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

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MACROECONOMIC DETERMINANTS OF SOFTWARE SERVICES EXPORTS AND IMPACT ON EXTERNAL STABILISATION FOR INDIA: AN EMPIRICAL ANALYSIS[1]

Aneesha Chitgupi[2]

Abstract

The impact of macroeconomic determinants on software services exports (SSE) is estimated by using a panel of 45 countries from 2000-2014. Software services exports (SSE) expressed as a percentage share of total world software services exports is used as dependent variable. Macroeconomic variables along with demographic variables are estimated using the TSLS fixed effects technique. Using the estimated coefficients from the cross-country panel model, India specific results are drawn to explain the impact of macroeconomic and demographic variables on India's SSE and their contribution towards achieving the objective of external stabilisation. The empirical results suggest that GDP, R&D expenditure and reduction in trade barriers of the exporting country improved SSE, whereas internet penetration may have led to the diversion of software services towards the domestic market, thereby reducing exports. Among demographic variables, the share of population within 30-39 improved the SSE. Together, R&D expenditure, reduction in trade barriers and population share (30-39) reduce the CAD/GDP ratio for India by 1.6 percentage points through their contribution towards SSE.

Keywords: *Software services exports, macroeconomic determinants, demographic variables, external stabilisation, India*
JEL codes: *F10, F41, J11*

Introduction

India has transformed itself into a service-driven economy where the services sector has emerged as a key driver of economic growth and contributor to the external sector, through services exports. Among services, software services exports have emerged as one of the largest contributors to services exports for India. Of the total net invisibles[1] receipts, net software services exports were 60.6 per cent for the year 2014-15 and 66.2 per cent in 2015-16 (RBI, 2016). Though the growth in software services exports has stagnated at around 5 per cent during the past few years on account of the challenging international business environment (Economic Survey, 2016-17), it continues to contribute towards reducing India's Current Account Deficit (CAD). CAD can be defined as the excess of imports over exports of goods and services; excess of national investments over national savings; or change in the international debt/investment position. Except for a few years (2001-04) India has historically experienced CAD reaching an alarming deficit of 4.8 per cent of GDP in 2012-13. Persistent deficits lead to the accumulation of borrowing from

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international capital markets, making the country an international debtor with foreigner investors owning claims over the country's economic assets. In addition, it leads to currency crises, inflationary pressures and overall loss to the economy. Thus, maintaining external stability and current account sustainability have been vital to India's macroeconomic policies.

One of the core macroeconomic objectives of India is external stabilisation or targeted reduction in the ratio of CAD to GDP. A persistent and high ratio of CAD to GDP indicates macroeconomic instability, requiring reversal in the future by way of increasing savings relative to investment, depreciation of the exchange rate or revaluation of external debts. In the case of an emerging economy such as India, with incomplete financial markets, persistent CAD, and volatile international investor sentiments, it is vital to ensure external stabilisation so as to prevent sudden current account reversals impeding economic growth and the overall welfare of the economy.

Historically, a sustainable level of CAD was considered to be 2 per cent of the GDP, which has shifted to a range of 2.4 to 2.8 per cent of GDP in recent years. This is on account of strong and sustained economic growth, sufficient foreign exchange reserves and domestic (fiscal and monetary) policies committed to ensuring external stability. Though, at present, India is capable of financing a CAD greater than 2 per cent, yet there is a need to reduce this ratio over the course of time to limit India's dependence on foreign capital which is pragmatic in the wake of the 2008 financial crisis.

Given the importance of services exports in reducing the CAD in general and software services in particular, this paper aims to estimate the macroeconomic determinants of software services exports (SSE) and their impact on the attainment of external stabilisation for India. The previous studies limit the analysis to either explaining the accounting relationship between CAD and SSE (i.e. subtracting the SSE from total exports in the current account) or examine the major determinants of SSE. The novelty of this research lies in establishing a link between the determinants of SSE and in achieving external stabilisation through improving these exports. The paper addresses two questions: one, what are the macroeconomic determinants of SSE? And second, how do these determinants influence the current account through SSE? The main objective of this analysis is to identify the determinants that can increase software services exports (SSE) for India in the future and thereby assist in achieving external stabilisation. The paper employs Two Stage Least Squares (TSLS) technique to estimate the coefficients of macroeconomic determinants of SSE using a panel data of 45 countries over 2000-2014. The estimated coefficients are used to calculate the country-specific simulation results for India in achieving external stabilisation.

Review of Related Literature

Trade Theories

The applicability of the trade theory for goods such as Ricardian: comparative advantage and Hekscher-Ohlin: factor endowments for services trade has been in debate for long. The early studies that have attempted to explain the trade in services using theories explaining goods trade include Deardorff (1985) and Sapir and Lutz (1981) highlighting the applicability of the comparative advantage and factor

endowments theory. The main findings of Sapir and Lutz (1981) suggest that conventional trade theory of factor endowments can be used to explain comparative advantage in services trade despite suffering from protectionism and trade barriers. Deardorff (1985) also supports the applicability of comparative advantage to trade in services, highlighting that if exporting of service requires exporting of a factor, then a country exporting a particular service is also abundant in the complementary factor (capital or specialised/skilled labour).

Further, Sapir and Lutz (1981) identify and test the validity of determinants of comparative advantage of goods trade to services trade. The dependent variable is expressed as the ratio of exports to imports of a particular service (transportation, insurance and others) and explanatory variables include relative endowments. Following the Heckscher-Ohlin-Samuelson (H-O-S) model, capital to labour ratio is included. Human capital endowments are added to incorporate the extended H-O-S which accounts for international differences in national resources and human capital. The model also includes ratio of national R&D expenditure to GDP to account for technological differences. Though absent from the model, the study also considers the impact of market imperfections in the form of tariff and non-tariff barriers in its qualitative analysis. Thus, the determinants could be categorised into human endowments (which includes education levels and skills), capital endowments and trade restrictions/protectionism. Abundance in physical and human capital explained considerably the advantage developed countries enjoyed in exporting services. For example, transportation services exports (freight and passenger) were related with capital abundance, whereas insurance services were linked with the availability of skilled human resources.

Determinants of Services Trade

Recent studies have incorporated a wider set of determinants of trade in services between nations such as Grunfeld and Moxnes (2003), Mirza and Nicoletti (2004), Kimura and Lee (2006) and Lennon (2006). The studies that focus on gravity modelling to analyse the determinants of services trade primarily include the size of the country (GDP, population) and distance between trading partners[2]. Other factors[3] such as institutions; infrastructure; human capital and cultural factors are also incorporated. Grunfeld and Moxnes (2003) use the gravity model technique of estimation to highlight the role of the GDP of the countries and distance on services trade. The study corroborates the conclusions of Deardorff (1985), suggesting that exports of services and FDI from the parent country are complements. Thus, in the presence of trade barriers where cross border sale (mode 1) of services may decline, the trade of services through commercial presence (mode 3) will be less affected if the exporting country is capital abundant. Kimura and Lee (2006) record that trade barriers had a strong negative impact on the services trade and countries in the same trade agreement benefitted in the services trade even though trade agreements do not explicitly include services, also economic liberalisation and increase in economic freedom positively impacted the services trade. Their study concludes that with greater movement towards economic liberalisation among economies, a faster growth in the services trade will be observed, compared to goods trade. The gravity model studies which analysed the determinants of bilateral services trade highlighted the importance of institutional

factors, domestic government and international trade policies and other cultural and colonial factors on the services trade, thus, expanding the range of factors affecting the services trade compared to conventional trade theories.

The criticism to applying the bilateral trade gravity model to services trade came from Eichengreen and Gupta (2012), stating that gravity theoretic models may suffer from the problem of double counting, thereby yielding inconsistent results. Their study uses the fixed effects model of panel estimation to a sample of 60 developed and developing countries for a period of 1990-2008. Apart from observing the positive impact of GDP (economic size), FDI inflows, merchandise trade and reduction in trade barriers (or greater globalisation) on services exports, their study identified that infrastructure such as telephone penetration and internet bandwidth were significant determinants of services exports. Similarly, Goswami *et al* (2012), using a panel model from 1990-2008 for 47 countries analysed the determinants of Other Commercial Services (OCS) and reiterated the importance of internet penetration on services exports. Interestingly, both studies found proxies of human capital such as tertiary educated population and average years of schooling to have insignificant coefficients in their estimations. Further, Nath and Liu (2017) analysed the role of ICT on ten categories of services trade using panel data for 49 countries from 2000 to 2013 to find that ICT was more important than access or skills for services trade, thus underscoring the importance of new age infrastructure for the services trade.

Though the literature has identified the quality of human capital to be an indispensable factor for services exports, yet it does not give importance to demographic variables such as the age structure. The conventional theory of trade says that abundance of labour will contribute in exporting labour intensive goods/services due to difference in relative prices between capital and labour. Thus, services which are labour intensive in nature will be impacted by the change in the population age structure of a country. Countries with a large working age population may find it cheaper to produce services and more lucrative to export when compared to manufactured goods that are capital intensive. World Bank's Global Monitoring Report (2015) makes a mention of demographic transition and its impact on trade in services. It suggests that in the period 2015-2030, early dividend countries (South Asia) characterised by a high share of young adults and post dividend countries (North America, Europe and Pacific countries) characterised by a rising share of mature adults will have a larger share of high skilled labour intensive services exports (eg. software services, health-care etc.)[4].

Determinants of Software Services Exports for India

The literature on software services has been rather country specific and qualitative due to data limitations on software exports. In the case of India, studies have highlighted the importance of cheap and skilled labour for India's success in the exports of software services. The other factors were the role of government interventions such as setting up of Software Technology Parks, Export Promotion Council and external factors such as the Y2K problem in US and Europe which contributed to the sudden spurt in software services exports for India (Heeks, 1996). The software services exported were highly customised,

characterised by large scale operations and at the lower end of value chain. By employing cheap and skilled labour, mainly the engineering graduates who were in abundant supply, the Indian software industry captured the export market for software services (Commander, 2003; Arora and Gambardella, 2004 and Athreye, 2005). The study by Tharakan *et al* (2005) highlighted that a large English-speaking population and the existence of the large Indian diaspora in the importing countries (US and Europe) had significantly contributed to an increase in software services exports to these nations. Sahoo *et al* (2013) emphasised the role of world demand, real exchange rates and manufacturing exports on modern services exports dominated by software services exports (SSE), apart from relative endowments (of physical capital, human capital and FDI). The increase in world demand and exports of manufacturing goods had a positive impact on the exports of modern services due to high income elasticity and network effects respectively, whereas real exchange rate had a negative impact, implying appreciation of the Indian Rupee reduces the competitiveness of services exports. The study further suggests that poor physical infrastructure impedes services exports and a higher index of economic freedom (proxy for institutional quality) promotes exports of modern services which supports the findings of Kimura and Lee (2006). Gupta *et al* (2015) corroborate the findings of Sahoo *et al* (2013) using company level data of information technology (IT) services exporters and find that the world demand and exchange rate had similar outcomes on companies' IT exports, whereas FDI in these companies had a negative impact, suggesting that there is a substitution relation between domestic demand and exports. The inclusion of Research and Development (R&D) expenditure yielded insignificant coefficient as it was low during the earlier 2000s and also due to a lag effect as there is a gestation period for such expenditures to create and supply commercially viable products and services.

Services Exports and External Stabilisation

Narrowing to the impact of services exports on current account, the study by Mann (2002) investigated the role of new economy services exports on the sustainability of the US current account. The other private services were termed as new economy services and included business, professional, IT services etc. closely resembling the modern services definition by Sahoo *et al* (2013) in the Indian case. The US has a higher income elasticity for imports compared to foreign income elasticity for US exports, implying that with increase in incomes, US tends to import more than the rest of the world's import from the US, thus culminating in a higher current account deficit for the US economy. The study suggested two channels through which the increase in new economy services would impact the US current account. One, the exports of new economy services had a higher foreign income elasticity as against other US exports and asymmetry in income elasticity which favoured imports over exports was 'mute' for this services trade. Second, increased economic growth in EU and other developing regions will follow the integration of these new services into the world economy which will lead to higher demand for these services from the US. The author mentions that though the combined effect of these two observations would reduce US deficits, it was not sufficient to improve the CAD to a sustainable level due to initial deficits and the low share of services in

US exports. In analysing the impact of services trade on global imbalances (i.e. current account imbalances across countries) Barattieri (2014) observes that due to asymmetric trade liberalisation between goods and services trade, some economies have suffered larger current account deficits as they enjoyed a comparative advantage in the export of services. The study makes a case for greater liberalisation for the services trade for economies to benefit from the trade of services, thus alleviating global imbalances in the current account.

Thus, the selected review of related literature highlights the following gaps in research which this paper aims to address. Economic determinants of services exports in general are usually analysed in isolation and have not been incorporated to analyse their resultant impact on the current account. In addition, the impact of services exports (especially software services) does not feature strongly in explaining its impact on the current account and its role in moving towards external stabilisation. The studies have also excluded the role of demographic variables as an important factor for software services exports. Most of the studies have analysed the impact of services trade on the US current account, but such analysis is missing in the Indian case. The paper answers the research question of how do the economic determinants of services exports (software services) including demographic variables impact the current account and external stabilisation through changes in software services exports. Some of these determinants overlap with the determinants of the current account, yet what is the indirect impact of these determinants through software services exports is the core research objective.

Trends in Software Services Exports

The section is divided into two sub-sections. The first section presents the trends in software services exports (SSE) in the global context and the second sub-section describes the trends for India.

Table 1 presents the top ten software services exporters from 2000 to 2014. India has been the top exporter of software services throughout the selected years. India's share in world SSE improved from 17.3 per cent in 2000 to 25.8 per cent in 2005, peaking at 28.5 per cent in 2010 and reducing to 23.7 per cent in 2014. With increase in exports of software services from middle income countries such as Philippines, Uruguay, Brazil, Malaysia etc., high income countries like US, UK, Israel and Germany observed a marked reduction in their share over the years. Yet, the top ten countries controlled greater than 80 per cent of the world SSE in 2014.

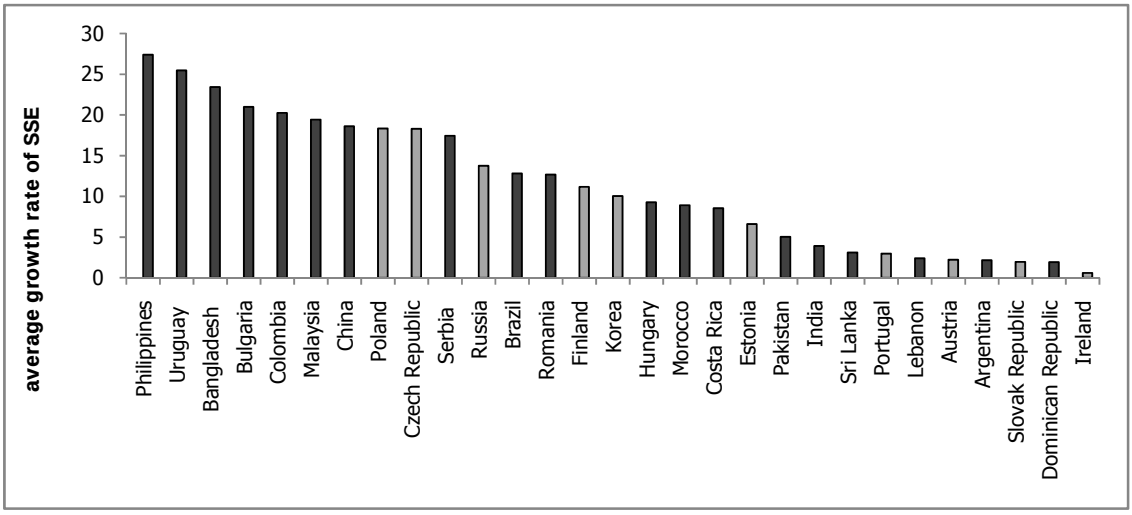
Table 1: Top Global Exporters of Software Services: 2000-2014

	2000		2005		2010		2014
(as a percentage share of total world software services exports)							
India	17.3	India	25.8	India	28.5	India	23.7
United States	16.3	Ireland	23.0	Ireland	20.3	Ireland	20.7
Israel	15.9	Germany	10.0	China	14.6	China	10.7
United Kingdom	12.7	United Kingdom	8.9	Germany	9.5	Germany	7.9
France	12.1	France	8.2	United States	4.9	United States	4.6
Canada	8.8	United States	6.3	Israel	4.6	Israel	4.6
Japan	4.6	Israel	5.4	United Kingdom	4.5	France	3.8
Sweden	4	Canada	4.3	France	3.6	United Kingdom	3.8
Norway	2.5	China	4.3	Canada	3.2	Finland	2.7
Australia	1.7	Belgium	3.0	Finland	2.5	Belgium	2.5

Source: IMF (2016).
Data for Ireland is available from 2005 onwards.

Figure 1 presents the countries that observed an average positive growth between 2000-2014. The remaining countries witnessed a decline in their share in the world SSE. A careful observation of the figures shows that the top five countries which witnessed average growth rates greater than 20 per cent from 2000-2014 were middle income countries. In addition, the sample countries, if categorised on the basis of demographic change, suggest that growth in SSE have largely accrued to Late Dividend and Early Dividend countries, which for most sample countries coincides with Upper Middle Income (UMI) and Lower Middle Income (LMI) classification respectively[5].

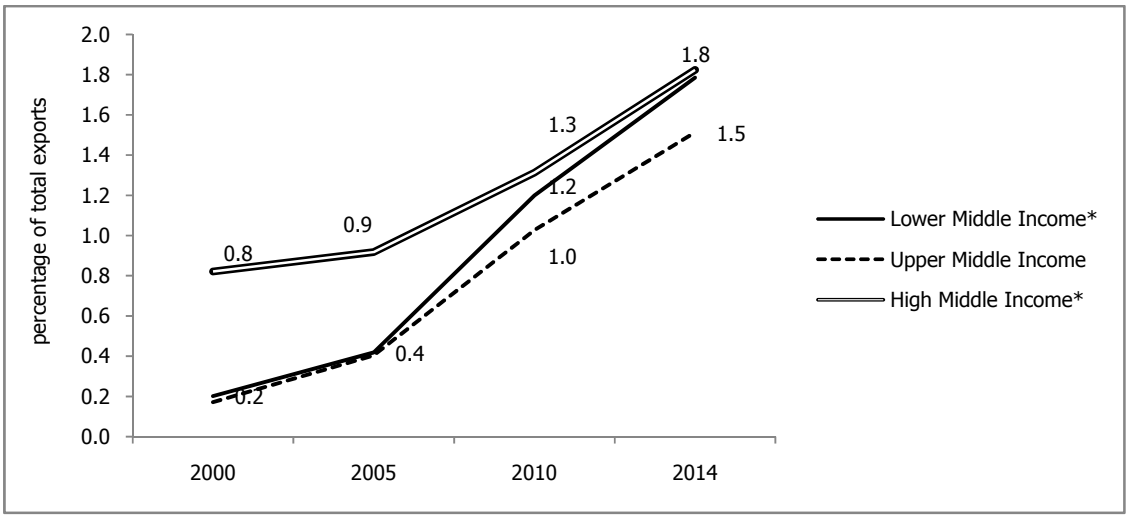
Figure 1: Average Growth Rates of SSE in Total World SSE for Select Sample Countries, 2000-2014



Source: IMF (2016).

Apart from an increase in software services exports by middle income countries, another fact to note is that the share of SSE in their respective total exports (goods and services) has also increased. Figure 2 presents the trend observed by Lower Middle (LMI), Upper Middle (UMI) and High Income (HI) sample countries[6] (see Appendix Table A.1 for list of sample countries) with regard to the share of software services exports to their respective total exports (goods and services). This highlights that countries that are in the process of rapid economic development are witnessing a growth towards service exports of which software services has seen a rise since 2005.

Figure 2: Average share of software services exports to total exports by income groups of countries: 2000-2014



Source: IMF (2016).

* India and Ireland are outliers and have been excluded from Lower Middle and High Income countries respectively. For the year 2014, share of software services exports to total exports for India and Ireland was 15.5 and 22.1 per cent respectively.

Correlates of software services exports and economic factors highlight the importance of infrastructure, FDI inflows and human capital to play a vital role in improving services trade. Table 2 depicts growth observed from 2005-2014 for the aforementioned determinants across sample countries using income classification of countries (see Appendix Figure A.1. for trends).

Table 2: Growth Rate of Economic Factors across Income Categories and India: 2005 to 2014

Particulars	Lower Middle Income	Upper Middle Income	High Income	India
Software services exports (share of world software exports)	146	87	-26	-8
Internet users (per 100 persons)	440	182	59	90
Net FDI inflows (% of GDP)	8	-36	-35	-0.5
R&D expenditure (% of GDP)*	24	30	12	123
Gross enrolment ratio[3], Tertiary	73	41	9	779

Source: World Bank (2016).

Note: *R&D expenditure is available up till 2010 for most countries, growth rate for which is from 2005-2010.

LMI countries experienced 146 per cent growth in SSE from 2005 to 2014; 87 per cent for UMI countries and -26 for HI countries. The highest growth in internet penetration during 2005 to 2014 has been observed for LMI countries followed by UMI countries. Internet penetration grew by 440 per cent for LMI countries which was 182 for UMI and 59 for HI countries. Another notable fact is FDI inflows, which had a positive growth for LMI at 8 per cent of GDP, were negative for UMI and HI. Though Research and Development expenditure (R&D) as a percentage of GDP is miniscule for LMI, yet it increased by 24 per cent. Highest growth in R&D expenditure was observed for UMI at 30 per cent. Gross enrolment ratio improved for LMI by 73 per cent as opposed to UMI (41 per cent) and HI (9 per cent). The high growth observed for internet penetration, FDI inflows, gross enrolment ratio (tertiary education) and improvement in R&D expenditure for LMI are said to have contributed to the high growth in software services exports.

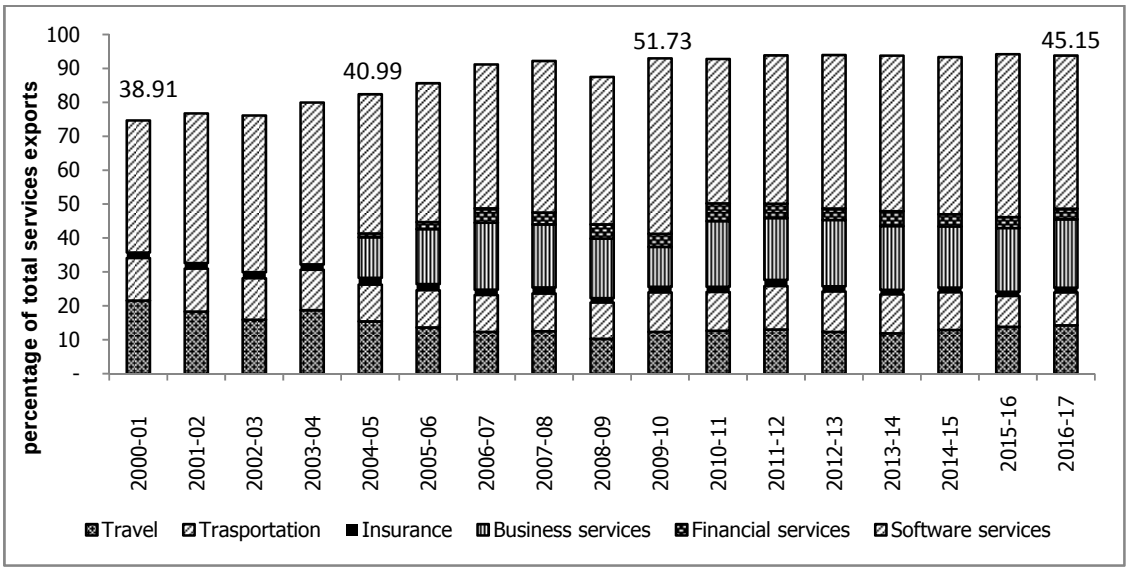
Juxtaposing India's experience shows that India's share in world software services exports has reduced by 8 per cent from 2005 to 2014 with the entry of other LMI countries like Philippines, Costa Rica, Bangladesh, etc. capturing global software trade. India's internet penetration improved by 90 per cent as compared to 440 per cent average growth observed for sample LMI countries. FDI shows a negative 0.5 per cent growth, whereas R&D expenditure and gross enrolment improved by 123 per cent and 779 per cent respectively.

Figure 3 shows the share of major services including software services in India's total services exports from 2000-01 to 2016-17. Software services increased from 38.9 per cent in 2000-01 to 40.9 in 2004-05, peaking at 51.7 per cent in 2009-10, declined to 45.2 per cent for 2016-17. Percentage share of business and financial services improved from 11.9 and 1.2 in 2004-05 to 18 and 3.6 in 2014-15 respectively. Travel services exports declined from 21.6 per cent in 2000-01 to 12.9 per cent in 2014-15, whereas exports of transport and insurance services have remained stagnant. Thus, the new economy or modern services such as business, financial and software services have a more dominant share in India's

[3] Gross enrolment ratio according to World Bank data is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown, which in this case refers to tertiary level education.

services export basket as compared to conventional or traditional services of travel, insurance and transportation.

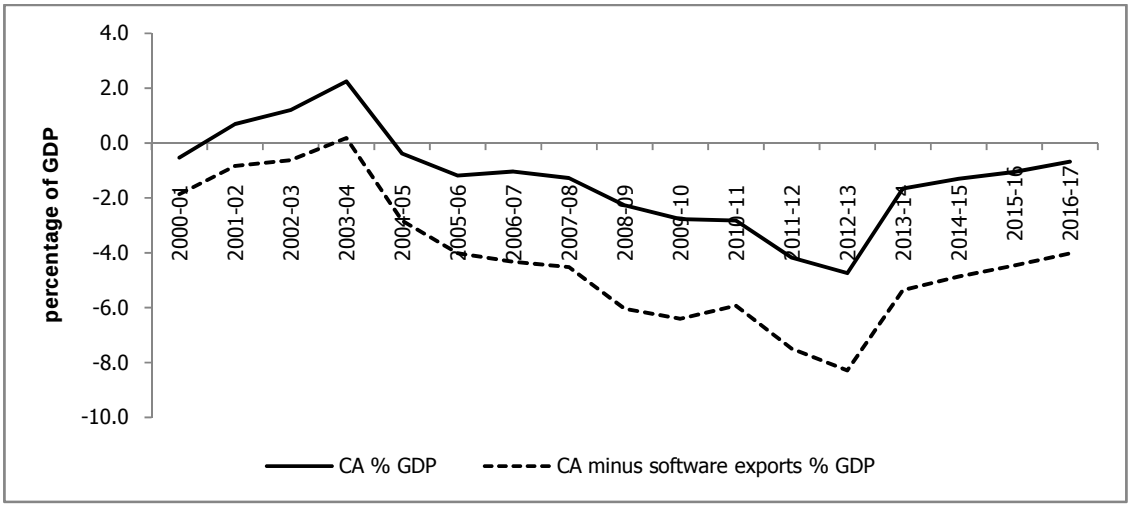
Figure 3: Major Services Exports as a Percentage Share of Total Services Exports, India, 2000-01 to 2016-17.



Source: RBI, 2016.

Software services not only play an integral role in India's services exports but also on external stabilisation. Figure 4 shows the importance of software services exports in India's current account. India's current account to GDP ratio in 2003-04 touched a peak surplus of 2.3 per cent which in the absence of software services exports would have been a mere 0.2 per cent. In a hypothetical situation, in the absence of software services exports from current account, India's external stabilisation ratio would have been -6 per cent in 2010-11 instead of -2.3 per cent and an unsustainable deficit of -8.2 per cent of GDP in 2012-13 instead of -4.7. Software services exports contributed nearly 1.5 percentage points in 2000-01 towards external stabilisation (CAD/GDP) which has increased to 3.3 percentage points by 2016-17. Thus, software service exports over the years have emerged as an important positive contributor towards India's current account balance.

Figure 4: Contribution of Software Services Exports in India's Current Account Balance, 2000-01 to 2016-17



Source: RBI, 2016.

This section highlighted that the growth in the SSE in the period post millennium has been rapid in the middle income countries. Smaller countries like Philippines, Bangladesh, Malaysia, etc. have increased their share of software services not only in their total export but also in the share of world SSE. The decline in the share of high income countries can be attributed to the emergence of lower and upper middle income countries which have captured the exports share due to outsourcing of lower value software services and cheap labour. India has remained the top exporter and has a quarter of the world's share in software services exports. In addition, half of the total services exported by India are SSE. These services also contribute positively towards India's external stabilisation. In the absence of the SSE, India's current account to GDP ratio would have reached unsustainable levels. Close to 3 percentage points were contributed by SSE towards India's external stabilisation, thus emphasising the magnitude of its contribution toward India's CAD.

Methodology

The absence of a trade theory that is exclusive to services trade is the reason why theories of goods trade have been extended or modified to incorporate the disparate feature of services trade. Services trade theories and empirical research highlight the applicability of endowments theory of resources to provide comparative advantage to certain countries in exporting services. Identifying the growth in software services exports (SSE) across countries showed that the highest growth has accrued to countries belonging to middle income countries which are also characterised by increasing working age population (15-64). Production of services being labour intensive supports the argument that countries with a larger human endowment have an advantage in producing services. The paper empirically analyses the role of conventional trade theory

determinants along with demographic variables to identify their impact on SSE using the panel estimations technique. The analysis is further extended to draw the India-specific impact of these determinants on India's external stabilisation and to assess the individual impact of SSE determinants on India's current account.

Cross-Country Analysis

Software services exports (SSE) are modelled as a function of macroeconomic variables such as of GDP of exporting country, openness to trade (globalisation), human capital, internet penetration (infrastructure), R&D expenditure and demographic variables for a sample of 45 countries from 2000 to 2014. Subsequently, the paper captures the impact of these variables on external stabilisation through changes in SSE for India, using country specific analysis from cross-country estimates.

Model. The empirical model is specified as follows:

$$SSE_{it} = \alpha + \beta_1 GDP_{it} + \beta_2 Global_{it} + \beta_3 FDI_{it} + \beta_4 R\&D\ expenditure_{it} + \beta_5 Internet_{it} + \beta_6 ICT\ goods\ exports_{it} + \beta_7 REER_{it} + \beta_8 Tertiary\ educated_{it} + \beta_9 Pop\ 20\text{-}29_{it} + \beta_{10} Pop\ 30\text{-}39_{it} + \beta_{11} Pop\ 40\text{-}49_{it} + \beta_{12} Pop\ 50\text{-}64 + \mu_{it} \quad (1)$$

In a concise form:

$$SSE_{it} = \alpha_{it} + X_{it}\beta + \mu_{it} \quad (2)$$

Where X refers to all macroeconomic variables and demographic variables
i: countries (1 to 45) and t: year (2000 to 2014)

In eq. (1) *SSE* stands for software services exports (percentage share of world software services exports) which is influenced by GDP, globalisation, FDI inflows, internet penetration, ICT goods exports, age structure variables, tertiary educated population and R&D expenditure. A higher GDP of the country suggests a movement towards larger contribution of services in the total output of the economy. Thus, a rising GDP indicates higher share of services and thereby its exports. Following Grunfeld and Moxnes (2003) trade barriers (*Global*) and openness to capital (*FDI*) are included as increased integration with the world economy measured through reduction in trade barriers and foreign capital has a significant impact on services trade. Internet penetration positively impacts trade in software services, as developers, especially in developing countries, gain access to foreign markets and is also an indicator of overall ICT infrastructure prevailing in the economy. International trade is affected by price elasticity. Thus, Real Effective Exchange Rate (REER) is included in the model. Countries can export more when the REER depreciates, as the price of the domestic good or service becomes cheaper and competitive.

Eichengreen and Gupta (2012) include goods exports while analysing determinants of services trade with a rationale that a country which has a high penetration in goods markets can export more

services through network effects. Using a similar rationale, the paper includes ICT good exports in the model to study the nature of the relationship between ICT goods and software services exports of them being complements or substitutes.

Studies (Kimura &Lee, 2006) have included size of the population (under gravity model as a variable to measure the size of trading economies), Eichengreen and Gupta (2012) have included working age (15-64) in panel analysis, yet demographic variable has not been analysed specifically for their contribution in services exports. A World Bank study (2015) assesses the impact of age structure transition on services trade, but the impact of age structure variables exclusively on software services exports has not been addressed. The working age population in this paper is defined as the population between 20-64 years. Further, it is divided into four age groups (20-29; 30-39; 40-49 and 50-64) to identify the age group that has maximum positive impact on software services exports. The model is estimated by dropping the four age structure variables and including another classification *Active youth* which the share of population in age group 20-39 in total population.

Total graduates (tertiary level) passing out in a given year is included to analyse impact of human capital on software services exports. Information Economy Report (2012) by United Nations highlights the positive role of innovation in software services trade; thus, R&D expenditure (public and private) is included in the model as a proxy of innovation.

Technique of estimation. The macroeconomic determinants of SSE are estimated using panel data of 45 countries from 2000-2014. The model may be affected by endogeneity bias, which is prevalent for macroeconomic estimations. In order to overcome endogeneity, two methods can be adopted. First, Instrumental Variables (IV) which are correlated with explanatory variables and uncorrelated with error terms can be used for estimation, but finding appropriate instrumental variables is usually difficult and thus, most macroeconomic analysis uses the second technique to overcome the endogeneity problem i.e. using lagged regressors as instruments.

The paper follows the use of lagged value of regressors as instruments to overcome the endogeneity problem. The Two Stage Least Squares (TSLS) method is selected to estimate the nature and impact of the macroeconomic determinants of software services exports (SSE).

Framework for India Specific Analysis

Country specific implications for India are calculated from cross-country estimation in (1). The India specific analysis includes the calculation of adjusted SSE (*Adj SSE*) which is obtained by the removal of the contribution of the significant variables and computed as:

$\Gamma_t = \hat{\beta}_1 * X_{1,t} + \hat{\beta}_2 * X_{2,t} + \ldots\ldots\ldots\ldots\ldots \hat{\beta}_n * X_{n,t}$, where n=number of significant variables (3)

$AdjSSE_t = (Actual\ SSE_t - \Gamma_t) - a$ (4)

$Adjustment\ Factor = AdjSSE_t - Actual\ SSE_t$ (5)

The $AdjSSE_t$ calculated by subtracting the sum of the significant estimated coefficients $(\hat{\beta})$ multiplied with their respective variables for each time period and the constant from *Actual* SSE_t. *Adjustment Factor* captures the contribution of the significant variables towards SSE for India.

Equations (3), (4) and (5) calculate the combined contribution of all the significant determinants on India's SSE, subsumed in the *Adjustment Factor.* But, the objective of the paper is to decompose the individual impact of the significant determinants and is calculated as:

Illustrated with an example; calculation of the contribution of R&D expenditure on India's SSE.

$$AdjSSE_{t\ without\ R\&D} = AdjSSE_t - \hat{\beta}_{R\&D} * R\&D\ exp_t \quad (6)$$

$$R\&D\ exp.\ contribution = AdjSSE_t - AdjSSE_{t\ ,without\ R\&D} \quad (7)$$

Similarly, the contributions of other significant variables can be computed using (6) and (7). The *Adjustment Factor* represented the overall contribution of all the variables, whereas the individual contribution of each variable can be calculated using (6) and (7) is part of the overall contribution towards India's SSE.

Thus, (7) can be re-written as:

$$\text{Variable contribution} = AdjSSE_t - AdjSSE_{t,,without\ variable} \quad (8)$$

The novelty of the paper lies in extending the impact of the determinants of the SSE on India's external stabilisation. The following explains the method applied:

$$Adj\ CAD_t/GDP_t = \frac{(Actual\ CAD_t + Adj\ SSE_{t\ ,without\ variable}) - Actual\ SSE_t}{GDP_t} * 100 \quad (9)$$

In order to capture the extent of change in the external stabilisation (CAD/GDP) for India, the *Actual* SSE_t is subtracted from the CAD for India in a given time period t and the $AdjSSE_{t,\ without\ variable}$ is added. Equation (9) provides the new external stabilisation ratio for India with subtraction of the contribution of the given determinant. If the $AdjCAD_t/GDP_t$ is marked with a larger deficit, it indicates that the variable positively contributed to the current account and helped in reducing the deficit and vice-versa.
Thus, in (9), the contribution of the given determinant is subtracted to capture the resultant impact on India's CAD and external stabilisation.

Variables and Data Description

Table 3 gives the list of variables and their sources that are employed in the estimation of the panel regression model.

Table 3: Variables and data sources

Variable		Measurement	Sources
Software Services Exports	*SSE*	Percentage of total world software services exports	IMF, Balance of Payments Statistics (2015)
Gross Domestic Product	*GDP*	Log of constant USD billion, base year=2010	World Bank, World Development Indicators (2015)
Trade Restrictions	*Global*	KOF Index of Globalisation	Dreher (2006), Gygli*et al* (2018)
Foreign Direct Investment	*FDI*	Percentage of GDP	World Bank, World Development Indicators (2015)
Internet penetration	*Internet*	Internet users per 100 persons	World Bank, World Development Indicators (2015)
Information and Communication goods exports	*ICT goods exports*	Percentage of total goods exports	World Bank, World Development Indicators (2015)
Real Effective Exchange Rate	*REER*	Index (CPI based)	Zsolt D, (2012)
Demographic Variables	*Pop 20-29, Pop 30-39, & Pop 40-49* *Active Youth 20-39*	Percentage share in total population	World Bank, Health Nutrition and Population Statistics (2015)
No. of persons graduating in tertiary level education	*Tertiary educated*	Percentage of 15-64 population	World Bank, World Development Indicators (2015) and UNESCO, Education Statistics (2016)
Research and Development expenditure	*R&D expenditure*	Percentage of GDP	World Bank, World Development Indicators (2015)

Source: Author's compilation.

The limitations of the study are that it uses an unbalanced panel with many countries having gaps in their data[7] (see Appendix Table A.3 for correlation matrix). The sample selection is based on the availability of data and is biased towards High Income countries as the sample has few Upper and Lower Middle Income countries. The supply side factors which promote or increase software services exports alone are estimated[8].

Empirical Results

This section is divided into two parts. The first part presents the nature and magnitude of macroeconomic and demographic variables' impact on the software services exports (SSE) using panel data for 45 countries from 2000-2014. It analyses and explains the determinants which make countries more competitive to export software services in the world. The second part uses the coefficients estimated from the panel analysis to draw India-specific impact of these determinants on India's external stabilisation.

Cross Country Panel Analysis

Table 4 presents the coefficients obtained from estimating different specifications of equation (1). The first column presents the results obtained from the pooled OLS. It depicts the relationship between software services exports (SSE) and select macroeconomic and demographic determinants. Country fixed effects are added with time fixed effects to account for the unobservable time-invariant variables across countries. The results depict the strong positive impact of GDP of the exporting country and economic globalisation on the share of SSE in world software services exports, whereas negative and significant relationship is observed for internet penetration variable and REER. The Ramsy RESET test (1969) which tests for functional form misspecification and omitted non-linear variables is significant, suggesting the model is misspecified and suffers from the omission of relevant variables. The model is re-estimated with excluded variables which include R&D expenditure, share of tertiary educated and demographic variables and the results are presented in column (2) and (3). The fixed effects model is selected over random effects and pooled regression model after employing Hausman test (1978) and F test for poolability of the dataset.

Both the fixed effects models present positive and significant relationship of software services exports with GDP, globalisation and R&D expenditure. This suggests that countries with increased integration with the world economy tend to have a higher share of software services exports in total world exports. Also, exports are higher when countries have a higher share of R&D expenditure as a percentage of GDP. This supports the argument that software services are technology driven and given the drastic improvements in Artificial Intelligence (AI), cloud computing and the development of personalised services, R&D expenditure is essential to maintain the competitive edge in exporting software services. The REER maintains a significant negative association, and appreciation in REER leads to decline in exports. The result confirms that countries lose their competitive edge in software exports if the domestic currency witnesses an appreciation, making exports more expensive.

The ICT goods exports as a share of total exports did not yield any significant relationship, the same specifications were run with merchandise exports as a share of GDP to check for network effects following (Eichengreen and Gupta, 2012; Bhanumurthy*et al*, 2014) which yielded insignificant results. The demographic variables in column (1), active youth population (20-39) and column (2) working age population (20-29; 30-39; 40-49 and 50-64) had no significant relationship with the exports of software services. The share of graduates in the working population also does not display any significant result. The gross enrolment ratio (tertiary level) was also estimated, replacing the share of graduate population which yielded insignificant results, similar to the results of Eichengreen and Gupta (2012) and Goswami *et al* (2012). Thus, the estimations presented in Table 6 highlight the role of core macroeconomic variables and no strong evidence in support of demographic variables could be witnessed.

Table 4: Determinants of Software Services Exports

Independent variables	Pooled (1)	Fixed Effects (2)	Fixed Effects (3)
Log GDP	11.66*** (7.41)	15.67*** (2.96)	13.12*** (3.08)
Global	0.06*** (4.08)	0.06*** (2.69)	0.05*** (2.77)
Internet	-0.05*** (-3.40)	-0.5 (-1.67)	-0.05 (-1.74)
FDI	-0.01 (-1.16)	0.004 (0.34)	0.01 (0.65)
REER	-0.03*** (-4.01)	-0.04** (-2.09)	-0.04** (-2.45)
R&D exp.		2.95*** (2.81)	2.5*** (2.42)
ICT goods exports		0.0003 (0.05)	0.0009 (0.49)
Active youth 20-39		-0.005 (-0.01)	
Pop 20-29			1.31 (0.39)
Pop 30-39			0.65 (1.66)
Pop 40-49			0.83 (1.51)
Pop 50-64			0.07 (0.20)
Total graduates (share of 15-64)		-0.069 (-0.7)	0.04 (0.04)
Constant	-128.61*** (17.08)	-175.89*** (-3.27)	-172.04*** (-3.86)
No of obs.	562	358	358
Countries	45	39	39
Avg. no of obs. per country		9.2	9.2
Time fixed effects	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes
RESET[a]	200.52***		
F test for fixed effects[b]		91.07***	87.46***
Hausmantest[c]		44.98***	49.39***

Note: * p<0.10; ** p<0.05; *** p<0.01

Source: Author's estimation based on equation (1).

Values in parentheses are t-statistic.

Heteroscedasticity robust standard errors are used to calculate t-statistic.

[a] Ramsey RESET test for functional form misspecification and omitted non-linear variables. H_0: model is correctly specified and there are no omitted non-linear variables.

[b] F test for poolability. Jointly tests the null, H_0: none of the country dummy are significantly different than 0.

[c] Hausman tests fixed effects against random effects model. H_0: difference in coefficients not systematic, random effects is favoured.

Macroeconomic estimations suffer from endogeneity biases as software services exports and macroeconomic determinants maybe simultaneously determined. Thus, the approach adopted in the paper is the use of lagged regressors as instruments to overcome endogeneity in the model.

In Table 5, the results in column (1) are estimations using lagged values of the determinants by a year, column (2) and (3) present the results of the two stage least square (TSLS) estimations. The main macroeconomic variables i.e. GDP, globalisation and R&D expenditure have maintained their sign and significance across all three estimations. The REER turns insignificant when the lagged value is instrumented for in the estimations and the population 30-39 turns significant and has a positive relationship with software services exports. The FDI variable was removed from TSLS estimations, the reasons being that it did not yield significant results in any of the previous models and also unlike other variables the F-statistic for FDI was less than 10[4] in all first stage regressions. To address the issue of relevance of the instruments, the Anderson-Rubin Wald test results suggest that the instruments are valid and reject the null that coefficients of endogenous variables estimated in the structural equation are jointly equal to zero. The under-identification test by Kleibergen-Paap highlight that the matrix of reduced form coefficients is identified and the null hypothesis that matrix of the reduced form coefficients has a rank K1-1 is rejected. The model includes an additional instrument of merchandise exports as a percentage of GDP in the regression and thus, Sargan-Hansen test of over-identifying restrictions is applied. The null hypothesis that instruments are exogenous cannot be rejected and thus, the estimations do not suffer from endogeneity bias. The diagnostic tests conducted confirm that the instruments used in column (2) and (3) are valid and the coefficients can thus be analysed to explain their impact on the share of software services exports for the panel data.

GDP has been positive and significant across all specifications; it means that increase in GDP is positively associated with having a higher share in software services exports in world software services exports. Countries which experience high economic growth tend to have a larger share in world software services exports. The results also highlight the importance of having fewer trade restrictions in order to promote software exports, which is in line with most of the previous studies on trade. The internet penetration has a significant negative coefficient which could be due to the fact that apart from being a proxy for internet infrastructure necessary to support the software industry, it can be looked upon as a proxy for domestic demand for software services. With increased access to internet, the domestic demand for software services increases and thus, shifting the focus of the domestic software industry towards meeting the domestic demand and thereby, reducing its exports.

The REER variable loses its significance in the specifications presented in Table 4 upon using its lagged value as an instrument. This suggests that the exchange rate affects the software services exports in the short run and has a negative impact in the current period only. This makes sense, as there will be a decline for software exports from the country immediately following an appreciation. The regressions were

[4] Staiger and Stock (1997) suggest a rule-of-thumb threshold, of F- statistic being greater than 10 in all first stage regressions for excluded instruments in order to overcome the problem of weak instruments.

estimated by using the current period REER and not by its lagged instrument; yet, the coefficients remained insignificant, which suggests that though REER is negatively associated with exports, it does not significantly impact the a country's share in world software services exports.

The software industry is highly technology driven and needs constant research on developing more customised and personalised services. Thus, R&D expenditure variable has a high and significant positive impact on exports of these services. Increase in R&D spending assists the domestic software industry to become more competitive in the world and thereby increases its share in the world software services exports. The share of ICT exports did not have any significant impact on software services. The analysis does not find evidence for the presence of network effect for software services. Even when the merchandise exports were instrumented, no significant impact was observed. Thus, a country having a high share of ICT goods exports in its export basket may not necessarily exploit those channels to export more software services.

Among the demographic variables, the age group of 30-39 had a significant positive impact. This suggests the countries with a population between age group 30-39 export more software services. But, the total graduate population did not have any significant impact on the software service exports. The results are contrary to the general argument that software services need a skilled labour force. This could also be due to the fact that software services are now technology and capital driven rather than skilled labour driven which is supported by the highly significant positive R&D variable. The estimations use country dummies to isolate the impact of time varying country specific characteristics. The analysis finds that India's dummy is positive and significant suggesting that there are other factors not included in the model that seem to impact India's software services exports. High productivity, low cost of labour, the existence of diaspora, export promotion schemes, etc. are not included in the estimated model which are key factors for India's large share in world software services exports.

Table 5: Determinants of Software Services Exports, 2000-2014

Independent variables	Lagged regressors (FE) (1)	TSLS (FE) (2)	TSLS (FE) (3)
Log GDP	5.87*** (3.73)	10.79** (2.76)	10.33*** (4.14)
Global	0.042** (2.54)	0.095* (2.10)	0.08* (2.16)
Internet	-0.08*** (-4.31)	-0.138*** (-3.50)	-0.13*** (-5.44)
FDI	-0.003 (-0.20)		
REER	-0.012 (-1.62)	-0.01 (-0.47)	-0.007 (-0.50)
R&D exp	2.14*** (2.14)	3.679* (2.47)	3.49** (2.17)
ICT goods exports	-0.001 (-0.52)	-0.004 (-1.30)	-0.003 (-0.85)
Active youth 20-39		0.356 (1.07)	
Pop 20-29	0.41 (1.24)		0.37 (0.75)
Pop 30-39	0.82** (2.19)		0.771* (1.76)
Pop 40-49	0.75 (1.21)		0.6 (0.86)
Pop 50-64	0.15 (0.47)		-0.09 (-0.19)
Total graduates (share of 15-64)	-0.16 (-0.21)	-0.56 (-0.50)	-0.26 (-0.24)
Constant	-96.11*** (-3.88)	-135.3*** (-3.38)	-143.1*** (-4.69)
No of obs	363	313	313
Countries	40	35	35
Avg no of obs per country	9.1	8.9	8.9
Time fixed effects		No	No
Country fixed effects	Yes	Yes	Yes
F test for fixed effects[a]		109.20***	102.66**
Hausmantest[b]		30.90***	49.39***
Anderson-Rubin Wald F test[c]		3.07***	5.19***
Kleibergen-Paap LM test[d]		12.59***	10.98***
Sargan-Hansen test[e]		0.15	0.47

Note: * p<0.10; ** p<0.05; *** p<0.01

Source: Author's estimation based on equation (1).

Values in parentheses are t-statistic.

Heteroscedasticity robust standard errors are used to calculate t-statistic.

[a] F test for poolability. Jointly tests the null, H_0: none of the country dummy are significantly different than 0.

[b] Hausman tests fixed effects against random effects model. H_0: difference in coefficients not systematic, random effects is favoured.

[c] Anderson-Rubin Wald Tests joint significance of endogenous regressors, relevant instruments test. . H_0: $B_1=0$ and orthogonality conditions are valid.

[d] Kleibergen-Paap LM, under-identification test. H_0: matrix of reduced form equations is under-identified.

[e] Sargan-Hansen test of over- identifying restrictions. H_0: instruments are exogenous.

Impact on India's External Stabilisation

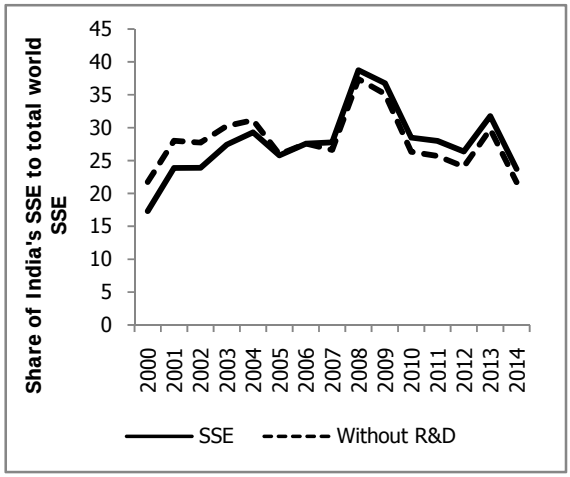
This section analyses the impact of macroeconomic and demographic variables on India's external stabilisation using the estimated coefficients from the TSLS procedure. The first part depicts the contribution of significant variables on India's SSE. The variable contribution towards India's SSE is calculated using equations (6) and (7) along with coefficients obtained from TSLS (FE) column (3). Figure 4 panel (a) to (d) present the contribution of individual determinants on India's SSE. The figure 4 (a) presents the contribution of R&D expenditure on SSE. It is observed that the SSE prior to 2005-06 lies below the calculated SSE (dotted line) without R&D expenditure ($AdjSSE_{t,\ without\ R\&D}$), after which it lies above. This depicts that without the contribution of R&D expenditure, India's SSE in total world SSE would be lower than the actual from 2005-06 periods. This depicts that after 2005-2006, R&D expenditure positively contributed to India's share in world SSE. On an average, a 2 percentage point boost to India's SSE was on account of R&D expenditure. Panel (b) shows a similar positive impact towards SSE by having higher integration with the world economy and lower trade barriers. It is found that globalisation variable yields similar pattern and contribution as R&D expenditure towards India's SSE. It is interesting to note that post 2005-06 both R&D expenditure and globalisation variable seem to exhibit a positive impact towards SSE. The overall boom in international trade in both goods and services during early 2000s could have triggered increased expenditure on R&D for their products to be competitive and relevant in the global market. The marked reduction in trade barriers post 2000 which reached a peak around 2004-05 also strongly contributed towards SSE for India.

An interesting pattern is observed in the case of internet penetration. Though indispensable as an infrastructure for software services, it seems to reduce the share of India's SSE in world SSE. It is found that the domestic consumption of software services has drastically increased, which has reduced the software services available for exports. It has made the software industry focus on domestic demand, emanating from increased access to internet which otherwise would have been available for exports. Nearly 4 percentage points of India's share in world SSE in 2014 was directed towards domestic consumption.

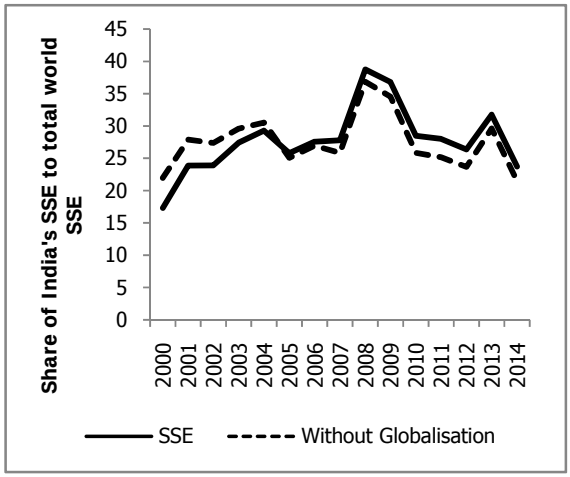
The largest positive contribution is observed from the share of total population in 30-39 age group presented in panel (d). It is observed that since 2000 the contribution of 30-39 population towards SSE has been increasing. An abundant population in this age group provides a competitive edge to India in exporting software. A rise is observed in the share of the population between 30-39 which are secondary and tertiary educated, and hence, available to be absorbed into various roles in the industry. India produces software services that are on the lower level of the value chain and require a large number of skilled persons to produce services that are repetitive and labour intensive as observed by various studies services (Commander, 2003; Arora and Gambardella, 2004 and Athreye, 2005). Only recently has the software industry moved towards more specialisation and innovation due to a paradigm shift observed in the way these services are produced with the advent of AI, cloud computing and machine learning. India always had a competitive advantage in producing software services at a cheaper cost as the industry employed an abundant skilled labour-force at low cost, in essence corroborating with the factor endowment theory.

Figure 4: Contribution towards India's SSE by individual determinants, 2000-2014, India

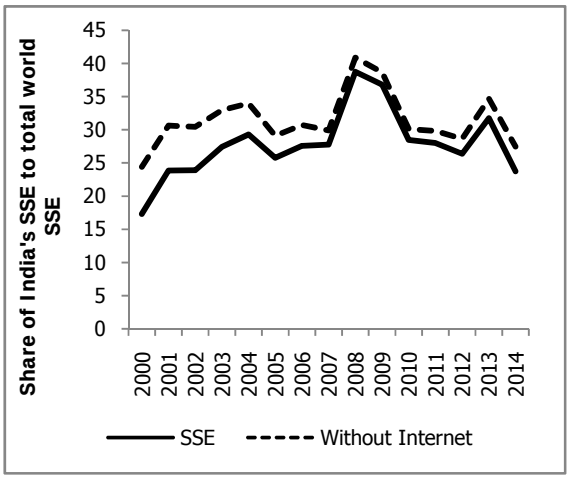
(a)



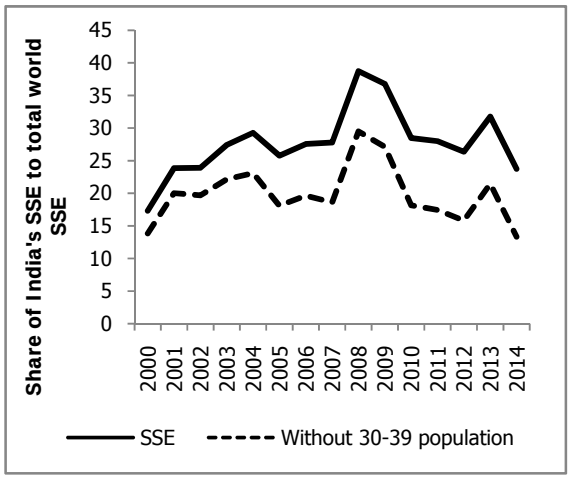
(b)



(c)



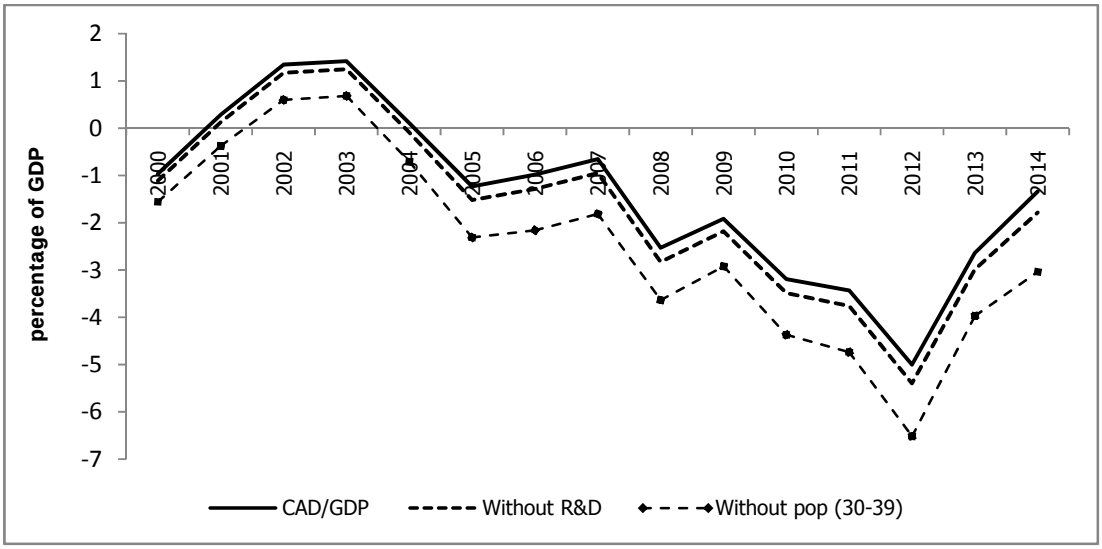
(d)



Source: Author's calculations based on equations (6) and (7) and estimated results from Table 4, TSLS column (3).

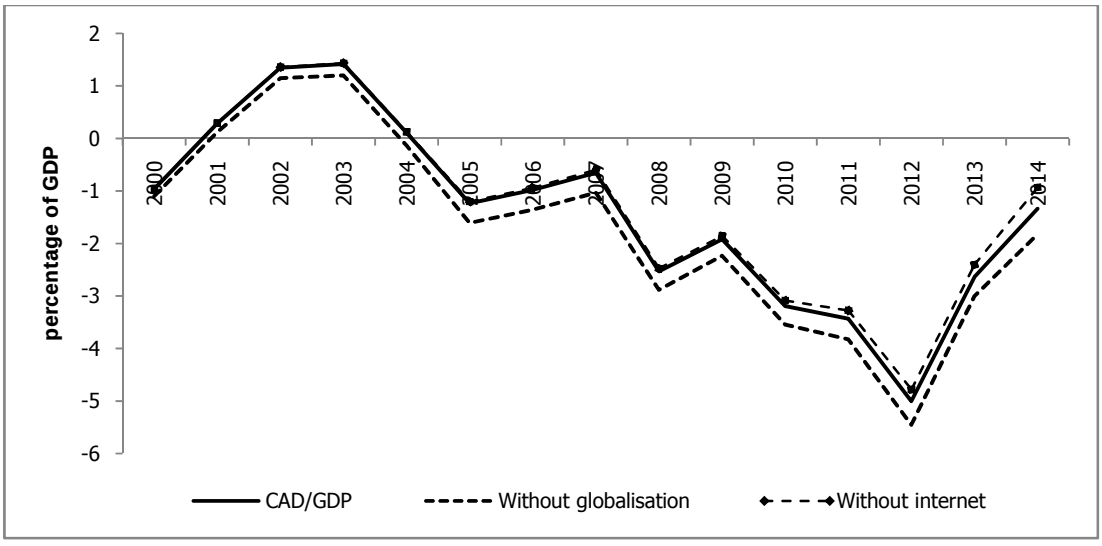
The following presents the resultant impact of the significant factors on India's external stabilisation. Figure 5 shows the contribution made by the macroeconomic and demographic determinants of SSE on India's CAD/GDP ratio i.e. external stabilisation.

Figure 5: R&D and Population (30-39) Variables' Contribution towards External Stabilisation, India, 2000-2014



Source: Author's calculations based on equation (9).

Figure 6: Globalisation and Internet Penetration Variables' Contribution towards External Stabilisation, India, 2000-2014



Source: Author's calculations based on equation (9).

Figure 5 and 6 extend the contribution of the select macroeconomic and demographic variables on India's external stabilisation using equation (9). The aforementioned figures capture the resultant impact of select determinants on CAD/GDP ratio through their impact on India's SSE. In figure 4 (d), it was observed that the share of the population aged 30-39 in total population had the highest impact on India's SSE,

thereby upon deducting its contribution in India's SSE, the CAD increases by an average of 1 percentage point. This suggests that if the positive impact of population aged 30-39 was subtracted from SSE, then the resultant impact on India's external stabilisation would be negative as it increases the CAD further. Presented earlier in figure 4, the SSE have reduced India's CAD/GDP by an average of 4 percentage points, of which nearly 1 percentage point of the CAD/GDP is reduced by the SSE through the positive contribution of population aged 30-39 in India's SSE. It is observed that if the positive contributions of R&D expenditure and globalisation towards SSE are subtracted, then the net effect on external stabilisation is that the CAD/GDP increases by 0.3 percentage points in both the cases (figure 5 and figure 6). Internet penetration, though significant, had a negligible impact on SSE till 2008, figure 6, but post that it had a negative impact as it reduced the share of India's SSE in world exports. It is observed that internet penetration improved the CAD/GDP ratio by close to 0.2 percentage points post 2008. The reason is that had the software services that were being directed towards the domestic market been exported, then CAD/GDP would have been reduced by that margin.

The section highlighted the positive contribution of macroeconomic and demographic variables on India's software services exports (SSE). The resultant impact of these variables on India's external stabilisation also highlighted the extent of their contribution towards CAD/GDP ratio through SSE.

Conclusions and Implications

India suffers from a persistent current account deficit (CAD) in the Balance of Payments and the paper highlights that India holds a strong advantage in exporting software services, and ranks as the top exporter of these services in the world. Based on trade theories and empirical literature, the analysis in the paper selected certain macroeconomic and demographic variables to estimate the nature and extent of the impact of these set of determinants on India's software services exports (SSE). The empirical estimations used a panel dataset of 45 countries over the 2000-2014 period and employed the TSLS estimation technique to calculate the coefficients of the select determinants. The analysis further calculated the impact of these determinants on India's external stabilisation through their contributions towards SSE using the significant coefficients from the TSLS estimations.

The empirical results underscore the importance of the population age structure on SSE. It was found that the population aged 30-39 had the highest contribution towards SSE after the GDP of the country. A rising GDP usually shifts the production from manufacturing to the services sector, thus increase in GDP had a strong positive impact on SSE. The reason for population aged 30-39 to have a positive impact on SSE is abundant cheap supply of labour. India benefitted immensely by employing the abundant labour force to produce software services that were on the lower rung of the value chain and were labour intensive.

Research and Development (R&D) expenditure as a percentage of GDP had a strong and significant positive impact, implying that software services are driven by innovations and technological improvements. A higher investment in R&D expenditure increases the competitiveness of software services.

Also, closer integration with the world economy through reduction in trade and other barriers also results in increase in SSE.

Surprisingly, the proxy for human capital, i.e. tertiary educated population to total population, did not yield any significant result. It was found that ICT goods exports in total goods exports also were insignificant, implying that a country exporting high technology exports need not be exporting software services. The reason for its inclusion is that maybe countries with a high share of ICT exports may find it easier to produce and export software services due to network effects and complementarity between these exports.

The net FDI flows as a share of the GDP did not yield significant results, whereas REER had negative and significant coefficient in the simple Fixed Effects model but loses its significance upon the estimation through TSLS. This suggests that in the immediate period, the REER has a negative impact on SSE, an appreciation of the domestic currency leads to a fall in the SSE, but instrumenting it with its lagged value causes it to lose its significance.

The India specific analysis computed the extent of contribution made by each significant determinant towards reducing CAD/GDP ratio through SSE. It was found that R&D expenditure and globalisation variables contributed nearly 3 percentage points to India's share in SSE in world's share. These determinants together positively contributed towards external stabilisation by reducing the CAD/GDP by 0.6 percentage points. Thus, it would be in India's interest to promote higher investments towards R&D due to rapid changes in technology and market demand towards greater personalised services. Also, it will be in India's favour to support global integration in times of the rapid spread of nationalist tendencies and anti-globalisation sentiments, especially in the US and Europe which are the largest consumers of Indian SSE.

It was also found that internet had a negligible impact on SSE and external stabilisation prior to 2008, post which it reduced India's share in SSE to world exports increased CAD/GDP by 0.2 percentage points due to channelling of the software services towards domestic consumption.

The largest contributor towards SSE was the share of population aged 30-39. Its contribution towards India's SSE was nearly 14 percentage points and its contribution to reducing CAD/GDP was close to 1 percentage point. Thus, India enjoying a demographic boom must provide opportunities to gainfully employ this population in high technology services industries. One must note that India's boom in software exports was on account of exporting services that were towards the bottom of the value chain like data warehousing, maintenance of websites which were repetitive and required a large labour-force. These services are being automated; thus, the focus must be to invest in training and developing the skills of the current labour force. Indian software industry needs to undergo a drastic upgradation to keep up with the fast pace of technological developments.

Appendix

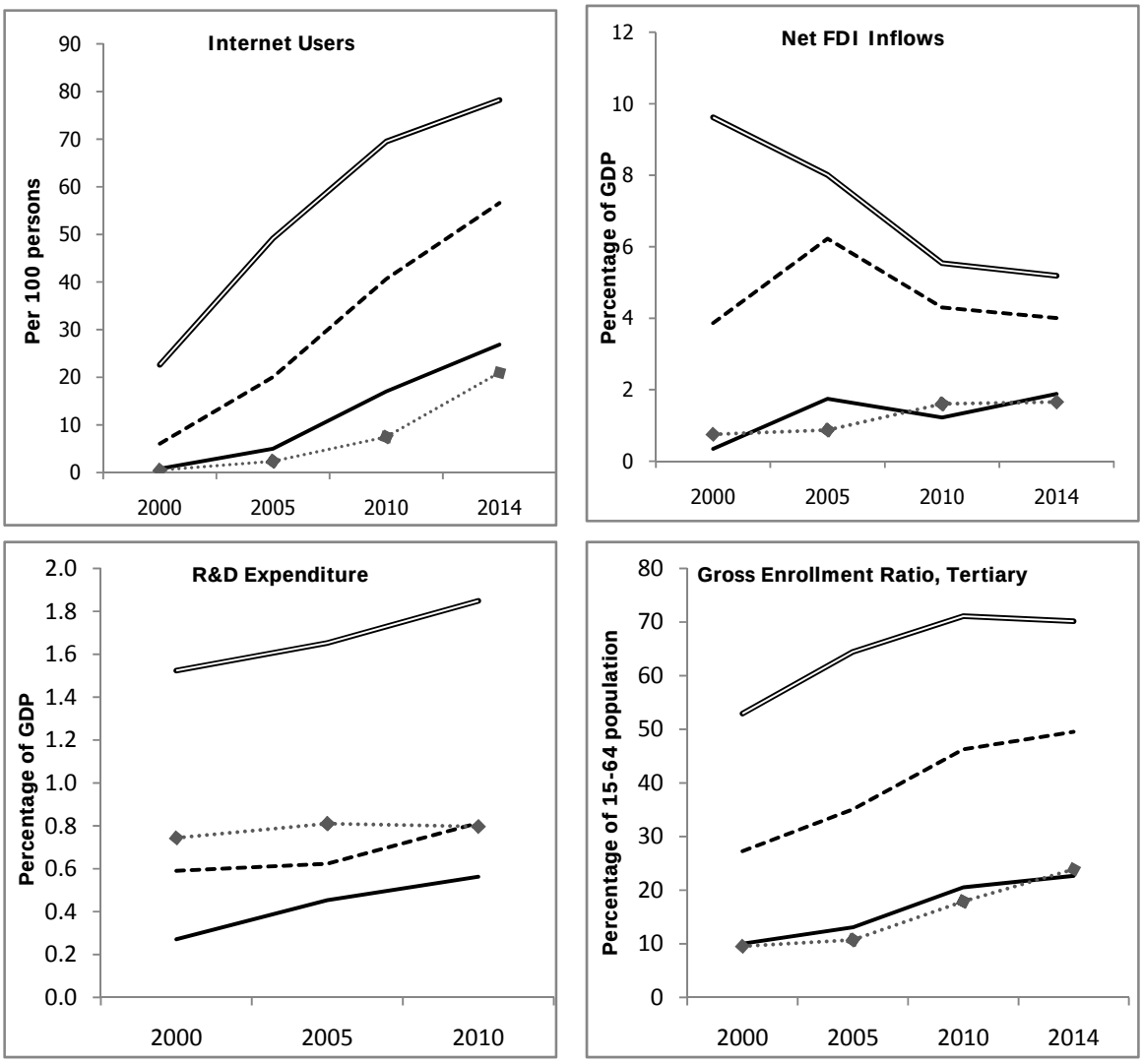
Table A.1: Sample Characteristics, 2015

High Income				Upper Middle Income		Lower Middle Income	
1.	Argentina [E]	16.	Italy [P]	29.	Brazil [L]	39.	Bangladesh [E]
2.	Australia [P]	17.	Japan [P]	30.	Bulgaria [P]	40.	India [E]
3.	Austria [P]	18.	Korea Rep. [P]	31.	China [L]	41.	Indonesia [E]
4.	Belgium [P]	19.	Latvia [L]	32.	Columbia [L]	42.	Morocco [L]
5.	Canada [P]	20.	Lithuania [P]	33.	Costa Rica [L]	43.	Pakistan [E]
6.	Croatia [P]	21.	Portugal [P]	34.	Dominican Republic [E]	44.	Philippines [E]
7.	Czech Rep. [P]	22.	Poland [L]	35.	Lebanon [L]	45.	Sri Lanka [L]
8.	Estonia [L]	23.	Russia [L]	36.	Malaysia [L]		
9.	Finland [P]	24.	Slovak Republic	37.	Romania [L]		
10.	France [P]	25.	Slovenia [P]	38.	Serbia [L]		
11.	Germany [P]	26.	United Kingdom [P]				
12.	Hungary [P]	27.	United States [P]				
13.	Iceland [L]	28.	Uruguay [L]				
14.	Ireland [L]						
15.	Israel [P]						

Source: World Bank (2015).

P, L and E refer to Post, Late and Early Dividend countries. The sample does not contain any Pre Dividend and Low Income countries and has been constructed on the basis of availability of data on software services exports for the period 2000-2014.

Figure A.2: Trends in Economic Factors across Income Categories: 2000 to 2014



High Income Upper Middle Income Lower Middle Income India

Source: World Bank (2016).

Table A.3: Correlation Matrix

	SSE	***Global***	***FDI***	***Internet***	***ICT goods exports***	***Tertiary educated***	***R&D exp.***	***REER***	***Pop 20-29***	***Pop 30-39***	***Pop 40-49***	***Pop 50-64***
SSE	1											
Global	0.1	1										
FDI	0.36***	0.25***	1									
Internet	-0.01	0.53***	0.05	1								
ICT goods exports	0.17*	0.46***	0.21***	0.15***	1							
Tertiary educated	-0.002	0.39***	0.2***	0.58***	0.14***	1						
R&D expenditure	0.19***	0.44***	-0.042	0.55***	0.19***	0.22***	1					
REER	0.01	-0.05	-0.08**	0.14***	-0.2***	0.03	0.16***	1				
Pop 20-29	-0.04	-0.62***	0.04	-0.6***	-0.16***	-0.28***	-0.45***	0.04	1			
Pop 30-39	0.06	0.08	0.14***	-0.06	0.11***	-0.08	-0.047	-0.04	0.08	1		
Pop 40-49	0.04	0.51***	0.04	0.5***	0.25***	0.35***	0.29***	-0.19***	-0.59***	0.14***	1	
Pop 50-64	-0.05	0.63***	0.05	0.7***	0.15***	0.5***	0.32***	-0.016	-0.79***	-0.02	0.68***	1

Note: * p<0.10; ** p<0.05; *** p<0.01

Source: Author's calculations.

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Notes

[1] 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).

[2] Goswami, *et al* (2012) provide exhaustive literature review of gravity model based empirical studies.

[3] Determinants of institutional variable include trade restrictions, ease of doing business, prevalence of corruption, investment climate, and export promotion policies, for analysing infrastructure variable telecommunications, internet penetration are included, level of education, share of educated population are used as proxies for human capital and cultural factors are proxied by common language, colonial interactions.

[4] Refer Global Monitoring Report: Development Goals in an Era of Demographic Change (2015), Chapter 5, pages 169-171 on definitions of Pre-dividend, Early-dividend, Late-dividend and Post-dividend countries.

[5] Among HI countries, 68 per cent belonged to Post Dividend and 28 per cent to Late Dividend, whereas, in the case of UMI countries, 80 per cent belonged to Late Dividend. Among LMI countries, 71 per cent belonged to Early Dividend.

[6] This paper uses a single year classification of countries based on income (GNI) by World Bank for 2015. Re-classification of countries like India (low income to lower middle income), China (lower middle to upper middle income), Russia (upper middle to high income), etc. during the sample period (2000-2014) has not been considered.

[7] Data gaps for certain variables were filled using interpolation. Also for countries like Ireland, Japan, Korea, France and Italy, growth rate in exports of telecommunication, computer and information services (BOPS, IMF) was used to interpolate data for software services exports for missing years.

[8] The model included world demand defined as percentage share of Europe and US GDP in total world GDP. The coefficient estimated was insignificant and its removal for the model did not change the sign and magnitude of coefficients for other explanatory variables.

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