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Is Digitalization a Pull Factor for Foreign Direct Investment?

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Abstract: The boom in digitalization post-2010 gained further momentum post-covid-19. Against this background, the paper is trying to gauge whether the extent of digitalization of a country is a pull factor for Foreign Direct Investment (FDI). In the literature review, the paper identifies five channels: *productivity channel, startup channel, information channel, trade channel, and ease of scalability channel* through which digitalization may attract FDI to the host country. Using panel data techniques over a cross-section of 40 countries, we evaluate the effect of higher digitalization along with the longstanding traditional determinants of FDI in this paper. The paper finds that digitalization as proxied by smartphone penetration and individuals using internet as percentage of population have positive and significant effect on FDI inflows in dynamic panel specification. In this light, the paper has important policy implications for furthering digital penetration and building digital infrastructure to bring in a virtuous cycle of investment and productivity.

Keywords: Digitalization; Foreign direct investment; Dynamic panel
JEL classification: F21, L86, C23

Introduction

Foreign direct investment (FDI) has been proven empirically to have contributed to the growth story of nations world-wide. By plugging the domestic saving and investment gap, it has brought in the requisite technology and knowledge to innovate products and processes. Romer (1993) points out that important "idea gaps" between rich and poor countries can be eased by the transfer of technological and business know-how to poorer countries through FDI with further spill-over effects. Host country also benefits from the increased level of employment, improved productivity, and overall economic growth. Various pull and push factors like gross domestic product (GDP), interest rates, trade openness, exchange rate, and domestic policies and institutions shape the trends of foreign capital inflows (as discussed in literature review). In addition to the well-established traditional determinants of FDI inflows into a country, the role of fast evolving digital machinery cannot be shoved aside.

Digital Economy can be defined as the application of internet-based technologies to the production and trade of goods and services (Casella & Formenti, 2019; UNCTAD, 2017). Key advancements in data analytics, artificial intelligence (AI), blockchain, Internet of

Things (IoT), cloud computing and other Internet–based services are transforming product, process, and markets, prompting a production and consumption revolution (Oztemel & Gursev, 2020).

Arguably the biggest economic impact comes from the digitalization of processes and supply chains across all sectors of the global economy (UNCTAD 2017 WIR; Xiong, et al., 2016). Transitioning to a digital economy can increase competitiveness across all sectors, building new opportunities for business, entrepreneurial activity, and for accessing overseas markets (Lee, et al., 2019).

Against this background, we are trying to understand whether digitalization is a key pull factor for attracting FDI in a country. Using suitable panel data techniques over a cross–section of 40 countries and period ranging from 2011–2019, we evaluate the effect of higher digitalization alongside the longstanding traditional determinants of FDI in this paper.

The structure of the paper is as follows. Section 2 presents literature review where the paper identifies various channels through which digitalization in a host country affects FDI in the country. It is followed by discussion on research design in section 3. Analysis and findings are reported in section 4, and section 5 concludes the paper.

1. Literature Review

Studies (Tiwari & Mutascu, 2011; Dattaray, Dutta & Mukhopadhayay, 2011) have suggested that main cross-country pull factors of FDI for the investing entity are market size, return on investment (RoI), level of technological adoption throughout the country, ease of doing business, certainty in the policy environment and socio-cultural familiarity.

GDP growth attracts FDI searching for access to larger markets. This causality need not be unidirectional as FDI through different channels can raise GDP growth of the host country (Tiwari & Mutascu, 2011). Higher growth signals Multinational Enterprises (MNEs) about better policies, human capital, and infrastructure. It boosts productivity by mechanisms of learning by doing and sparing resources for education, and research and development (R&D) (Dattaray, et al., 2011). Hence, the relation between FDI and GDP growth is most likely to be dynamic (Yetkiner & Burcu, 2008; Masron, 2017).

Generally, the focus is on average rate of return on standard investments for attracting FDI, the neoclassical framework suggests that differences in the marginal product of capital across countries explains the cross-border movement of capital (Lucas, 1990). We choose internal rate of return (IRR), provided by Penn World Table 10.0 as the measure of return on capital. It considers variance in composition of capital stock across countries, hence a good proxy for marginal product of capital. IRR on capital is chosen such that it sets the "pure profits" to zero (Inklaar & Woltjer , 2019).

In contrast to the neoclassical framework (Solow, 1957), the endogenous growth models developed by Lucas (1988), Rebelo (1991) and Romer (1986) bring in human capital in the form of R&D. A bidirectional association between FDI and human capital is observed (Dutta, Kar, & Saha, 2017). Several channels for different types and qualities of human capital affecting FDI exist in the literature (Kottaridi, Louloudi, & Karkalakos , 2019; Ali, Cantner, & Roy, 2017). To control for different dimensions of human capital without losing degrees of freedom, we use human capital index scores given by Penn World Table 10.0 (University of Groningen, 2021). Further, FDI inflows and total factor productivity (TFP) of the host country are subject to endogeneity (Herzer, 2011). TFP of the sample countries is sourced from Penn World Table 10.0. Studies (Borensztein et al., 1998; Chang and Luh, 2000; Xiaming et al., 2001; Ng 2007) have pointed out that FDI leads to a rise in TFP through technological diffusion.

Other push and pull aspects like inflation, trade openness, exchange rate, external indebtedness play a crucial role in determining the trends of foreign capital flows. Trade openness can substitute FDI inflow or complement them (Fontagne, 1999). Trade openness attracts FDI inflows that are export oriented (Sahoo, 2012; Caril-Caccia & Pavlova, 2018). Literature highlights that investors prefer countries with higher regional trade integration (Aizenman & Noy, 2006). Trade and investment are recognised to have bidirectional association (OECD, 2002). Overall trade (exports plus imports) normalized by GDP can be proxied for trade openness (Altotaibi & Mishra, 2014). Under favourable FDI regime, exchange rate has a

positive and significant impact on the average FDI inflows (Alba, et al., 2010; Ali, et al., 2017). However, extant literature also presents contradicting empirical findings on how REER impacts FDI inflows. (Huong, et al., 2020).

More recently, political stability, regulations, and institutional variables have been studied as well (Masron, 2017; de Castro et al., 2013; Ghazal and Zulkhibri, 2015). We have used Foreign Direct Investment Regulatory Restrictiveness Index (FDI RRI) (OECD, 2022) and government integrity as a measure of corruption in the public institutions of the host country (Heritage Foundation, 2022).

In addition to the traditional pull factors, information and communication technology (ICT) adoption has been identified as a determinant of FDI. ICT adoption significantly enhances the absorptive capacity of a nation (Cuevas-Vargas, et al., 2022). ICT infrastructure and skills link local producers to international market networks, therefore, attracting FDI in services and manufacturing. Apart from customer support and data processing, high value-added activities such as design and product development and software sector also attract FDI. Moreover, foreign investors invest in countries that already have an ICT infrastructure. Consequently, poorer countries may find themselves in a 'low-ICT trap' (Addison & Heshmati, 2003).

While ICT sector is primarily associated with infrastructure that makes internet accessible to the relevant stakeholders, digitalization is characterized by the pivotal role of internet in key economic aspects (World Investment Report, 2017). The following are the channels through which digitalization affects economic activities and acts as a pull-factor for FDI.

Productivity channel - Digital technologies are built on ICTs. It is a long duration technology shock (Consolo, et al., 2021) which has accelerated throughout the globe post-2010. While it certainly enhances labour productivity (Eurofound, 2018), the trend of declining TFP (Consolo, et al., 2021) across the globe despite the acceleration in the digital technologies brings out the productivity puzzle. What may be postulated is that without digital innovation, the fall in TFP would have been even more glaring.

At the macro level, productivity gains may be hazy due to the slow adoption, diffusion and delays in full operationalisation at the aggregate level. Resource misallocation, inadequate economic institutions, shortages in relevant skills and infrastructure, higher minimum critical penetration for benefits to be realised[1], can be behind this (Liu, Mian, & Sufi , 2020; Zago, 2021).

Literature provides evidence that digitalization shock augments productivity at micro level (Gal, et al., 2019). It enhances productivity by increasing ease of knowledge sharing within the company and making productions processes more efficient (Anderton, et al., 2020). Thus, an increase in digital capabilities of a host country is expected to act as a significant pull factor for FDI.

Startup channel - Investment in digital technologies is characterised by a higher share of investment in intangible capital[2]. Countries, with budding tech startup ecosystem and growing e-commerce, can be found to fund their need for high initial investment[3] in new age tech startups through the FDI route (Bradley, Durufle, Hellman, & Wilson, 2019; FDI INDIA, 2020). Startups use social media to target their customers and investors. It secures funding in two ways (Banerji & Reimer, 2019; Gloor, Colladon, Grippa, Hadley, & Woerner, 2020; Bayar & Kesici, 2020). First, it reduces the search cost for the investors to identify potential investment opportunities. Second, it provides investors with additional information regarding the quality of the company or the project that they are investing in (Jin, et al., 2017) which reduces information asymmetries faced by foreign venture capitalists.

Information Channel - Digital technologies reduce the impediments for communication and boost access to market information beyond borders (Lee, et al., 2019). It is relatively easier for the investors to track the market developments in the host country on real time basis and respond effectively.

Trade channel - digitalization is likely to affect FDI inflows via boosting cross-border trade. However, we can expect forces in both, positive and negative, directions. Replacement of physical flow of goods by a

1 Digitalization is a "general-purpose" technology (GPT) characterized by large and pervasive impact. GPTs require a high enough stock of complementary, specialized physical, human, and managerial capital to be fully operational. Therefore they suffer from implementation lags (Anderton, et al., 2020).

2 It consists of data, software and R&D.

3 Foreign investors are seen to be gaining a major share in the investments to the startups with (Devigne, et al., 2018).]

flow of virtual goods might reduce the requirement of investments in country A by a manufacturer in country B to access country A's market. For example, creation of digital platforms that allow cross-border e-commerce might reduce the need for a manufacturer in country B to invest in physical distribution chains in country B. However, at the same time, it may boost investment in ICT infrastructure.

Ease of scalability channel – Firms with digitalized operations are easily scalable. Additionally, economic margins and financial margins go up owing to cost saving and increase in revenue. Thus, easy scalability of a digitally intense venture in a small time (Visconti, 2020), and online marketing may enhance the ability of foreign investors to reach out to a larger market at a lesser cost and at a faster pace. Such factors should encourage FDI in a country with greater digital adoption.

To sum up, extent of digitalization may be an important determinant of FDI inflows.

2. Research Design

2.1 Selection of countries and period of analysis

The panel dataset covers 40 countries over the period 2011-2019. Although the first shoots of information technology were first seen in 1990s, digital economy has proliferated significantly post-2010 (Satyanand, 2021). During the period 2010-2015, number of tech-related companies in UNCTAD ranking among the top 100 MNEs more than doubled. In the set of largest MNEs, tech companies were the most dynamic with respect to growth in assets, operating revenues, and employee count, higher than other MNEs in the segment (Contractor et al., 2020).

OECD's FDI RRI is available 2011 onwards. Data on smartphone penetration is miniscule before 2011 for many developing countries in the sample. Penn World Tables, version 10.0 as revised in June 2021 provide data on TFP and human capital till 2019. Thus, keeping in mind the availability of data relevant for our analysis, the sample period is chosen to be 2011-19.

Countries are chosen for which the data was consistently available during the selected period. Our sample consists of 26 high income countries, 11 upper middle-income countries, and 3 lower middle-income countries[4]. The list of countries is given in the appendix (**Table B**).

Variables indicating digital adoption - We looked at various indicator variables that might be taken as a proxy for extent of digitalization (S/N 9-19, **Table 1**) in the host country. Data for variable 17 was available for 26 countries from BIS (Bank for International Settlements) for a period of 2012-2020. Estimation was done for components of digital payments – large value digital payments (Value) as a per cent of GDP and retail digital payments (Value) as a per cent of GDP. Statista data on digital payments is available for 40 countries, however for a smaller duration of 2017-2021. Given a low number of observations for the sources on digital payments and e-commerce revenues, the summarized results are included as part of robustness checks.

Table 1 : Data Sources

S/N	Variables	Sources
1	Foreign Direct Investment Inflow	UNCTAD
2	Human Capital	Penn World Tables, 10.0
3	Internal Rate of Return	Penn World Tables, 10.0
4	Total Factor Productivity	Penn World Tables, 10.0
5	Real Effective Exchange rate	BIS
6	Gross Domestic Product	World Bank
7	Trade as percent of GDP	World Bank
8	Services trade as percent of GDP	World Bank
9	Smartphone Penetration	Statista
10	Fixed broadband per 100 persons	World Bank
11	Secure internet servers per 1 million persons	World Bank
12	Individuals Using internet per 100 persons	World Bank
13	Cellular Subscriptions per 100 persons	World Bank
14	FDI Regulatory Restrictiveness Index	OECD
15	Government Integrity	Heritage Foundation
16	Large Value digital payments value as % of GDP (for a set of 8 countries)	Red Book statistics, BIS
17	Retail Payments value as % of GDP (for a set of 18 countries)	Red Book statistics, BIS
18	Digital Payment Value of transactions (available for 2017–2021)	Statista

4 As per World Bank's classification. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

continued Table:

S/N	Variables	Sources
19	Ecommerce Revenues (available for 2017–2021)	Statista

2.2 Estimation strategy

We began with standard panel data estimation strategies to study the determinants of FDI. Owing to cross-sectional correlation in the dependent variables, cross-sectional correlation in the error terms across panels may make it incorrect to estimate standard Fixed Effect (FE) and Random effects (RE) model. Thus, we employ Generalized Least Squares (GLS) with correlated disturbances (STATA Corp, 2013). There is likely persistent tendency in the FDI inflows series, which might bring into endogeneity bias while estimating static models (Saini & Singhania, 2018). Arellano-Bond's GMM estimator addresses the problem of endogeneity (Arellano & Bond, 1991). Literature concerning its efficiency is well-established (Baltagi, 2008). We use robust standard errors[5], which are robust to certain types of misspecification (STATA Corp, 2013). It gives heteroskedastic-consistent estimate of variance-covariance matrix of estimator (Cameron & Trivedi, 2009). We also conduct Arellano-Bond test for serial correlation. While specifying the model GDP growth, Real Effective Exchange Rate, services trade as percent of GDP were taken to be endogenous variables. While in most cases, there is unidirectional causality from exchange rate to FDI, exchange rate is found to have bidirectional association with FDI in some countries (Lily, et al., 2014; Qamaruzzaman, et al., 2019). It was found in the literature that trade in services (Jithin & Babu, 2022; Dash & P, 2013 ;Wong, et al., 2009) varies endogenously with FDI.

Panel Unit Root

We employ second-generation panel unit root test to account for cross-sectional dependence (Pesaran (2004) CD test[6]) in the series while testing for the presence of unit root test (Pesaran (2007) CIPS[7] test). If the cross-sectional independence assumption was satisfied, first-generation unit root test - Brietung (2000)[8] was conducted to ascertain the same. Appropriate transformation of the variable was done with either log transformation or first differencing. The summarized results are given in the appendix(**Table C**).

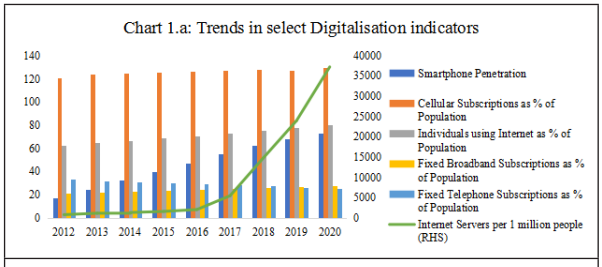
Robustness

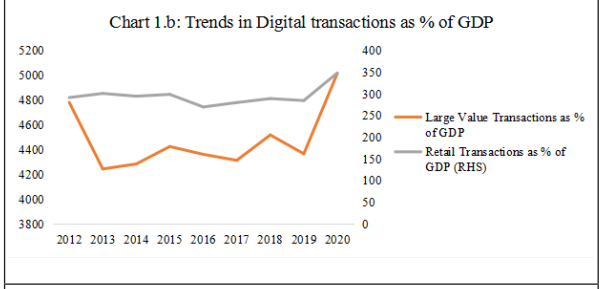
We performed analysis using several additional specifications employing different indicators of FDI along with other measures of digitalization (for which the data available was limited). We used the natural log of stock of FDI[9] and FDI sans Mergers & Acquisitions (M&As) which is the most volatile component of FDI as a dependent variable. We also used variable 16-19 (**Table 1**) as other proxies for digitalization to establish robustness of our results for analysis till 2021 (appendix **Table A – Table 4**) .

3. Results and Discussion

3.1 Preliminary data analysis

Digital adoption as indicated by the chosen variables is clearly on rise during the sample period (**Chart 1.a**). Smartphone penetration has risen substantially during the sample period to reach average of 73 percent in 2020. Post-2015 number of secure servers per 1 million people have shown a significant improvement.





Sources: World Bank (1.a); BIS (1.b)
Note: **Chart 1.a and 1.b** give averages of indicators for a set of 40 countries and 18 countries respectively.

Correlation analysis between the digital indicator variables and FDI inflows shows a positive and significant correlation of FDI inflows with smartphone penetration, fixed broadband per 100 persons, large value, and retail digital transactions as a percent of GDP, log of digital payments, and log of ecommerce

5 provided by vce (robust) in STATA

6 STATA's xtcd command implements this, (Das, 2019).

7 xtcips command in STATA implements this (Sangiacomo, 2018).

8 STATA's xtunitroot brietung implements this test (STATA Corp, 2013).

9 Stock of FDI is the direct investment entry in the liabilities side in the International Investment Position published by IMF.

revenues (see **Table 2**). Correlation amongst the digital indicator variables is positive and significant as expected. Correlation between cellular subscriptions and fixed broadband is negative.

Table 2. Correlation Analysis between FDI Inflow and Digital Indicator Variables

Digitalization Indicator variables	Pairwise correlation with FDI Inflows
(1) FDI Inflow	1.000
(2) Smartphone Penetration	0.157***
(3) Fixed broadband per 100 persons	0.503***
(4) Secure internet servers per 1 million persons	0.079
(5) Individuals Using internet per 100 persons	0.049
(6) Cellular Subscriptions per 100 persons	−0.002
(7) Large Value digital payments value as % of GDP (for a set of 18 countries based on BIS data)	0.282***
(8) Retail Payments value as % of GDP (for a set of 18 countries based on BIS data)	0.209***
(9) Log of Digital Payment Value of transactions (for the period 2017−2021 based on STATISTA data)	0.538***
(10) Log of Ecommerce Revenues (for the period 2017−2021 based on STATISTA data)	0.535***
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$	

Table 3. Correlation Analysis between TFP and Digital Indicator Variables

	(1)	(2)	(3)	(4)	(5)	(6)
(1) Total Factor Productivity (Constant Prices)	1.000					
(2) Total Factor Productivity (Current Prices)	0.090*	1.000				
(3) Smartphone Penetration	0.174***	0.297***	1.000			
(4) Cellular Subscriptions per 100 persons	0.076	−0.079	0.180***	1.000		
(5) Individuals Using internet per 100 persons	0.157***	0.681***	0.636***	0.150***	1.000	
(6) Secure internet servers per 1 million persons	0.119**	0.249***	0.471***	0.023	0.343***	1.000
(7) Fixed broadband per 100 persons	0.043	0.649***	0.527***	0.024	0.857***	0.354***
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$						

As discussed in section 2, digitalization is likely to increase the productivity at the macro and micro level. Although a rigorous analysis must be done to establish the plausibility of the channel, a simple correlation analysis between total factor productivity and digital indicator variables reveals a positive association between the two (except for cellular subscriptions) (**Table 3**).

Trade in services as percent of GDP, which can be considered as a proxy for level of preparedness for digital transformation, is anticipated to have a positive relationship with the digital indicator variables. Correlation coefficients tabulated in **Table 4** stand testimony to this.

Table 4. Correlation Analysis between Trade in services and Digital Indicators

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) Services Trade as % of GDP	1.000					
(2) Smartphone Penetration	0.282***	1.000				
(3 Individuals Using internet per 100 persons	0.323***	0.633***	1.000			
(4) Cellular Subscriptions per 100 persons	0.207***	0.176***	0.132**	1.000		
(5) Secure internet servers per 1 million persons	0.312***	0.473***	0.340***	0.013	1.000	
(6) Fixed broadband per 100 persons	0.309***	0.529***	0.856***	−0.003	0.350***	1.000
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$						

3.2 Estimation results:

Static Panel Models

Panel Feasible Generalised Least Squares (FGLS) regression output is summarized in **Table 5.** Smartphone penetration and individuals using internet have expected and statistically significant signs. This suggests a positive association between digitalization and FDI in the sample countries. Besides this, appreciation in domestic currency also attracts FDI in the model with Smartphone penetration. This is consistent with the empirical literature for emerging markets (Huong, Nguyen, & Lien, 2020). IRR differential is positive and significant across models (except in model with Individuals using Internet as % of population), similarly FDI RRI and Government Integrity have expected signs and are significant across models (except in model with Individuals using Internet as % of population). A surprising result was that GDP growth and Trade as a share of GDP which proxies for the developmental potential and openness respectively, turn out to be insignificant while on the other hand, Human Capital, along expected lines is positive and significant across models except for the model with Smartphone penetration.

This lays down the foundation for the hypothesis and furthering the empirical analysis. However, due to presence of persistence effects in FDI Inflows, these results should be taken with a grain of salt.

Table 5. Feasible Generalised Least Squares Regression Results

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5
	Dependent Variable: FDI Inflow				
Human Capital	30,624	56,128***	54,063***	59,142***	53,735***
	(22,233)	(18,371)	(15,664)	(15,609)	(15,712)
Log REER	183,771**	47,273	123,693	128,236	130,235
	(74,853)	(38,617)	(86,954)	(91,439)	(86,467)
GDP Growth	538.6	169.1	362.1	320.0	418.6
	(438.3)	(390.5)	(499.8)	(488.0)	(483.0)
Δ (Trade as % of GDP)	457.3	194.4	185.7	226.7	201.2
	(286.2)	(329.6)	(282.3)	(280.6)	(279.4)
IRR Differential	283,583*	124,045	339,419**	352,900***	336,600**
	(158,156)	(164,176)	(136,716)	(133,871)	(138,891)
Δ (FDI RRI)	−324,878**	108,838*	−300,772*	−284,568*	−314,073**
	(139,496)	(60,424)	(157,657)	(154,642)	(155,582)
Government Integrity	321.7***	2.271	213.6**	198.2**	230.1***
	(84.16)	(87.82)	(86.89)	(79.81)	(82.86)
Δ(Total Factor Productivity)	−6,803	52,619	33,452	33,611	38,648
	(55,999)	(57,315)	(60,239)	(56,014)	(52,512)
Smartphone Penetration	32,169*				
	(19,541)				
Δ (Individuals using Internet as % of population)		1,830*			
		(1,002)			
Δ (Cellular Subscriptions per 100 persons)			129.4		
			(435.5)		
Δ (Fixed Broadband connections per 100 persons)				2,021	
				(4,245)	
Secure Internet Servers per 1 million					0.0307
					(0.146)
Constant	−862,414**	−288,559*	−640,717	−678,576	−670,587*
	(357,505)	(162,575)	(407,211)	(424,363)	(402,026)
Observations	312	312	312	312	312
Number of countries	39	39	39	39	39

Standard errors in parentheses

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

Dynamic Panel models

Smartphone penetration and individuals using internet as percentage of population have positive and significant effect on FDI inflows. It empirically verifies the paper's contention of application of internet-based technologies in economic activities as pull factor for FDI inflows as seen in model 1 and 2. FDI inflows in the past period influences FDI inflows in the current period significantly as expected. It confirms the persistence effects in FDI, validating our dynamic specification of the model. A negative coefficient on the second lag needs further exploration, however oscillating pattern observed in the trends of FDI might explain it. An increase in relative IRR significantly increases FDI inflow across all the five models. Trade in services as percent of GDP and its lag is seen to have a positive relation with FDI inflows. It is significant across the 5 models, indicating importance of services sector in bringing in more FDI. Human capital has positive sign across the models; however, it is significant only in Model 4. Coefficient on TFP is positive as expected, though insignificant. Lack of absorptive capacity of a host country can be a key reason for absence of any statistical relationship between FDI inflows and TFP (Abdullah & Chowdhury, 2020). FDI RRI has expected association with FDI. The coefficients, however, are statistically insignificant. We reject the null hypothesis that all the coefficients except the constant are zero for each model using the Wald statistic, thus ruling out any kind of misspecification. The results hold for all the models discussed in the robustness checks section. summarized results are given in the appendix(**Table A**).

Table 6. Arellano−Bond dynamic panel−data estimation (One−Step Results)

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5
	Dependent Variable: FDI Inflows				
FDI Inflow (t−1)	0.208	0.237	0.246	0.235	0.246
	(0.160)	(0.145)	(0.162)	(0.161)	(0.167)
FDI Inflow (t−2)	−0.235**	−0.199**	−0.201*	−0.190**	−0.198**
	(0.104)	(0.0858)	(0.103)	(0.0878)	(0.0947)
REER	4,567	4,207	4,780	4,566	4,283
	(3,014)	(3,009)	(3,350)	(3,241)	(3,258)
REER (t−1)	−1,488	−2,088	−2,505	−2,317	−2,144
	(2,552)	(2,458)	(2,706)	(2,523)	(2,603)
GDP Growth	−1,087	−1,050	−1,159	−1,089	−1,062
	(828.9)	(822.4)	(890.0)	(857.2)	(858.5)
GDP Growth (t−1)	−815.5**	−553.5	−528.1	−467.4	−532.5*
	(405.8)	(351.4)	(354.0)	(346.1)	(318.3)
Δ (Services trade as % of GDP)	6,221***	6,307***	6,273***	6,172***	6,120***
	(1,695)	(1,740)	(1,799)	(1,728)	(1,662)
Δ (Services trade as % of GDP) (t−1)	6,219***	5,833***	5,860***	5,545***	5,634***
	(2,273)	(2,034)	(2,203)	(1,988)	(2,041)
Human Capital	13,064	45,672	46,872	64,406*	45,399
	(19,249)	(27,974)	(32,109)	(38,225)	(32,639)
Δ (FDI RRI)	−13,714	−11,431	−15,870	−13,456	−14,097
	(21,365)	(22,214)	(23,531)	(22,412)	(21,746)
IRR Differential	1.867e+06***	1.872e+06***	1.919e+06***	1.915e+06***	1.915e+06***
	(487,190)	(484,000)	(478,559)	(483,041)	(477,159)
Government Integrity	−32.18	−7.722	−29.19	−23.51	−15.97
	(86.20)	(81.49)	(82.22)	(82.95)	(79.41)
Δ(Total Factor Productivity)	134,120	184,967	157,457	146,110	148,845
	(152,008)	(158,841)	(161,708)	(159,751)	(160,614)

continued Table:

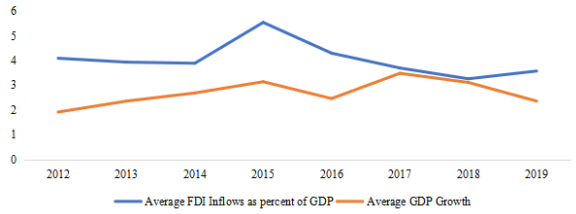
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5
Smartphone Penetration	38,755*				
	(19,899)				
Δ (Individuals using internet per 100 people)		2,000*			
		(1,023)			
Δ (Cellular Subscriptions per 100 persons)			−303.8		
			(340.0)		
Internet Servers per 1 million				−0.123	
				(0.0946)	
Δ (Fixed Broadband connections per 100 persons)					1,345
					(2,905)
Constant	−345,286*	−346,208*	−359,393*	−412,162*	−344,434
	(190,607)	(201,207)	(215,682)	(242,405)	(217,460)
Number of Observations	240	240	240	240	240
Number of Countries	40	40	40	40	40

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

FDI and GDP Growth Conundrum

A negative significant relationship between growth and FDI as presented in the results (**Table 4 and 5**), stands in contrast with the empirical literature as highlighted in the literature review. As can be seen in **Chart 3**, a contradictory relationship has been seen to be brewing up between FDI and GDP growth. Between 2012-14, FDI inflows to GDP ratio was falling along with a simultaneous increase in GDP growth. Both the variables moved in sync for a brief period in 2015 and 2016. World Investment Reports ascribes this to failure of FDI to translate into creating productive capacities.

Chart 3: Average FDI Inflows as a % of GDP and Average GDP Growth



Source: Authors' Calculations

Slowing growth and a sharp fall in commodity prices dominated the global macroeconomic scenario post-2015. The main explanation for this mismatch between FDI and the macroeconomic situation was an immense increase in M&As. M&As are the most dynamic components of FDI inflows. It is evident from its very high share in value terms (55% of aggregate FDI flows) but a miniscule share (1%) in the number of aggregate FDI projects, as seen in 2016 (Caril-Caccia & Pavlova, 2018).

Although M&As have been identified to intensify productive capacities, the major deals were regarding corporate reconfiguration in 2015. Such a reconfiguration led to large movements on Balance of Payments basis, yet a meagre change in terms of actual operation.

In 2017, FDI flows fell by 14 per cent which again was in stark contrast to the accelerated growth in GDP and trade during the year. The decrease was in part caused by a decrease in the value of cross-border M&As but even accounting for that, the 2017 decline remained very high. This decline was mainly attributed to large scale repatriations of accrued foreign earnings by the US multinational enterprises in the early quarters of 2018 due to changes in tax policies at the end of 2017 (UNCTAD, WIR, 2018).

4. Conclusion and Policy Implications

The paper establishes importance of smartphone and internet penetration in attracting FDI inflows. Smartphone penetration have been associated with e-commerce adoption and expansion of sharing economy via digital platforms (Thanji & Vasantha, 2016; Henama, 2021), thereby, confirming the validity of *startup channel* affecting FDI.

It is found that the social media users access it through their smartphones (Petrov, 2022; Dixon, 2019).

Also, around 93% of internet users across the globe, as of January 2022, are social media users (Chaffey, 2022). Given this, the paper also gives indirect credence to the potential of digitalization in dealing with information asymmetries beyond borders.

Positive association between TFP and digital smartphone and internet penetration (**Table 2**) when looked together with the results of the model in **Table 3** validate the *productivity channel*. COVID-19 pandemic adversely affected FDI Inflows (Hayakawa, et al., 2022), during 2020 and 2021. Appropriate calibration of investment promotion policies and digitization strategies should be exploited for a favourable effect on economy and employment post-pandemic. Public-private partnerships aimed at exploiting increasing returns to scale possible due to digitalization should be leveraged. Regulatory framework regarding the digital environment raises concerns related to privacy and cyber security. Thus, digital-friendly investment climate should be put in place at a faster pace with data protection and security in mind. Developed countries being ahead in digital adoption vis-à-vis the developing countries might push the former in a virtuous cycle of increased FDI and deepen their digital integration while keeping the latter in a 'low-digitalization trap' as highlighted by Addison and Heshmati (2002). The developing countries must take a two-pronged approach, focusing both on the supply and demand side for attracting FDI in the digital economy. On the supply side, policy makers need to create digital friendly investment climate and on the demand side they must take care of digital investment needs and priorities of firms and how these can be facilitated; in other words, the "demand" for digital investment opportunities (WEF, 2020).

With rising digitalization of economic activities, relationship between digitalization and FDI is expected to be strengthened. Role of provision of digital public goods is immense in digital transformation of economic activities. Thus, initiatives like India Stack, Open Network for Digital Commerce, National Health Stack, Account Aggregator Ecosystem are in the right direction. In the future, it is necessary to explore the impact of digitalization on other components of capital flows, as it is relevant from the perspective of macro-financial stability. Further analysis emphasizing each channel may also be explored.

Disclaimer

The views expressed in this article are those of the authors and do not represent the views of the Reserve Bank of India (RBI).

References

[1] Abdullah, M. & Chowdhury, M., 2020. Foreign Direct Investment and Total Factor Productivity: Any Nexus?. *Margin: The Journal of Applied Economic Research.*

[2] Addison, T. & Heshmati, A., 2003. *The new global determinants of FDI flows to developing countries: The Importance of ICT and Democratization.* s.l.:s.n.

[3] Adedoyin, F. F., Bekun, F. V., Driha, O. & Balsalobre‐Lorentee, D., 2020. The effects of air transportation, energy, ICT and FDI on economic growth in the industry 4.0 era: Evidence from the United States. *Technological Forecasting & Social Change*.

[4] Aizenman, J. & Noy, I., 2006. FDI and trade—Two‐way linkages?. *The Quarterly Review of Economics and Finance.*

[5] Alba, J., Wang, P. & Donghyun , P., 2010. THE IMPACT OF EXCHANGE RATE ON FDI AND THE INTERDEPENDENCE OF FDI OVER TIME. *The Singapore Economic Review.*

[6] Ali, M., Cantner, U. & Roy, I., 2017. Knowledge Spillovers Through FDI and Trade: The Moderating Role of Quality‐Adjusted Human Capital. In: *Foundations of Economic Change*. s.l.:Springer.

[7] Ali, Y. S., Ibrahim, M. I. & Omar, Z. M., 2017. Impact of Change in Exchange Rate on Foreign Direct Investment: Evidence from Somalia. *Journal of Economics and Sustainable Development.*

[8] Altotaibi, A. & Mishra, A., 2014. Determinants of International Financial Integration of GCC Markets. In: *Emerging Markets and the Global Economy*. s.l.:s.n.

[9] Anderton, R. et al., 2020. Virtually everywhere? digitalization and the euro area and EU economies. *ECB Occassional Paper Series.*

[10] Arellano, M. & Bond, S., 1991. Some Tests of specification for panel data: Monte Carlo Evidence and an Application to Employment Equations. *Review of Economic Studies*, Volume 58.

[11] Baltagi, B., 2008. *Econometric Analysis of Panel*

Data. New York: Wiley.

[12] Banerji, D. & Reimer, T., 2019. Startup Founders and their LinkedIn connections: Are well-connected entrepreneurs more successful?. *Computers in Human Behaviour*.

[13] Bayar, O. & Kesici, E., 2020. The Impact of Social Media on Venture Capital Financing: Evidence from Twitter Interactions.

[14] Bradley, W., Durufle, G., Hellman, T. & Wilson, K., 2019. Cross-Border Venture Capital Investments: What Is the Role of Public Policy?. *Journa of Risk and Financial Management.*

[15] Cameron, C. & Trivedi, P., 2009. *Microeconometrics using STATA*. s.l.:STATA Press.

[16] Caril-Caccia, F. & Pavlova, E., 2018. Foreign direct investment and its drivers: a global and EU perspective. *ECB Economic Bulletin,* Issue 4.

[17] Caruso, L., 2018. Digital innovation and the fourth industrial revolution: epochal social changes?. *AI & SOCIETY.*

[18] Casella, B. & Formenti, L., 2019. FDI in the digital economy: a shift to asset-light international footprints. *Transnational Corporations.*

[19] Chaffey, D., 2022. *Global social media statistics research summary 2022*. [Online] Available at: https://www.smartinsights.com/social-media-marketing/social-media-strategy/new-global-social-media-research/

[20] Chang, C. C., & Luh, Y. H. (1999). Efficiency change and growth in productivity: the Asian growth experience.[0]*Journal of asian Economics,*[0]10(4), 551-570.

[21] Choi, S., Furceri, D. & Chansik, Y., 2021. Policy Uncertainty and Foreign Direct Investment. *Review of International Economics.*

[22] Consolo, A. et al., 2021. digitalization: channels, impacts and implications for monetary policy in the euro area. *Occasional Paper Series 266, European Central Bank.*

[23] Contractor, F., Dangol, R., Nuruzzaman & Raghunath, S., 2020. How do country regulations and business environment impact foreign direct investment (FDI) inflows. *International Business Review.*

[24] Cuevas-Vargas, H., Aguirre, J. & Parga-Montaya, N., 2022. Impact of ICT adoption on absorptive capacity and open innovation for greater firm performance. The mediating role of ACAP. *Journal of Business Research,* Volume 140, pp. 11-24.

[25] Dash, R. K. & P, P., 2013. FDI, services trade and economic growth in India: empirical evidence on causal links. *Empirical Economics.*

[26] Das, P., 2019. *Econometrics in Theory and Practice.* s.l.:s.n.

[27] Dattaray, M., Dutt, A. & Mukhopadhayay, K., 2011. Foreign direct investment and economic growth in less developed countries: an empirical study of causality and mechanisms. *Applied Economics* .

[28] Devigne, D., Manigart, S., Vanacker , T. & Mulier, K., 2018. VENTURE CAPITAL INTERNATIONALIZATION:SYNTHESIS AND FUTURE RESEARCH DIRECTIONS. *Journal of Economic Surveys.*

[29] Dixon, S., 2019. *Social Media & User-Generated Content,* s.l.: s.n.

[30] Driffield, N., & Henry, M. (2007). Trade, FDI and technology diffusion in developing countries: the role of human capital and institutions.[0]*Preliminary Draft.*

[31] Dutta, N., Kar, S. & Saha, S., 2017. Human capital and FDI: How does corruption affect the relationship?. *Economic Analysis and Policy,*.

[32] Eberhardt, M., 2011. *XTCD: Stata module to investigate Variable/Residual Cross-Section Dependence.* [Online]
Available at: https://ideas.repec.org/c/boc/bocode/s457237.html

[33] Eurofound, 2018. *Automation, digitalization and platforms: Implications for work and employment,* Luxemborg: Publications Office of the European Union.

[34] FDI INDIA, 2020. *Foreign Investment in Indian Startups*. [Online] Available at: https://www.fdi.finance/blog/foreign-investment-in-indian-startups/

[35] Fontagne, L., 1999. Foreign Direct Investment and International Trade; Complements or Substitutes. *OECD Science, Technology and Industry Working Papers.*

[36] Freund, C. & Diana, W., 2002. The Internet and International Trade in Services. *American*

Economic Review.

[37] Froyen, R., 2013. *Macroeconomics.* s.l.:Pearson.

[38] Gal, P. et al., 2019. digitalization and productivity: In search of the holy Grail − Firm level empirical evidence from EU countries. *OECD Economics Department Working Papers No. 1533.*

[39] Gloor, P. A. et al., 2020. The impact of social media presence and board member composition on new venture success: Evidences from VC−backed U.S. startups. *Technological Forecasting and Social Change.*

[40] Gujarati, D. & Porter, D., 2009. *Basic Econometrics.* s.l.:s.n.

[41] Hayakawa, K., Lee, H.−H. & Park, C.−Y., 2022. The Effect of COVID−19 on Foreign Direct Investment. *ADB Economics Working Paper series.*

[42] Henama, U. S., 2021. *eCommerce Within the Tourism Industry in the Global South: The Case of the Sharing Economy in South Africa.* s.l., Springer.

[43] Heritage Foundation, 2022. *2022 Index of Economic Freedom.* [Online]

Available at: https://www.heritage.org/index/freedom−from−corruption

[44] Herzer, D., 2011. The Long−run Relationship between Outward Foreign Direct Investment and Total Factor Productivity: Evidence for Developing Countries. *Journal of Development Studies.*

[45] Huong, T. T. X., Nguyen, M.−L. T. & Lien, N. T. K., 2020. An empirical study of the real effective exchange rate and foreign direct. *Investment Management and Financial Innovations.*

[46] Inklaar, R. & Woltjer , P., 2019. *pwt documentation.* [Online] Available at: https://www.rug.nl/ggdc/docs/pwt91_whatsnew.pdf

[47] Jin, F., Wu, A. & Hitt, L., 2017. Social Is the New Financial: How Startup Social Media Activity Influences Funding Outcomes. *Proceedings.*

[48] Jin, W. & Zang, Q., 2013. Impact of change in exchange rate on foreign direct investment: evidence from China. *Lingnan Journal of Banking, Finance and Economics.*

[49] Jithin, P. & Babu, S., 2022. Testing for the Bidirectional Relationship Between FDI in Services and Trade in Services: Evidence from Emerging Economies. *Foreign Trade Review.*

[50] Khadaroo, J. & Seetanah, B., 2009. The Role of Transport Infrastructure in FDI: Evidence from Africa using GMM. *Journal of Transport Economics and Policy.*

[51] Kottaridi, C., Louloudi, K. & Karkalakos , S., 2019. Human capital, skills and competencies: Varying effects on inward FDI in the EU context. *International Business Review.*

[52] Lee, Y.−Y., Falahat, M. & Sia, B.−K., 2019. Impact of Digitalization on the Speed of Internationalization. *International Business Research.*

[53] Lily, J. et al., 2014. Exchange rate movement and Foreign Direct Investment in Asean Economies. *Economics Research Journal.*

[54] Liu, E., Mian, A. & Sufi , A., 2020. LOW INTEREST RATES, MARKET POWER, AND PRODUCTIVITY GROWTH. *NBER WORKING PAPER SERIES.*

[55] Lucas Jr, R. E. (1988). On the mechanics of economic development.^{0}*Journal of monetary economics,*^{0}*22*(1), 3−42.

[56] Masron, T., 2017. Relative Institutional Quality and FDI Inflows in ASEAN. *Journal of Economic Studies,* 44(1).

[57] Ng, T. H. (2007). Foreign direct investment and productivity: Evidence from Sub−Saharan Africa.^{0}*Unpublished paper (Vienna: UNIDO)*.

[58] Noorbaksh, F., Paloni, A. & Youssef, A., 2001. Human Capital and FDI Inflows to Developing Countries: New Empirical Evidence. *World Development.*

[59] OECD, 2002. *Foreign Direct Investment for Development,* s.l.: s.n.

[60] OECD, 2022. *OECD Foreign Direct Investment Regulatory Restrictiveness Index.* [Online]

Available at: https://goingdigital.oecd.org/indicator/74

[61]. Oztemel, E. & Gursev, S., 2020. Literature review of Industry 4.0 and related technologies. *Journal of Intelligent Manufacturing.*

[62]. Petrov, C., 2022. *51 Mobile vs. Desktop Usage Statistics For 2022.* [Online] Available at: https://

techjury.net/blog/mobile-vs-desktop-usage/#gref

[63] Qamaruzzaman, M., Karim, S. & WEI, J., 2019. Does Asymmetric Relation Exist between Exchange Rate and Foreign Direct Investment in Bangladesh? Evidence from Nonlinear ARDL Analysis. *The Journal of Asian Finance, Economics and Business*.

[64] Rebelo, S. (1991). Long-run policy analysis and long-run growth.[0]*Journal of political Economy,*[0]*99*(3), 500-521.

[65] Robert E. Lucas, J., 1990. Why doesn't capital flow from rich to poor countries?. *American Economic Review*, pp. 92-96.

[66] Romer, P. M. (1986). Increasing returns and long-run growth.[0]*Journal of political economy,*[0]*94*(5), 1002-1037.

[67] Romer, P., 1993. Idea Gaps and Object Gaps in Economic Development. *Journal of Monetary Economics.*

[68]. Sahoo, P., 2012. Determinants of FDI in South Asia: Role of Infrastructure, Trade Openness, and Reforms. *The Journal of World Investment & Trade.*

[69] Saini, N. & Singhania, M., 2018. Determinants of FDI in developed and developing countries: a quantitative analysis using GMM. *Journal of Economic Studies.*

[70] Salike, N., 2016. Role of human capital on regional distribution of FDI in China: New evidences. *China Economic Review.*

[71] Sangiacomo, M., 2018. *XTCIPS: Stata module to compute Pesaran Panel Unit Root Test in the Presence of Cross-section Dependence.* [Online] Available at: https://ideas.repec.org/c/boc/bocode/s457850.html

[72] Satyanand, P. N., 2021. Foreign Direct Investment and the Digital Economy. *ARTNeT on FDI Working Paper Series.*

[73] Solow, R. M., 1957. Technical Change and the Aggregate Production Function. *The Review of Economics and Statistics.*

[74] STATA Corp, 2013. *xtgls.* [Online] Available at: https://www.stata.com/manuals13/xtxtgls.pdf

[75] STATA Corp, 2013. *xtunitroot*. [Online] Available at: https://www.stata.com/manuals/xtxtunitroot.pdf

[76] STATA Corp, 2013. *xtxtabond.* [Online] Available at: https://www.stata.com/manuals/xtxtabond.pdf

[77] STATA, n.d. *xtabond postestimation.* [Online] Available at: https://www.stata.com/manuals/xtxtabondpostestimation.pdf#xtxtabondpostestimation

[78] Thanji, M. & Vasantha, S., 2016. ICT Factors Influencing Consumer Adoption of E-Commerce Offerings for Education. *Indian Journal of Science and Technology.*

[79] Tiwari, A. K. & Mutascu, M., 2011. Economic Growth and FDI in Asia: A Panel-Data Approach. *Economic Analysis and Policy.*

[80] Ulucak, R., Danish & Khan , S. U.-d., 2020. Does information and communication technology affect CO2 mitigation under the pathway of sustainable development during the mode of globalization?. *Sustainable Development..*

[81] University of Groningen, 2021. *PWT Documentation.* [Online]
Available at: https://www.rug.nl/ggdc/docs/human capital in pwt 90.pdf

[82] Visconti, R. M., 2020. Digital Scalability and Growth Options. In: *The Valuation of Digital Intangibles.* s.l.:s.n.

[83] Wijeweera, A., Villano, R. & Dollery, B., 2010. Economic Growth and FDI Inflows: A Stochastic Frontier Analysis. *Journal of Developing Areas.*

[84] Wong, K. N., Tang, T. C. & Fausten, D., 2009. Foreign Direct Investment and Services Trade: Evidence from Malaysia and Singapore. *Global Economic Review.*

[85] World Bank, n.d. *Mobile Cellular Subscriptions per 100 people,* s.l.: s.n.

[86] Xiong , W., Zhao , Z. & Fang, J., 2016. Influence of Internet plus to International Business Development. *American Journal of Industrial and Business Management.*

[87] Yetkiner, I. & Burcu, T., 2008. Endogenous determination of FDI growth and economic growth: the OECD case. *International Journal of Public Policy.*

[88] Zago, R., 2021. Job Polarization, Skill Mismatch and the Great Recession.

APPENDIX

Table A: Random Effects Model (Based on Statista data for period 2017–2021)

VARIABLES	Model with Digital Payments	Model with Ecommerce Revenues
	Dependent Variable: FDI Inflows	
Log of Digital payments value of transactions	2.957e+10***	
	(8.598e+09)	
Log of Ecommerce Revenues		2.773e+10***
		(8.734e+09)
Log of Real Effective Exchange Rate	1.110e+10	7.269e+09
	(8.294e+09)	(7.924e+09)
Trade as percent of GDP	1.838e+08**	1.258e+08
	(8.686e+07)	(1.679e+08)
GDP Growth	1.343e+09*	1.455e+09*
	(7.817e+08)	(8.437e+08)
COVID Dummy	−1.095e+10*	−1.117e+10
	(6.325e+09)	(6.807e+09)
Constant	−7.677e+10***	
(2.298e+10)	−5.009e+10**	
(2.251e+10)		
Observations	200	195
Number of Countries	40	39
Robust standard errors in parentheses		
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$		

Table B: Sample Countries

Countries in the Dynamic Panel Analysis	
Argentina	Israel
Australia	Italy
Austria	Japan
Belgium	Lithuania
Brazil	Malaysia
Canada	Netherlands
Chile	New Zealand
China	Norway
Colombia	Peru
Czech Republic	Philippines
Denmark	Poland
Finland	Portugal
France	Romania
Germany	Russian Federation
Greece	Singapore
Hong Kong SAR, China	South Africa
Hungary	Sweden
India	Thailand
Indonesia	United Kingdom
Ireland	United States

Table C: Summaries Panel Unit Root Test Results

Variables	Cross-Sectional Dependence	Stationarity
FDI Inflow	Yes	I(0)

续表：

Variables	Cross−Sectional Dependence	Stationarity
REER	Yes	I(0)
GDP Growth	Yes	I(0)
Trade in service/GDP	Yes	I(1)
Trade as percent of GDP	Yes	I(1)
Human Capital	Yes	I(0)
Smartphone Penetration	Yes	I(1)
Individuals using internet per 100 people	Yes	I(1)
Cellular Subscriptions per capita	No	I(1)
Fixed Broadband connections per capita	Yes	I(1)
Fixed Telephone connections per capita	Yes	I(1)
Internet Servers per 1 million people	Yes	I(1)
IRR Differential	Yes	I(0)