports could be the advent of new disruptive technologies such as cloud-computing, machine learning and artificial intelligence. India experienced a boom in its software exports on account of Information Technology (IT) services that were on the lower spectrum of the value chain such as website maintenance, data warehousing and other customised services. A shift towards automation of these services will render India's software industry obsolete.

Given the above facts and changes in world economy, the question that arises is that will India's current account be sustainable in the absence of its invisibles component (especially remittance inflows and software services exports)? How important are software services exports and remittances in contributing to India's current account sustainability?

Methodology

Conceptual Framework

Among the three definitions of CAB: (i) difference between imports and exports of goods and services; (ii) difference between national investments and savings and (iii) change in international debt/investment position (Sachs, 1981), this chapter explains the concept of current account sustainability using the third definition of change in debt/investments of a country. Persistent deficits in the current account lead to accumulation of borrowing from international capital markets making the country an international debtor with foreign investors having a claim on the country's economic assets.

Thus, current account sustainability refers to a situation where a country is able to repay its external debts by generating current account surpluses in future. Using inter-temporal budget constraint of the economy, current account sustainability means that the present value of future current account surpluses are able to meet the existing external borrowings and interest payments. In practice, it refers to the solvency of a country and its ability to honour external debts (Melesi-Ferretti & Razin, 1996).

Further, CAB in essence is change in the international debt position for a country. One way to ensure its sustainability is to link the size of net borrowings to the size of the economy (GDP), thus restricting growth of liabilities to specified ratio of the GDP. External stabilisation, which is restricting or gradually reducing the CAD to GDP ratio and shifting towards surpluses over time, can be looked upon as reducing the level of what a country owes as a share of what it produces. Thus, current account sustainability, which in a nutshell is paying the present deficits through future surpluses, leads to external stabilisation as it ensures gradual reduction in CAD to GDP and reduced dependence on foreign borrowings.

Theoretical Background

Current account is defined as the change in net foreign assets or borrowings, or net international investment position.

$$CAB_t = B_{t-1} + rB_{t-1} - B_t \quad \text{..... (1)}$$

Where CAB_t is the current account balance in time period *t,* which is equal to external borrowings in time period *t-1* plus interest payments (rB_{t-1}) minus any further borrowings made during period *t*. Equation (1) is re-written as:

$$CAB_t = B_{t-1}(1 + r) - B_t \quad \text{..... (2)}$$

If borrowings in period *t* are greater than *t-1* then, CAB would deteriorate by the difference between B_t and $B_{t-1}(1 + r)$.

Table 2: Description of Notations

	Notations	Description
1.	CAB_t	Current account balance in time t
2.	X_t	Merchandise/goods exports in time t
3.	M_t	Merchandise/ goods imports in time t
4.	B_t	Borrowings in time t
5.	R	Mean rate of interest
6.	NI_t	Net invisibles
7.	MM_t	Merchandise imports + Net invisibles
8.	λ_t	Discount rate at time t
9.	r_o	Current rate of interest
10.	Z_t	Merchandise imports + net invisibles + difference in interest payments between long-run mean interest rate r and current rate of interest r_o

Source*: Author.*

Sustainability of current account requires establishing relationship between current account components. The methodology is co-integration of exports and imports to check for current account sustainability, originally developed by Husted (1992). It was modified by Hassan and Holmes (2016) to analyse the impact of remittances on current account sustainability by way of including and excluding it from total imports in a panel analysis. Analysis in this paper modifies and uses the methodology of Hassan and Holmes (2016) to include SSE and remittances under invisibles for India. In the first step towards analysing current account sustainability, the budget constraint for an economy is derived as follows:

$$Y_t = C_t + I_t + (X - M)_t + NI_t \quad \text{..... (3)}$$

Where, Y is a measure of national income which includes consumption expenditure (C), investment (I), balance of trade (X – M) and net invisibles (NI). Together, $(X - M)_t + NI_t$ constitute the CAB for time *t.*

Net invisibles include the following:

$$NI = NST + NCT + NY \quad \text{..... (4)}$$

Where NST stands for net services trade, NCT is net current transfers and NY is net current income.

Substituting Equation (2) in Equation (3) one arrives at:

$$C_t = Y_t - I_t + B_t - B_{t-t}(1 + r) \quad \text{..... (5)}$$

Where consumption is financed from income and external borrowings and re-written as:

$$Y_t - C_t - I_t = (X - MM)_t \quad \text{..... (6)}$$

Where, $(X - MM)_t = CAB_t$ and $MM = M + N$, if NI is positive then M will reduce by the same extent and vice-versa as imports are negative or debit item in CAB.

Equations (5) and (6) are used to derive the inter-temporal budget constraint (IBC).

$$(X - MM)_t = B_{t-1}(1 + r_t) - B_t \quad \text{..... (7)}$$

IBC is obtained by solving forward (Appendix Equations A.1):

$$B_t = \sum_{i=1}^{\infty} \lambda_i (X - MM)_{t+i} + \lim_{n\to\infty} \lambda_n B_{t+n} \quad \text{..... (8)}$$

Where $\lambda_i = \prod_{j=1}^{i} \frac{1}{1+r_{t+j}}$

Where, λ_i is discount rate and defined as product of *i* terms of (1/1+ r_t). Thus, discounted future value of current account balances (CAB = X – MM) is difference between present borrowing and present value of future borrowings in international financial markets. Thus, the accumulated current account balances is equal to total change in foreign borrowings (or lending) for a given time period. The study by Husted (1992) derived the above equations to state that term $\lim_{n\to\infty} \lambda_n B_{t+n}$, if equal to zero, ensures that present value of future current account surpluses are able to repay the borrowings from international capital markets, whereas if positive it suggests that the country is "bubble financing" its external borrowings i.e. borrowing in the present for repaying past debts.

Formation of Testable Hypothesis

Testable equation to analyse current account sustainability by establishing co-integrating relationship between exports (*X*) and imports plus invisibles (*MM*) is derived as follows:

Equation (7) is expanded to include prevailing interest rate (r_t) in international financial markets, greater or less than long-run mean (r). The fluctuations in interest rate may affect interest burden of a country and thereby the CAB.

$$Z_t = MM_t + (r_t - r)B_{t-1} \quad \text{..... (9)}$$

$$Z_t + (1 + r)B_{t-1} = X_t + B_t \quad \text{..... (10)}$$

Re-arranging equation (10)

$$B_t = Z_t - X_t + (1 + r)B_{t-1} \quad \text{..... (11)}$$

The forward iterations of foreign borrowings in equation (11) yields (Appendix Equations A.2):

$$rB_{t-1} + Z_t = X_t + \sum_{j=1}^{\infty} \lambda^j \left(\Delta X_{t+j} - \Delta Z_{t+j}\right) + r \lim_{n\to\infty} \lambda^{n+1} B_{t+n} \quad \text{..... (12)}$$

Substituting equation (9) in (12)

$$r_t B_{t-1} + MM_t = X_t + \sum_{j=1}^{\infty} \lambda^j \left(\Delta X_{t+j} - \Delta Z_{t+j}\right) + r \lim_{n\to\infty} \lambda^{n+1} B_{t+n} \quad \text{..... (13)}$$

The LHS of equation (13) is total imports plus invisibles including interest payments on external borrowings.

Assuming that exports of goods (X_t) and imports of goods plus net invisibles (Z_t, which includes net services exports, net current transfers and net current income) are non-stationary series i.e. they are random walks with drift (intercept term), and follow Auto-Regression of order one AR(1) processes with representation as follows:

$$X_t = a_1 + X_{t-1} + e_{1t}$$

$$\Delta X_t = a_1 + e_{1t}$$

$$\Delta X_{t+j} = a_1 + e_{1t+j} \quad \text{(14)}$$

Similarly,

$$Z_t = a_2 + Z_{t-1} + e_{2t}$$

$$\Delta Z_t = a_2 + e_{2t}$$

$$\Delta Z_{t+j} = a_2 + e_{2t+j} \quad \text{(15)}$$

Where, a_1 and a_2 are drift parameters and e_{1t} and e_{2t} are error terms.

Substituting equation (14) and (15) in equation (13), deterministic equation is transformed into stochastic form as follows:

$$r_t B_{t-1} + MM_t = X_t + \sum_{j=1}^{\infty} \lambda^j \left(a_1 + e_{it+j} - a_2 + e_{2t+j}\right) + r \lim_{n\to\infty} \lambda^{n+1} B_{t+n} \quad \text{(16)}$$

$$r_t B_{t-1} + MM_t = X_t + \left(\frac{a_1 - a_2}{r}\right) + \sum_{j=1}^{\infty} \lambda^j \left(e_{it+j} - e_{2t+j}\right) + r \lim_{n\to\infty} \lambda^{n+1} B_{t+n} \quad \text{(17)}$$

Because $\sum_{j=1}^{\infty} \lambda^j = \sum_{j=1}^{\infty} \frac{1}{(1+r)} = \frac{1}{r}$

$$X_t = MM_t + r_t B_{t-1} + \left(\frac{a_2 - a_1}{r}\right) + \sum_{j=1}^{\infty} \lambda^j \left(e_{2t+j} - e_{1t+j}\right) - r \lim_{n\to\infty} \lambda^{n+1} B_{t+n} \quad \text{(18)}$$

$\sum_{j=1}^{\infty} \lambda^j \left(e_{2t+j} - e_{1t+j}\right) = u_t$

And, $\left(\frac{a_2 - a_1}{r}\right) = a$

This can be re-written as:

$$X_t = \alpha + \beta \bar{M}_t + u_t \quad \text{(19)}$$

Where $MM_t + r_t B_{t-1} = \bar{M}_t$ and $\lim_{n\to\infty} \lambda^{n+1} B_{t+n} = 0$

Following section presents the empirical framework to estimate Equation (19).

Technique of Estimation

In section 4.3, mathematical derivations emanating from theory yielded Equation (19) as the testable equation. Where, stationarity of current account deficits is established by finding that exports and imports plus invisibles are co-integrated with a known long-run co-integrating vector β [1,-1].

If β equals 1 then, one per cent increase in $\bar{M}_t$ leads to a percentage increase in X_t and CAB remains at the same level as before, but in a situation where β is less than one (β<1) one per cent increase in $\bar{M}_t$ is accompanied by β per cent increase in X_t which is less than increase in $\bar{M}_t$ culminating into an increase in CAD by (1-β) per cent.

If there exists a long-run equilibrium between X_t and $\bar{M}_t$, the current account is sustainable but in a weak sense, it settles at a higher deficit in the long run rather than return to its initial deficit level. As only a part of the increase in imports is met by increase in exports, the excess deficit needs to be

financed through external borrowings at higher interest (Hassan & Holmes, 2016). Thus, a value of β closer to one, gives stronger evidence of sustainability of current account.

Non-stationary of current account indicates that discounted deficits do not converge asymptotically to zero, making the country a net debtor as exports are insufficient to pay for imports. The increased accumulation of foreign debt due to increasing divergence between exports and imports may precipitate into BOP instability.

Based on Equation (19), to test for sustainability of current account, four alternatives of $\bar{M}$ are used. In Equation (19), $\bar{M}$ includes imports and net invisibles (NI), this is the first measurement of $\bar{M}$. The second measurement excludes only net remittances $(\bar{M} - q)$ and other components of NI are included. The third measurement excludes only SSE, $(\bar{M} - s)$ and the last measurement excludes both remittances and SSE ($\bar{M}$-q-s). The aim of this analysis is to assess the sensitivity of co-integration for different measurements of $\bar{M}$.

In order to empirically estimate the testable hypothesis, the auto-regressive distributed lags (ARDL) model is used. The model is specified as follows:

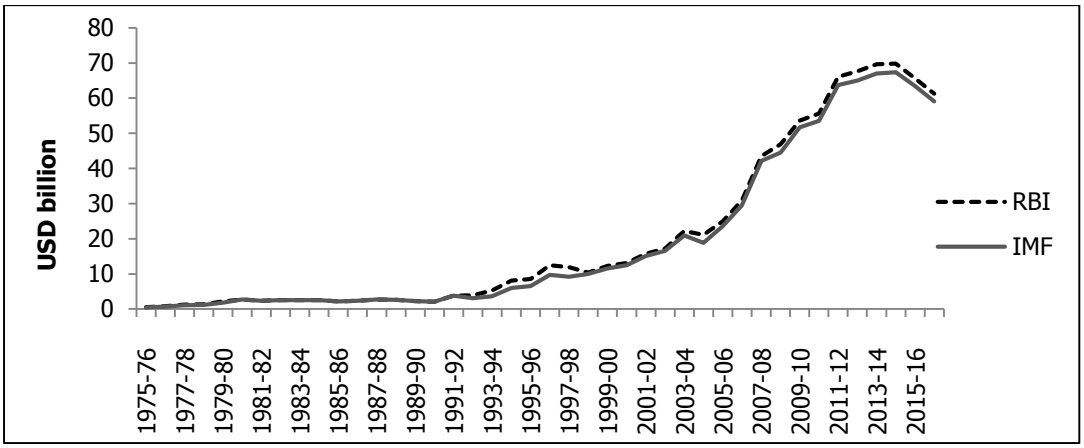
$$\Delta X_t = \alpha + \sum_{i=1}^{m} \lambda_i \Delta X_{t-i} + \sum_{i=0}^{n} \tau_i \Delta \bar{M}_{t-i} + \varphi X_{t-1} + \beta \bar{M}_{t-1} + \varepsilon_t \quad \text{..... (20)}$$

The bound-testing approach to ARDL model developed by Pesaran *et al* (2001) is used to estimate the long-run relationship between (X) and different measurements of $(\bar{M})$. The ARDL method is known to incorporate differentiated lags for independent variables and includes lagged values of dependent variable presented in Equation (20).

Variables and Data Description

The RBI's data on private transfers is similar to IMF's BPM6 definition of personal transfers. Items included in private transfers are workers' remittances for family maintenance, local withdrawals from Non-Resident Rupee Accounts (NRE/NRO), gold and silver brought in through passenger luggage and personal gifts, donations to charitable/religious institutions. The only items not included in personal transfers according to BPM6, but included in private transfers by RBI, are donations to charitable/religious institutions. By definition, personal transfers are inter-household transfers, and gifts/donations to charitable/religious institutions are recorded in secondary income account under other current transfers and not personal transfers. Thus, the difference between IMF's personal transfers and RBI's private transfers is negligible as gifts/donations to charitable/religious institutions form a small part of total private transfer inflows (Figure 1). This chapter uses the term remittances synonymous to private transfers.

Figure 1:Comparison between RBI and IMF databases on Total Remittances Inflows, 1975-76 to 2016-17, India.



Source: RBI (2018) and IMF (2017).

Data on software services as a separate item on the services trade is available from 2000-01 and was included with miscellaneous services before 2000-01. As per RBI definition, software services exports include hardware consultancy and implementation, software consultancy and implementation, database and data processing charges, and repair and maintenance of computers which is synonymous to computer services exports as per IMF BPM6.

Table 3 presents the variables and data sources and Table 4 gives descriptive statistics of the variables.

Table 3: Variable and Data Sources

	Variables	Measurement	Sources
1.	Merchandise exports	Quarterly data, Percentage of GDP at current (market prices)	RBI, 2018
2.	Merchandise imports		
3.	Private transfers/ remittances		
4.	Software services exports		
5.	Net Invisibles (net services, net transfer and net income)		
6.	GDP at current (market prices)		RBI, 2018

Source: Author.

Table 4: Descriptive Statistics

Statistics	X (exports) (1)	$\bar{M}$ (imports plus net invisibles) (2)	$\bar{M}$-q (without net remittances) (3)	$\bar{M}$-s (without net SSE) (4)	$\bar{M}$-q-s (without net remittances and net SSE) (5)
Mean	13.39	12.95	16.21	15.78	19.03
Median	13.15	12.98	16.10	16.10	19.00
Maximum	18.26	20.43	24.28	23.78	27.94
Minimum	8.44	5.42	8.79	7.17	10.17
Std. Dev.	2.57	4.14	4.29	4.77	4.92
Observations	67	67	67	67	67

Source: Author's calculations.

Estimation Results

The sustainability of current account is tested using ARDL approach to co-integration (Equation 20) and quarterly data from 2000-2001:Q1 to 2016-17:Q3. The analysis considers three cases i.e. $\bar{M}$ without net remittances ($\bar{M}$-q), $\bar{M}$ without net software services exports ($\bar{M}$-s) and $\bar{M}$ without net remittances and net software services exports ($\bar{M}$-q-s) to study whether net remittances and net SSE are vital to ensure current account sustainability or whether their contributions are marginal with minimal impact.

Test Results for Stationarity

The prerequisite before undertaking time series econometric analysis is to establish the order of integration of the variables under study. Table 5 and 6 present the unit root tests for exports of goods (X) and imports ($\bar{M}$), under the four specific measurements using the ADF and Phillips-Perron tests for stationarity. Results show that all the series are integrated of order one, I (1).

Table 5: Stationarity, Augmented Dickey-Fuller Test.

Null hypothesis: Series has unit root.

Variable	t- statistic					
	At Level			At First Difference		
	None	Intercept	Intercept + Trend	None	Intercept	Intercept + Trend
X	0.16	-2.02	-1.12	-4.09***	-4.11***	-4.48***
$\bar{M}$	-0.19	-1.51	-0.89	-4.28***	-4.25***	-4.43***
$\bar{M}$-q	-0.21	-1.54	-0.87	-4.13***	-4.11***	-4.42**
$\bar{M}$-s	0.00	-1.67	-0.66	-4.18***	-4.19***	-4.51***
$\bar{M}$-q-s	-0.05	-1.69	-0.73	-4.06***	-4.08***	-4.57***

*Note: ***, **Denotes significance at the 1 and, 5 per cent level respectively.*

Source: Author's estimation with maximum lag length equal to 4 and based on AIC.

Table 6: Stationarity, Phillips-Perron Test.

Null hypothesis: Series has unit root.

Variable	Adj. t- statistic					
	At Level			At First Difference		
	None	Intercept	Intercept + Trend	None	Intercept	Intercept + Trend
X	0.13	-2.47	-2.53	-10.8***	-11.21***	-23.98***
$\bar{M}$	-0.24	-2.17	-2.26	-11.17***	-12.01***	-12.77***
$\bar{M}$-q	-0.16	-2.08	-2.13	-9.04***	-9.09***	-10.58**
$\bar{M}$-s	-0.06	-2.12	-2.15	-9.69***	-10.47***	-12.71***
$\bar{M}$-q-s	-0.00	-2.02	-2.02	-8.56***	-8.73***	-10.7***

*Note: ***, **Denotes significance at the 1 and, 5 per cent level respectively.*

Source: Author's estimation based on Newey-West using Bartlett-Kernel.

ARDL Estimation Results

The presence of cointegration between variables in the ARDL model specified in Equation (20) is examined using F test or Wald test. The Wald test is used to examine the joint null hypothesis of zero

co-integration between variables (H_0: φ=β=0) against the alternate on presence of co-integration. The F statistic is compared with two set of critical values or bounds (upper bound and lower bound). If the value of calculated F statistic is greater than the upper bound then the null of no co-integration can be rejected. However, if the computed F statistic is smaller than the lower bound, the null cannot be rejected. The test is inconclusive if the F statistic falls between the two bounds.

Table 7: Co-integrating Equations and Error Correction Term, 2000-2001:Q1 to 2016-17:Q3, India

Dependent variable: *X*

	M **(total goods imports) (1)**	$\bar{M}$ **(imports plus net invisibles) (2)**	$\bar{M}$**-q (without net remittances) (3)**	$\bar{M}$**-s (without net SSE) (4)**	$\bar{M}$**-q-s (without net remittances and net SSE) (5)**
Lag structure of ARDL	(2,1)	(1,3)	(2,1)	(1,2)	(2,1)
Long run coefficients					
Imports variable (***β***)	**0.45***** (11.81)	**0.59***** (12.13)	**0.54***** (8.61)	**0.5***** (11.94)	**0.48***** (9.59)
Constant term	4.61*** (5.94)	5.75*** (8.71)	4.67*** (4.42)	5.55*** (8.1)	4.4*** (4.53)
Co-integrating form					
Error correction term	-0.56*** (-4.27)	-0.6*** (-5.58)	-0.43*** (-3.99)	-0.6*** (-5.28)	-0.47*** (-3.92)
D(X(-1))	-0.28*** (-2.88)		-0.27*** (-2.86)		-0.23** (-2.4)
D(Imports)	0.49*** (8.57)	0.38*** (6.19)	0.44*** (7.68)	0.39*** (7.03)	0.42*** (7.67)
D(Imports(-1))		-0.16*** (-2.85)		-0.11** (-2.02)	
D(Imports(-2))		-0.10* (-1.68)			
F statistic	5.88***	10.03***	5.15**	9.01***	4.97**
Critical Value Bounds					
Significance	Lower Bound	Upper Bound			
10%	3.02	3.51			
5%	3.62	4.16			
1%	4.94	5.58			

*Note: ***,**, * Denotes significance at 1, 5 and 10 per cent respectively.*

Source: Author's calculations using Equation (6.20).

Values in parenthesis are t-statistic.

Lag selection is based on AIC.

Table 7 presents the long-run co-integration coefficient for total exports (*X*) and total imports of goods (*M*) are significant under all specifications. The error correction term (ECT), which tests whether the short term deviations between exports and imports return to the equilibrium path, is negative and highly significant indicating the presence of long-run relationship between the variables across all the measurements of imports *(M)*. Also, the F statistic lies above the critical bounds at either 1 per cent or 5 per cent level of significance. Thus, the null of no co-integration is rejected for all the specifications estimated.

Column (1) shows the co-integrating coefficient for merchandise imports which is 0.45 and highly significant. This indicates that for every one percentage point increase in total imports of goods,

exports of goods increases by 0.45 percentage point. Thus, there exists a 0.55 percentage point deficit in the balance of trade (BOT). In the short run, however, 0.56 per cent of the deviations in X are adjusted per quarter towards long-run equilibrium level. As the long-run equilibrium coefficient under this specification is far less than one, India would suffer from weak sustainability of current account and larger deficits.

In the second specification, imports include merchandise, services, transfers and income ($\overline{M}$), thereby reducing the total imports as India enjoys surpluses in its invisibles component. The long-run coefficient of 0.59 in column (2) implies that when invisibles are included, higher sustainability is ensured for India's current account. The long-run coefficient improves from 0.45 to 0.59 when net invisibles are included. In order to calculate the specific component of net invisibles contributing to higher sustainability (higher β value), net remittances and net software services exports are subtracted from net invisibles in column (3) and (4) respectively.

It is observed that when net remittances and net SSE are subtracted from net invisibles, the long-run coefficient reduce to 0.54 and 0.5 respectively from 0.59 in column (2). This implies that individually net remittances and net software services exports make considerable contribution towards India's current account sustainability. If net remittances are excluded from net invisibles then one percentage point increase in $\overline{M}$ is accompanied by 0.54 percentage point increase in X and in the case of exclusion of SSE, X would increase by 0.5 percentage point.

In column (5) net remittances and net SSE are subtracted from net invisibles which yields a long-run coefficient of value 0.48 which is closer to 0.45 in column (1) where net invisibles were excluded for estimation. This offers evidence for net remittances and net SSE as primary components of net invisibles and their absence yield results similar to a situation when net invisibles are excluded.

Analysing the speed of adjustment parameter or the error correction term (ECT), as mentioned earlier, is negative and significant for all the specifications. This evidence can be used to justify the time taken to adjust towards long-run equilibrium after a short-run shock. In column (1) where co-integration between imports and exports of merchandise goods is estimated, 45 per cent of the short-run disequilibrium of the previous quarter is corrected in the current quarter, indicating that it would take slightly over two quarters for short-run shock to be absorbed by the system. In the case where import component included net invisibles (column (2)), 60 per cent of the short-run shocks of previous quarter is corrected in current period. In comparison to the ECT term in column (1), the time taken to correct the short-run disequilibrium improved in column (2). Thus, inclusion of net invisibles reduces the time taken to adjust the system to the long-run path. In the absence of contributions from invisibles component, India's current account would have taken comparatively more time to correct the short-run disturbances. Comparison between the ECT terms of column (3) and column (4) which excludes net remittances and net SSE respectively shows that while 43 per cent of short-run disequilibrium is corrected in the absence of remittance, about 60 per cent is corrected without SSE. This implies that contribution by remittances in ensuring current account sustainability is greater that SSE as it would take shorter time to adjust the disequilibrium in presence of remittances rather than SSE.

The presence of co-integration between exports and imports for all specifications implies sustainability of India's current account with and without net invisibles. However, sustainability is

weaker in the absence of net invisibles implying that India's dependence on foreign capital and external borrowings would be higher without the contributions of net invisibles. This has two implications on the external stabilisation; (a) a larger deficit in the absence of invisibles may increase dependence on foreign financing to bridge the gap, further widening the CAD due to increased interest payments and adversely affecting CAD/GDP ratio, and (b) increase in exposure to foreign capital and borrowings in the BOP may require larger surpluses to be generated in future to repay the increased accumulated debt. Though, weak sustainability is observed in the absence of net invisibles, India will have to increase its dependence on external sources of finance which may percolate to higher interest rates in the domestic economy and increased vulnerability to external capital movements.

The necessary diagnostic tests presented in Table 8 indicate that the estimated ARDL model does not suffer from non-normality, serial correlation, heteroscedasticity or misspecification error. The table also provides the ARDL model representation across different measurements of imports used to calculate the long-run coefficients.

Table 8: ARDL Model Representation, 2000-2001:Q1 to 2016-17:Q3, India

Dependent variable: X

	M **(total goods imports) (1)**	$\bar{M}$ **(imports plus net invisibles) (2)**	$\bar{M}$**-q (without net remittances) (3)**	$\bar{M}$**-s (without net SSE) (4)**	$\bar{M}$**-q-s (without net remittances and net SSE) (5)**
Lag structure	(2,1)	(1,3)	(2,1)	(1,2)	(2,1)
X (-1)	0.16 (1.25)	0.39*** (3.59)	0.3** (2.4)	0.39*** (3.42)	0.29** (2.36)
X (-2)	0.29*** (2.82)		0.27*** (2.79)		0.233** (2.36)
Imports	0.49*** (8.15)	0.38*** (5.96)	0.44*** (7.23)	0.39*** (6.65)	0.41*** (7.23)
Imports (-1)	-0.25*** (-3.12)	-0.18** (-2.07)	-0.21*** (-2.67)	-0.19** (-2.37)	-0.19** (-2.55)
Imports (-2)		0.06 (0.76)		0.11* (1.96)	
Imports (-3)		0.10 (1.64)			
C	2.56*** (3.75)	3.47*** (4.82)	2.02*** (3.09)	3.34*** (4.58)	2.09*** (3.10)
R sq	0.89	0.87	0.87	0.87	0.88
DW stat	1.93	2.17	1.99	2.16	1.98
Diagnostic tests					
Jarque-Bera : χ^2 (normality)	2.27 (0.32)	1.35 (0.21)	2.99 (0.31)	2.42 (0.74)	1.33 (0.54)
Breusch-Godfrey: χ^2 (No Serial Correlation)	0.34 (0.85)	2.63 (0.45)	0.24 (0.88)	2.13 (3.45)	0.04 (0.97)
Breusch-Pagan-Godfrey: χ^2 (Homoskedasticity)	5.43 (0.25)	3.29 (0.65)	4.94 (0.29)	4.75 (0.31)	5.35 (2.53)
Ramsey RESET: F-stat (model specification)	0.44 (0.51)	0.48 (0.49)	0.19 (0.67)	0.69 (0.41)	0.72 (0.39)

Note: ***, ** and * *denotes significance at 1, 5 and 10 per cent respectively.*

Values in parenthesis are t statistic.

Conclusions and Policy Implications

The trends in foreign capital flows suggest high volatility especially post 2008-09 GFC. This could lead to deterioration in quality of financing CAD with increase in external borrowings rather than non-debt capital flows. In the light of volatile movements of foreign capital on one hand and increased global uncertainty with respect to trade and migration on the other, this paper attempts to provide a snapshot of the dependence of India's current account on its invisibles components (especially net remittances and net SSE).

Using time series data for India from 2000-01 to 2016-17, the analysis highlighted the magnitude of their contribution in reducing CAD by establishing a co-integrating relationship between export and imports. The evidence supporting higher co-integrating coefficient in the presence of net invisibles highlights the importance of remittances and SSE in ensuring current account sustainability in the long-run. In addition, it was observed that in the absence of net invisibles, speed of adjustment was longer and the short-run economic shocks continued to persist in India's current account for a longer duration. This further underlines the importance of net invisibles in arresting further deterioration in current account as the disequilibrium is adjusted swiftly in the presence of net invisibles. The analysis also probes into the individual contribution of remittances and SSE. In doing so it was found that remittances assist more towards sustainability of India's current account as compared to SSE. Thus, reductions in remittances can be assumed to deteriorate the current account more than reductions in SSE. Sustainability of the current account is analysed in the context of international debt position of a country. Exclusion of net remittances, specifically SSE and remittances shows weakening of India's current account sustainability. Reductions in invisibles could enhance India's dependence on foreign debt in the absence of stable non-debt creating capital inflows. This may have detrimental impact on India's external stabilisation as increased debt requires generation of larger future surpluses in the current account and larger current CAD due to increased interest payments.

Increasing uncertainty with respect to immigration policies in developed countries such as the US, UK Europe and GCC due to rise in nationalist agenda and increased trade frictions, especially with the US, may have a detrimental impact on key contributors of invisibles. Thus, policies need to be focused on developing new avenues and markets for migration and services exports (specifically software services in which India holds comparative advantage). With the advent of disruptive technologies (Artificial Intelligence, cloud computing, machine learning etc.), a serious consideration in upgrading and enhancing the competiveness of India's software services is the need of the hour in order to maintain strong exports. In addition, there needs to be a thrust on exports in general to reduce India's dependence on foreign capital by bridging the gap between imports and exports.

References

Apergis, N, K P Katrakilidis and N M Tabakis (2000). Current Account Deficit Sustainability: The Case of Greece. *Applied Economic Letters, 7:* 599-603.

Baharumshah, A Z, E Lau and S Fountas (2005). Current Account Deficit Sustainability: A Panel Approach. *Journal of Economic Integration,* 20 (3): 514-29.

Callen, T and P Cashin (1999). *Assessing External Sustainability in India* (IMF Working Paper No. WP/99/181). Washington DC: International Monetary Fund.

Chen, S W (2011). Current Account Deficits and Sustainability: Evidence from the OECD Countries. *Economic Modelling,* 28 (4): 1455-1464.

Christopoulos, D and M A León-Ledesma (2010). Current Account Sustainability in the US: What Did We Really Know About It? *Journal of International Money and Finance,* 29 (3): 442-459.

Fountas, S and J L Wu (1999). Are the U.S. Current Account Deficits Really Sustainable? *International Economic Journal,* 13: 51-58.

GOI (2018). *Economic Survey 2017-18.* Department of Economic Affairs. New Delhi: Ministry of Finance. Retrieved from http://mofapp.nic.in:8080/economicsurvey/

Goyal, R (2012). *Sustainable Level of India's Current Account Deficit* (Vol. RBI Working Paper No16/2012). Mumbai: RBI. Retrieved from https://rbidocs.rbi.org.in/rdocs/Publications/PDFs/WPSSLI070812.PDF

Gundlach, E and S Sinn (1992). Unit Root Tests of the Current Account: Implications for International Capital Mobility. *Applied Economics,* June, 617–620.

Hassan, G M and M J Holmes (2016). Do Remittances Facilitate a Sustainable Current Account? *The World Economy,* 39 (11): 1834-1853. doi:10.1111/twec.12361

Holmes, M J, T Panagiotidis and A Sharma (2011). The Sustainability Of India's Current Account. *Applied Economics,* 43: 219-229.

Husted, S (1992). The Emerging US Current Account Deficit in the 1980s: A Cointegration Analysis. *The Review of Economics and Statistics,* 74 (1): 159-166.

IMF (2013). *IMF Multilateral Policy Issues Report: 2013 Pilot External Sector Report.* Washington DC: International Monetary Fund. Retrieved from https://www.imf.org/external/np/pp/eng/2013/062013.pdf

———— (2016). *Balance of Payments and International Investments Position*. Retrieved from https://data.imf.org/?sk=7A51304B-6426-40C0-83DD-CA473CA1FD52&sId=1390030341854

———— (2017). *IMF Policy Paper 2017 External Sector Report.* Washington DC: IMF. Retrieved from http://www.imf.org/external/pp/ppindex.aspx

Mann, C L (2002). Perspectives on the US current account deficit and sustainability. *The Journal of Economic Perspectives,* 16 (3): 131-152.

Milesi-Ferretti, G M and A Razin (1996). *Current-Account Sustainability.* International Finance Section, Department of Economics. New Jersey: Princeton University.

Obstfeld, M and K Rogoff (1996). *Foundations of International Macroeconomics.* Cambridge, MA: MIT Press.

Obstfeld, M and K Rogoff (2007). The Unsustainable U.S. Current Account Position Revisited. In R H Clarida (ed), *G7 Current Account Imbalances: Sustainability and Adjustment* (pp. 339-375). Chicago University Press. Retrieved from http://www.nber.org/books/clar06-2

RBI (2018). *Database on Indian Economy*. Retrieved from https://dbie.rbi.org.in/DBIE/dbie.rbi?site =statistics

Sachs, J D (1981). The Current Account and Macroeconomic Adjustment in the 1970s. *Brookings Papers on Economic Activity,* 12 (1): 201-282.

Sahoo, M, S M Babu and U Dash (2016). Long-Run Sustainability of Current Account Balance of China and India: New Evidence from Combined Cointegration Test. *Intellectual Economics,* 10 (2): 78-91.

———— (2016). Current Account Sustainability in SAARC Economies: Evidence from Combined Co-integration Approach. *Theoretical and Applied Economics,* 23 (4): 281-298.

Shastri, S, A K Giri and G Mohapatra (2018). Testing the Sustainability of Current Account for Major South Asian Economies: A Panel Data Approach. *South Asia Economic Journal,* 19 (1): 1-21.

Singh, T (2015). Sustainability of Current Account Deficits in India: An Intertemporal Perspective. *Applied Economics,* 47 (46): 4934-4951.

World Bank (2017). *World Development Indicators Database.* Washington, DC: World Bank. Retrieved from https://databank.worldbank.org/data/source/world-development-indicators

Appendix

Equations A.1

Solving for IBC: Derivations for Equation (8)

$(X - MM)_t = B_{t-1}(1 + r_t) - B_t$

$B_t = -(X - MM)_t + B_{t-1}(1 + r_t)$ ..... (a.1)

$B_{t+1} = -(X - MM)_{t+1} + B_t(1 + r_{t+1})$

$$B_{t+2} = -(X - MM)_{t+2} + B_{t+1}(1 + r_{t+2})$$

which can be re-written as

$B_{t+2} = -(X - MM)_{t+2} - (X - MM)_{t+1}(1 + r_{t+2}) + B_t(1 + r_{t+1})(1 + r_{t+2})$

$B_{t+3} = -(X - MM)_{t+3} - (X - MM)_{t+2}(1 + r_{t+3}) - (X - MM)_{t+1}(1 + r_{t+2})(1 + r_{t+3}) + B_t(1 + r_{t+1})(1 + r_{t+2})(1 + r_{t+3})$

$$B_{t+n} = -(X - MM)_{t+n} - (X - MM)_{t+n-1}(1 + r_{t+n}) - \cdots - (X - MM)_{t+1}(1 + r_{t+2}) \dots (1 + r_{t+n-1})(1 + r_{t+n}) + B_t(1 + r_{t+1}) \dots + (1 + r_{t+n-1})(1 + r_{t+n})$$

$$B_t = \frac{(X - MM)_{t+n}}{(1 + r_{t+1}) \dots + (1 + r_{t+n-1})(1 + r_{t+n})} + \frac{(X - MM)_{t+n-1}}{(1 + r_{t+1}) \dots + (1 + r_{t+n-1})} \dots + \frac{(X - MM)_{t+1}}{(1 + r_{t+1})} + \frac{B_{t+n}}{(1 + r_{t+1}) \dots + (1 + r_{t+n-1})(1 + r_{t+n})}$$

$B_t = \sum_{i=1}^{\infty} \lambda_i (X - MM)_{t+i} + \lim_{n \to \infty} \lambda_n B_{t+n}$ ..... (a.2)

Where $\lambda_i = \prod_{j=1}^{i} \frac{1}{1+r_{t+j}}$

Equations A.2

Iterative Dynamics of foreign borrowings: Derivations for Equation (18)

$B_t = Z_t - X_t + (1 + r)B_{t-1}$ .....(b.1)

$B_{t+1} = Z_{t+1} - X_{t+1} + (1 + r)B_t$

$B_{t+2} = Z_{t+2} - X_{t+2} + (1 + r)B_{t+1}$

Which can be re-written as

$B_{t+2} = Z_{t+2} - X_{t+2} + (1 + r)(Z_{t+1} - X_{t+1}) + (1 + r)^2 B_t$

Expanding B_t further

$B_{t+2} = Z_{t+2} - X_{t+2} + (1 + r)(Z_{t+1} - X_{t+1}) + (1 + r)^2(Z_t - X_t) + (1 + r)^3 B_{t-1}$

$B_{t+3} = Z_{t+3} - X_{t+3} + (1 + r)(Z_{t+2} - X_{t+2}) + (1 + r)^2(Z_{t+1} - X_{t+1}) + (1 + r)^3 (Z_t - X_t) + (1 + r)^4 B_{t-1}$

$B_{t+n} = Z_{t+n} - X_{t+n} + (1 + r)(Z_{t+n-1} - X_{t+n-1}) + (1 + r)^2(Z_{t+n-2} - X_{t+n-2}) + \cdots + (1 + r)^n (Z_t - X_t) + (1 + r)^{n+1} B_{t-1}$

$B_{t+n} = \sum_{j=0}^{n} (1 + r)^{n-j} \left(Z_{t+j} - X_{t+j}\right) + (1 + r)^{n+1} B_{t-1}$

$B_{t-1} = \frac{B_{t+n}}{(1 + r)^{n+1}} - \frac{\sum_{j=0}^{n} (1 + r)^{n-j} (Z_{t+j} - X_{t+j})}{(1 + r)^{n+1}}$

$B_{t-1} = \frac{B_{t+n}}{(1 + r)^{n+1}} - \frac{\sum_{j=0}^{n} (Z_{t+j} - X_{t+j})}{(1 + r)^{1+j}}$

$B_{t-1} = \sum_{j=0}^{n} \lambda^{1+j}\left(X_{t+j} - Z_{t+j}\right) + \lambda^{n+1} B_{t+n}$..... (b.2)

where $\lambda = \frac{1}{(1+r)}$

Solving the process till infinity yields

$B_{t-1} = \sum_{j=0}^{\infty} \lambda^{1+j}\left(X_{t+j} - Z_{t+j}\right) + \lim_{n\to\infty} \lambda^{n+1} B_{t+n}$.....(b.3)

Expanding the above equation

$B_{t-1} = \lambda(X_t - Z_t) + \lambda^2(\Delta X_{t+1} - \Delta Z_{t+1}) + \lambda^2(\Delta X_t - \Delta Z_t) + \lambda^3(\Delta X_{t+2} - \Delta Z_{t+2}) + \lambda^3(\Delta X_{t+1} - \Delta Z_{t+1}) + \cdots + \lim_{n\to\infty} \lambda^{n+1} B_{t+n}$

$B_{t-1} = \lambda(X_t - Z_t) + \lambda \sum_{j=1}^{\infty} \lambda^j (\Delta X_{t+j} - \Delta Z_{t+j}) + \lambda \sum_{j=1}^{\infty} \lambda^{1+j} \left(\Delta X_{t+j} - \Delta Z_{t+j}\right) + \cdots + \lim_{n\to\infty} \lambda^{n+1} B_{t+n}$

.....(b.4)

Re-arranging equation .....(b.3)

$\sum_{j=0}^{\infty} \lambda^{1+j}\left(X_{t+j} - Z_{t+j}\right) = B_{t-1} - \lim_{n\to\infty} \lambda^{n+1} B_{t+n}$.....(b.5)

Substituting (b.5) in (b.4)

$B_{t-1} = \lambda(X_t - Z_t) + \lambda \sum_{j=1}^{\infty} \lambda^j (\Delta X_{t+j} - \Delta Z_{t+j}) + \lambda \left[B_{t-1} - \lim_{n\to\infty} \lambda^{n+1} B_{t+n}\right] + \cdots + \lim_{n\to\infty} \lambda^{n+1} B_{t+n}$

$B_{t-1} = \lambda(X_t - Z_t) + \lambda \sum_{j=1}^{\infty} \lambda^j (\Delta X_{t+j} - \Delta Z_{t+j}) + \lambda B_{t-1} + (1-\lambda) \lim_{n\to\infty} \lambda^{n+1} B_{t+n}$

$B_{t-1} - \lambda B_{t-1} = \lambda \left[(X_t - Z_t) + \sum_{j=1}^{\infty} \lambda^j (\Delta X_{t+j} - \Delta Z_{t+j}) + \frac{(1-\lambda)}{\lambda} \lim_{n\to\infty} \lambda^{n+1} B_{t+n}\right]$

$\frac{1-\lambda}{\lambda} B_{t-1} + Z_t = X_t + \sum_{j=1}^{\infty} \lambda^j (\Delta X_{t+j} - \Delta Z_{t+j}) + \frac{(1-\lambda)}{\lambda} \lim_{n\to\infty} \lambda^{n+1} B_{t+n}$

As $\frac{1-\lambda}{\lambda} = r$

$rB_{t-1} + Z_t = X_t + \sum_{j=1}^{\infty} \lambda^j (\Delta X_{t+j} - \Delta Z_{t+j}) + \frac{(1-\lambda)}{\lambda} + r \lim_{n\to\infty} \lambda^{n+1} B_{t+n}$..... (b.6)

Recent Working Papers

409 Environmental Fiscal Instruments: A Few International Experiences
Rajat Verma and K Gayithri

410 An Evaluation of Input-specific Technical Efficiency of Indian Fertilizer Firms
Soumita Khan

411 Mapping Institutions for Assessing Groundwater Scenario in West Bengal, India
Madhavi Marwah

412 Participation of Rural Households in Farm, Non-Farm and Pluri-Activity: Evidence from India
S Subramanian

413 Inequalities in Health Outcomes: Evidence from NSS Data
Anushree K N and S Madheswaran

414 Urban Household Enterprises and Lack of Access to Production Loans
Shika Saravanabhavan and Meenakshi Rajeev

415 Economic and Social Benefits of SHG-Bank Linkage Programme in Karnataka
Meenakshi Rajeev, B P Vani and Veerashekharappa

416 Two Decades of Fiscal Decentralization Reforms In Karnataka: Opportunities, Issues and Challenges
M Devendra Babu, Farah Zahir, Rajesh Khanna and Prakash M Philip

417 Karnataka State Budgets - How Far Have They Promoted Inclusiveness?
K Gayithri and Vijeth Acharya

418 Caste Discrimination Practices in Rural Karnataka
I Maruthi and Pesala Peter

419 Food Security in Brics - Current Status and Issues
Malini L Tantri and Kumar Shaurav

420 Impact of Age Structure Transition on Current Account Balance for India: An Empirical Analysis
Aneesha Chitgupi

421 Market Value and Capital Structure: A Study of Indian Manufacturing Firms
Dhananjaya K and Krishna Raj

422 Inequity in Outpatient Healthcare Use and Utilization of Public Healthcare Facilities: Empirical Evidence from NSS Data
Anushree K N and S Madheswaran

423 Role of Worker's Compensation Benefit in Estimating Value of Statistical Life
Agamoni Majumder and S Madheswaran

424 Making Every Drop Count – Micro-Level Water Demand Accounting Challenges and Way Forward
Chaya Ravishankar, Sunil Nautiyal and S Manasi

425 Conceptualizing Peri-Urban-Rural Landscape Change for Sustainable Management
Mrinalini Goswami

426 Social Entrepreneurship: A Business Model for Sustainable Development
Neeti Singh and Anand Inbanathan

427 Revenue-Based Business Model to Growth-Based Business Model: A Critical Review of Indian Pharmaceutical Industry
P Omkar Nadh

428 Role of Social Entrepreneurship in the Quality of Life of Its Beneficiaries
Neeti Singh and Anand Inbanathan

429 Land Alienation in Tripura: A Socio-Historical Analysis
Rajiv Tewari

430 The Indian Mining Industry: Present Status, Challenges and the Way Forward
Meenakshi Parida and S Madheswaran

431 Impact of Irrigating with Arsenic Contaminated Water on Farmers' Incomes in West Bengal
Madhavi Marwah Malhotra

432 Macroeconomic Determinants of Software Services Exports and Impact on External Stabilisation for India: An Empirical Analysis
Aneesha Chitgupi

433 Fiscal Dependency of States in India
Darshini J S and K Gayithri

434 Determinants of Farm-Level Adoption of System of Rice and Wheat ntensification in Gaya, Bihar
Shikha Pandey and Parmod Kumar

435 Monsoon Diseases in Lower Kuttanad (Kerala): An Environmental Perspective
Bejo Jacob Raju and S Manasi

436 Risk Sources and Management Strategies of Farmers: Evidence from Mahanadi River Basin of Odisha in India
Jayanti Mala Nayak and A V Manjunatha

437 Determinants of Intra Urban Mobility: A Study of Bengaluru
Shivakumar Nayka and Kala Seetharam Sridhar

438 Structure and Strategy of Supermarkets of Fruits and Vegetables Retailing in Karnataka: Gains for Whom?
Kedar Vishnu and Parmod Kumar

439 Income and Vehicular Growth in India: A Time Series Econometric Analysis
Vijayalakshmi S and Krishna Raj

440 A Critical Review of Apprenticeship Policy of India
K Gayithri, Malini L Tantri and D Rajasekhar

441 Sustainability Concerns on Sugarcane Production in Maharashtra, India: A Decomposition and Instability Analysis
Abnave Vikas B

442 Economic, Occupational and Livelihood Changes of Scheduled Tribes of North East India
Reimeingam Marchang

443 **Need for a Study of State Policies towards the Development of Religious Minorities in Karnataka**
Azhar Khan C A

444 **An Analysis of Bilateral Trade Between Canada and India**
Malini L Tantri and Preet S Aulakh

445 **Should they Avoid the Middlemen? An Analysis of Fish Processing Firms in India**
Meenakshmi Rajeev and Pranav Nagendran

446 **Growth and Consolidation of Kerala Non-Gazetted Officers' Union: From Its Formative Years to Union Militancy Phase**
Jithin G

447 **The Relationship Between Economic Growth and Carbon Emissions in India**
Kaumudi Misra

448 **Tax Revenue in India: Trends and Issues**
Pratap Singh

449 **Technical Efficienc of Unorganised Food Processing Industry in India: A Stochastic Frontier Analysis**
Padmavathi N

450 **Demonetisation 2016 and Its Impact on Indian Economy and Taxation**
Pratap Singh

451 **Impact of Perform-Achieve-Trade Policy on the Energy Intensity of Cement and Iron and Steel Industries in India**
Kaumudi Misra

452 **Impact of Non-Cognitive Skills on Cognitive Learning Outcomes: A Study of Elementary Education in India**
Indrajit Bairagya and Rohit Mukerji

453 **Assessment of Vulnerability to Floods in Coastal Odisha: A District-Level Analysis**
Niranjan Pradhan and S Madheswaran

454 **Who Benefits from Higher Education Expenditure? Evidence from Recent Household Survery of India**
Ramanjini and Karnam Gayithri

455 **How the Modern Food Retail Chains Emerging as Alternative Channels of Agricultural Marketing? Evidence from Karnataka**
Kedar Vishnu, Parmod Kumar and A V Manjunatha

456 **Educational Development, and Household and Public Expenditures on Education in Manipur**
Reimeingam Marchang

457 **Social Audit of MGNREGA - A Panacea or a Placebo? Issues and Ways Forward in Karnataka**
Sanjiv Kumar and S Madheswaran

458 **State, Religion and Society: Changing Roles of Faith-Based Organisations in Kerala**
Abdul Raoof

459 **Single Child Families in Tripura: Evidence from National Family Health Surveys**
N Pautunthang and T S Syamala

460 **MGNREGA Ombudsman a Forlorn Scarecrow: Issues and Ways Forward in Karnataka**
Sanjiv Kumar and S Madheswaran

461 **Dynamics of Procurement of Modern Food Retail Chains: Evidences from Karnataka**
Kedar Vishnu and Parmod Kumar

462 **Determinants of Micro-Level Decisions of Sugarcane Farmers**
Lavanya B T and A V Manjunatha

463 **Assessing Quality of Higher Education: An Empirical Study of Commerce Graduates, Kerala State**
Indrajit Bairagya and Bino Joy

464 **Farmers' Perception on Risk and Management Strategies in Mahanadi River Basin in Odisha: An Economic Analysis**
Jayanti Mala Nayak and A V Manjunatha

465 **An Analysis of Revenue Diversification Across Select Indian States**
J S Darshini and K Gayithri

466 **Urban Governance in the Context of Urban 'Primacy': A Comparison of Karnataka and Andhra Pradesh**
Anil Kumar Vaddiraju

467 **Urban Financing and Accountability Structures - Case Study of Bruhat Bengaluru Mahanagara Palike**
Shankari Murali and S Manasi

468 **Status of Unorganised Food Processing Industry in Inida - A Study on Key Performance Indicators**
Padmavathi N

Price: ₹ 30.00

ISBN 978-81-943874-5-9

INSTITUTE FOR SOCIAL AND ECONOMIC CHANGE
(ISEC is an ICSSR Research Institute, Government of India
and the Grant-in-Aid Institute, Government of Karnataka)
Dr V K R V Rao Road, Nagarabhavi P.O., Bangalore - 560 072, India
Phone: 0091-80-23215468, 23215519, 23215592; Fax: 0091-80-23217008
E-mail: manjunath@isec.ac.in; Web: www.isec.ac.in