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How Service Inputs Influence Export Dynamics? Experience of Manufacturing Firms from Developing Countries

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How Service Inputs Influence Export Dynamics?
Experience of Manufacturing Firms from Developing Countries

Sonia Pant[(1)] , Debashis Chakraborty [(2)]

Abstract

A major section of the existing literature on export behaviour of firms does not consider services as a source of heterogeneity. However, over the last few decades the manufacturing sector has witnessed increasing use of services inputs, especially in case of exporting firms, across the development spectrum. This paper proposes a theoretical basis for this trend by adapting the existing literature to the services context. An empirical analysis involving developing country firms by using the World Bank Enterprise Survey (WBES) database confirms that exports from manufacturing firms are positively influenced by the use of services inputs, both at the intensive and extensive margins. The empirical results underline that services input use in manufacturing could be a source of heterogeneity in determining export behaviour of these firms. It is further noted that services such as transport & communication services, IT services, R&D services, legal and related services play an important role in determining the decision to enter the export market, while they do not play a significant role impacting the intensive margin. A key policy implication for developing countries is that efficiency enhancing reforms, covering the unshackling of services sector, will go a long way in promoting manufacturing competitiveness and export performance.

JEL Codes: F13, F14, F23, L80

Keywords: Manufacturing Productivity, Manufacturing exports, service inputs in manufacturing, embedded and embodied services, heterogenous firms, Trade in Value Added (TIVA) data, World Bank Enterprise Survey (WBES) data

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1. Introduction

It has been observed that around two-thirds of global economic activities are made up of services, while about half of the global workforce is engaged in services. In terms of value-added trade, services directly and indirectly contribute about 50 per cent of global trade (Ghani et al., 2012). Modern services such as Information and Communication Technology (ICT), logistics, banking and insurance, business services etc. that have evolved due to the 3Ts (i.e., growing tradability, technology and reduced transport costs) have increased national outputs, provided dynamic growth enabling benefits, and are essential components in merchandise goods production (Ghani et al., 2012). A major section of the existing literature examines the role of services as crucial inputs in the production process, including their function as producer services (Lanz & Maurer, 2015; Mercer-Blackman & Ablaza, 2019).

A major proportion of trade in the current context is conducted in intermediate products and services rather than in final categories, as these are crucial inputs in the production process across various industries. Miroudot et al. (2009) state that trade in intermediate products constitutes about 56 percent and 73 percent of trade in goods and services, respectively. The dominance of services in intermediate trade underlines the deepening usage of services as inputs by all sectors, especially, manufacturing (Shepherd, 2018). Growing utilization of services as intermediate inputs can be viewed from the perspective of splintering and disembodiment of services from goods. Bhagwati (1984) explained that with technological advancement and specialization, certain services such as transport, storage and communication, finance, etc., which were embodied in the value of a merchandise product, now splinter and be outsourced, in turn becoming a part of inter-firm transactions. The rising use of services is intertwined with the fourth industrial revolution (Industry 4.0), which is transforming the manner in which services are delivered, consumed, and used by different sectors, including manufacturing. Digitization of services across sectors such as finance, retail, business services, health, education, etc., is fastening the process of service input orientation withing the manufacturing segments

by leveraging technological advancements and capitalizing on growth opportunities in a services-driven economy (Matthess & Kunkel, 2020). Disembodiment of a service from another service or breaking down a service into discrete components or functionalities has important implications for comparative advantage (especially for developing countries), as it increases the tradability of services and makes it easier to get them embedded into goods (Bhagwati, 1984b; WTO, 2019).

Dependence of manufacturing on services in terms of buying services inputs, hiring services professionals and selling services output has been termed in the literature as servicification (Kommerskollegium, 2019). Servicification is a multidimensional phenomenon that is becoming increasingly apparent worldwide. In recent times it is being studied intensively due to the emergence of Global Value Chains (GVC) and geographically dispersed production models. The availability of microdata at the firm level, the International Input-Output database, and value-added trade data from the Organisation for Economic Co-operation and Development (OECD), i.e., the Trade in Value-Added (TIVA) data, has aided research in this area. These datasets provide a comprehensive view of how businesses operate within GVCs and how international trade affects economic performance.

World Bank (2018) suggests that technological advancements and globalization have transformed the global manufacturing sector, requiring a renewed focus on leveraging the synergies between manufacturing and services. In this context, there is a need to understand whether this trend of increasing usage of service inputs is a statistical illusion, merely a result of new way of capturing data (on value added basis); or is it because of increase in tradability and productivity that use of services enables. It is also important to analyze whether services play any role in enhancing productivity and exports of the end-user manufacturing sectors. Answers to these concerns have immense implications for policy formulation, especially for Low and Middle-Income Countries (LMIC), whose share in global manufacturing exports in on the rise (Bekkers et al., 2023).

Research in this branch of literature has focused on empirically ascertaining and verifying the growing use of services by manufacturing segments (Lanz & Maurer, 2015; Liu et al., 2020). On the other hand, only a few theoretical studies exist on servicification (Francois

& Hoekman, 2010). The existing empirical studies are majorly in the context of high-income countries (Mercer-Blackman & Ablaza, 2019). The underlying logic is that empirical modelling on servicification requires either input-output data sets or firm-level data sets, both of which are not developed at a very disaggregated level in many developing countries until recently. Firm-level cross-country studies are relatively scarce as comparable data sets across boundaries are difficult to access and compile. A couple of studies that has attempted to focus on this aspect use the World Bank's Enterprise Survey (WBES) dataset (World Bank, Undated). Most of the existing firm-level studies use panel data specifications and analyze issues such as the growing proportion of services input procurement in user firms, services being exported as a part of final product offering by manufacturing firms, the importance of foreign participation in the provision of services, etc. (Pant & Chakraborty, 2024). Some studies on servicification experience in LMICs also examine the relationship between policy reforms in the services sector and manufacturing and services productivity (Arnold et al., 2016; Hoekman & Shepherd, 2017).

Given this background, there is ample scope to analyse the influence of servicification on exports in a firm-level cross-country context. The current paper, which intends to explore this question, is structured as follows. First, a brief literature review is placed in Section 2. Section 3 states the theoretical framework. Section 4 presents the data and methodology used in the empirical analysis. Section 5 contains the results and inferences from the empirical analysis. Finally, on the basis of the results, certain policy conclusions are drawn in Section 6.

2. Literature Review

Structural transformation refers to reallocating economic activity and resources across different sectors of the economy, typically from agriculture to industry and then to services. However, today, services play a more crucial role in all levels of economic development than they did in the past. In the existing literature, this has been explained in terms of evolution of supply chains and stages of processing related relationship (i.e., the concept of value-added trade) and from the viewpoint of splintering and disembodiment of services from goods due to technical change, growth, and greater opportunities for realizing economies of scale.

Table 1: Services (not incl. construction) Value-Added component of Gross Exports

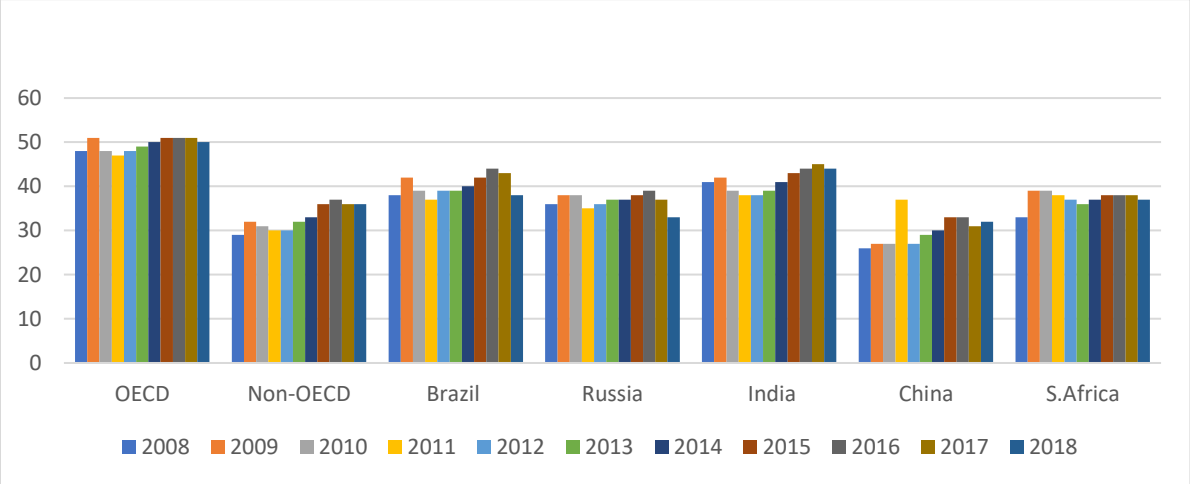
Services value added as a percentage of Gross Exports											
	2008	***2009***	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***
OECD	48	51	48	47	48	49	50	51	51	51	50
Non-OECD	29	32	31	30	30	32	33	36	37	36	36
Brazil	38	42	39	37	39	39	40	42	44	43	38
Russia	36	38	38	35	36	37	37	38	39	37	33
India	41	42	39	38	38	39	41	43	44	45	44
China	26	27	27	37	27	29	30	33	33	31	32
South Africa	33	39	39	38	37	36	37	38	38	38	37

Source: Authors computation based on OECD TIVA (undated)

There is a rich branch of trade literature that examines input-output relationships and value-added trade (Arnold et al., 2011; Lodefalk, 2013; Arnold et al., 2016; Crozet & Milet, 2017, Thangavelu et al., 2018). This literature looks at international manufacturing process through the prism of global supply chains. More recently, the emergence of the TIVA database has contributed to the understanding of the increasing use of services by manufacturing firms. Using this database, Lanz and Maurer (2015) point out that service value-added contributes to about 30-35 percent and 25 percent of the value of manufactured exports, in developed and developing countries, respectively. It can be observed from latest TIVA data that developing countries like Brazil and India hold a strong position amongst the emerging LMICs, as their service content of total exports is closer to

the corresponding figure for advanced OECD countries (Table 1 and Figure 1). The figures reported in the table underline the emergence of these economies as major users of service inputs.

Figure 1: Services Value-Added as a % of Gross Exports



Source: Authors computation based on OECD TIVA (undated)

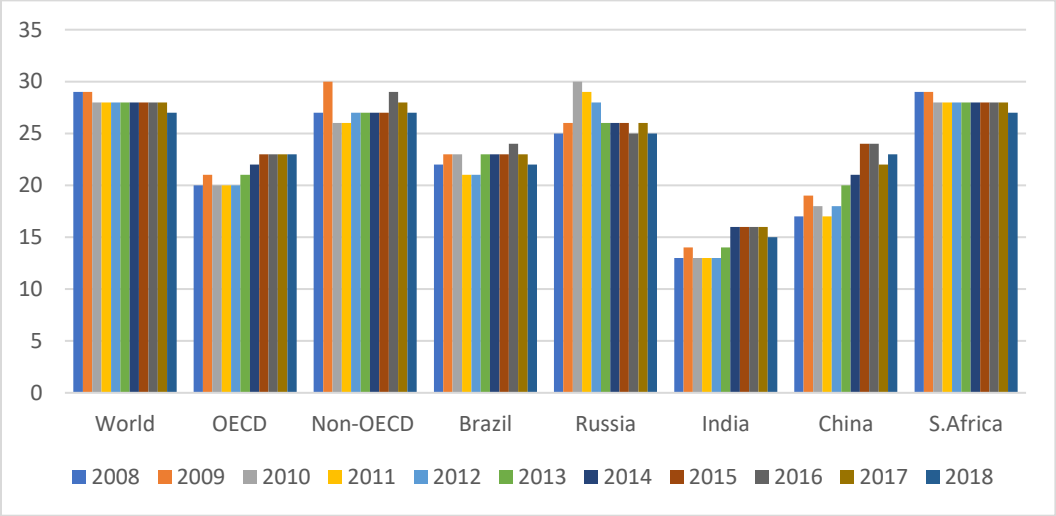
However, in contrast, emerging economies like China and Russia are characterized by a relatively lower share of service content in their manufacturing exports among the BRICS countries (Table 2 and Figure 2). The scenario prevailing in India is also below the corresponding OECD average. This underlines a limited assimilation of services in the merchandise exports of these countries and indicates a scope for increasing the services contribution to their manufacturing exports. A similar conclusion emerges for other similarly placed LMICs, after consulting the TIVA dataset. This contention has been corroborated by Chanda and Chakrabarty (2019), who point out that services sector in India show limited integration with manufacturing. In particular, IT-enabled service (ITeS) categories, which is the dominant form of service exports from India, has particularly weak interlinkages with manufacturing exports. The need for recognition of the importance of services in stimulating manufacturing exports is warranted (World Bank, 2018). Several other LMICs also remain in the same policy plane as India, suggesting a need for further reforms and deregulation therein.

Table 2: Services (not incl. construction) Value-Added component of Manufacturing Exports

Services value added as a percentage of Gross Exports											
	2008	***2009***	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***
OECD	29	29	28	28	28	28	28	28	28	28	27
Non-OECD	20	21	20	20	20	21	22	23	23	23	23
Brazil	27	30	26	26	27	27	27	27	29	28	27
Russia	22	23	23	21	21	23	23	23	24	23	22
India	25	26	30	29	28	26	26	26	25	26	25
China	13	14	13	13	13	14	16	16	16	16	15
South Africa	17	19	18	17	18	20	21	24	24	22	23

Source: Authors computation based on OECD TIVA (undated)

Figure 2: Services Value-Added as a % of Manufacturing Exports



Source: Authors computation based on OECD TIVA (undated)

In the established GVCs spread across countries, services function as a binding link integrating and coordinating the various stages of production and distribution, thereby enabling the smooth operation of complex production networks. Miroudot (2019) suggests that in the future, intermediate services will become seamlessly integrated into different production processes, making the traditional distinction between goods and services obsolete.

In terms of theoretical literature, the existing trade models on firm behaviour can provide a perspective on the possible reasons for increasing use of services, though this has not been explicitly studied. Models devoted to studying the export behaviour of firms mostly consider a single attribute, i.e., heterogeneously distributed amongst firms, as a determinant of success in the export market. For instance, models proposed by Bernard et al. (2003) and Melitz (2003), rely mainly on firms' heterogeneity in productivity. In both set of models, productivity and fixed exporting costs create a differentiation between exporting and non-exporting firms. This implies that, for a given fixed cost of exporting, firms with higher productivity are more inclined to engage in export activities. Likewise, for firms with the same level of productivity, a reduction in the fixed cost of exporting increases the likelihood of their participation in international markets.

Differences in product quality are significant for many markets, suggesting that 'quality sorting', 'productivity sorting' or a combination of the two could determine the presence as well as profitability in export markets. Ability to produce quality is seen as a determinant of heterogeneity in the works of Baldwin and Harrigan (2011), Johnson (2012), Verhoogen (2008) etc. Hallak and Sivadasan (2008) depart from this trend and consider a model in which firm heterogeneity originates from differences in productivity and calibre. However, the existing theoretical studies do not focus explicitly on services usage as a determining factor of productivity or exports. There could be scope to model services in this framework and study it as a source of firm heterogeneity, determining export performance.

In terms of empirical literature, the majority of it focusses on the OECD countries and examines indicators such as the services share (both domestic and imported) in total inputs; service exports by goods exporting firms; use of services and its impact on manufacturing productivity and exports to establish servicification etc. (Kelle & Kleinert, 2010; Arnold et al., 2011; Kelle, 2013; Lodefalk, 2013; Crozet & Milet, 2017; Berardino & Onesti, 2020). In one of the early studies, Francois and Woerz (2008) noted an increasing indirect contribution of services in merchandise exports for a panel of OECD countries over 1994-2004. They also find a positive association between services openness and increasing competitiveness of technology and skill-intensive industries. Lodefalk

(2013) analysed the Swedish input-output data and observed that proportion of services in total inputs doubled over the period 1975-2005. Using firm-level data, Lodefalk (2014) reported that firms producing higher proportion of in-house services display greater productivity and exports. Based on plant-level data, Kelle and Kleinert (2010, 2013) concluded that one-fourth of the German services exports were undertaken by manufacturing firms. Using firm-level data, Crozet and Milet (2017) observed that in France percentage of services as a proportion of sales of manufacturing significantly expanded during 1997-2001. Arnold et al. (2011) used firm-level data to connect the increase in manufacturing productivity in the Czech Republic between 1998-2003 to the rising foreign participation in the provision of services. The growing foreign participation and competition in the input market is considered conducive for greater efficiency. Berardino and Onesti (2020) considered the dynamic interplay between services and manufacturing for the major OECD economies and noted that the interaction between services and manufacturing is not a one-way process but a two-way process involving mutual benefits and contributions. This type of integration creates competitive advantages for the firms, leading to better value propositions and superior customer relations.

Using the WBES dataset, Hoekman and Shepherd (2017) focused on the LMICs and observed a strong positive association between: (1) services and manufacturing productivity; (2) manufacturing productivity and export performance; and (3) services trade policies and manufacturing exports. The effect of growing servicification becomes evident from the analysis. Also using the WBES dataset, Pant and Chakraborty (2024) studied the effect of services input usage on export volumes of existing exporters and exporting decision for new exports, in case of LMICs. The analysis observed a positive influence of services inputs on both intensive (i.e., export performance) and extensive margins (i.e., decision to export) of exports. It was apparent from the analysis that different types of services (e.g., ICT, transport & logistics, research & development, legal, finance and related services) are crucial in influencing the decision to enter the export market, while they have a less significant effect on already existing exporters.

Given this background, the current analysis contributes to the literature in the following manner. First, it proposes a simple theoretical framework explaining the increasing use of

services by manufacturing firms. It is held that the use of services could significantly influence export behaviour, leading to heterogeneity among firms in terms of their export participation. Hence, a framework based on the Melitz (2003) model that focus on 'quality' as a determinant of firm heterogeneity is adapted in the current context. Instead of 'quality', service is considered here as a determinant of firm heterogeneity. Accordingly, services are modelled as input (more specifically, services embodied in merchandise goods) and output (embedded services such as after sales services that are bundled together with goods) and its impact, if any, on firm-level exports has been examined.

The proposed model is then empirically tested to study whether services use as inputs has any discernible impact on exports of user firms, for a large set of LMICs using the WBES dataset. In line with the nature of WBES, a panel data specification with country, year, and sector fixed effects is used to address clustering in the data. The empirical analysis verifies the theoretical framework and finds that service inputs have a favourable effect on firm-level exports from the manufacturing sectors. The effect is studied separately for both new firm's decision to enter export markets (extensive margin) and performance of existing exporters (intensive margin).

3. Theoretical Framework

A rich section of research on export behavior of firms has argued that exporting firms are systematically distinct from non-exporters. In most cases they are bigger, more productive, more skill and capital-intensive, and pay higher wages than non-exporter units. Differences in productivity is seen as a main source of this heterogeneity. However, this literature does not consider services as a determinant of heterogeneity in firm behaviour, which can be manifested in the differing ability of firms to export or conduct international business successfully.

In this section a simple theoretical framework is introduced to understand the manner in which services can function as a determinant of a firms' export behaviour. The model is inspired from the heterogeneous firm models (Melitz, 2003; Bernard et al, 2003), wherein the source of heterogeneity is the difference in firm productivity levels. The motivation of the proposed framework is however based on the theoretical literature considering 'quality' as a source of firm heterogeneity. Quality as a determinant of firm export behavior has been developed by Baldwin and Harrigan (2011), Johnson (2012), Verhoogen (2008), Hallak and Sivadasan (2008), among others.

Services can have a role on both the consumer as well as the producer sides in determining the export behaviour, in addition to the standard determinants to derive an export supply function. Accordingly, the standard model is augmented to allow firms to embody services (such as R&D, logistics, marketing etc.) in their products subject to the cost of embodying these services. Firms use services as inputs as it improves the quality of their products, leading to product differentiation in the eyes of the consumer, and contribute to more efficient production, in turn lowering prices. Accordingly, firms characterized by higher productivity choose to procure more and more of higher quality services as inputs in their production process. In the standard model, prices are inversely related to productivity (through the marginal cost function) and higher productivity firms charge lower prices. In this model, as the use of services as inputs entails costs, this raises both the marginal cost and prices. The final effect of productivity on prices depends on the interplay between these two forces. On the consumer side, the presence of services in embedded form within

the product (after-sales services, customized usage of the product etc.) serves as a 'demand shifter', as the presence of quality service inputs yields higher utility per unit of good consumed.

It needs to be noted that transport / trade costs are not included in the simple model, as most of the services can be imported without an explicit 'border' hindrance (Findlay & Warren, 2000). Moreover, the model is also not extended to study how services determine the entry and exit decisions of firms, or the equilibrium in a closed and open economy framework. The purpose of the paper is to understand how services can be a source of heterogeneity in determining the export behaviour of a representative firm, with the aim to derive its export supply function. The proposed model, once developed, is empirically verified for a set of developing country firms.

Consumer Side

The consumer preference for variety is described by a Dixit-Stiglitz (1977) Constant Elasticity of Substitution (CES) utility function for all varieties i available in the sector j, which is as follows:

$$U_j = \left(\sum_{i \in S} \left(q_{ij} \delta_{ij}^{\gamma} \right)^{\sigma - 1/\sigma} \right)^{\sigma/(\sigma-1)}$$

Where,

q_{ij} quantity of consumption of i^{th} good in sector j.

δ_{ij}^{γ} δ represents the services embedded in the merchandise product, which give utility to the consumer (include after-sales services and other services that customize the good to the consumer's taste and preferences). δ can be seen as a measure of taste for diversity. γ is a parameter or an index representing the desire for embedded services in the good.

σ has the standard interpretation and represents the elasticity of substitution between different varieties and which is greater than 1 .

Consumers maximize their utility subject to a budget constraint: $\sum_i p_{ij} q_{ij} = E$, where E represents total expenditure on all varieties i.

Working through the consumer optimization problem in the Dixit-Stiglitz (1977) framework gives the quantity demanded of the i^{th} good in sector j as follows:

$$q_{ij} = \frac{E \left(\delta_{ij}^{\gamma}\right)^{\sigma-1} p_{ij}^{-\sigma}}{\sum_i \left(\delta_{ij}^{\gamma}\right)^{\sigma-1} p_{ij}^{-\sigma}}$$

Accordingly, the value of total exports (or export revenue)2 of the i^{th} good in sector j is given by:

$$X_{ij} = \left(\delta_{ij}^{\gamma}\right)^{\sigma-1} \left(\frac{p_{ij}}{P_j}\right)^{1-\sigma} E \quad (1)$$

Where,

P_j represents the CES price indicator represented as $\left(\sum_i \left(\frac{p_{ij}}{\delta_{ij}^{\gamma}}\right)^{1-\sigma}\right)^{1/(1-\sigma)}$

As the model is not considering trade costs, the total export function does not include the same.

Production Side

Assuming the standard monopolistic competition model, production function is defined in the following manner:

$$l_j = f + \beta q_j$$

Where,

l_j represents the unit cost function

f represents the fixed cost

[2] To generate the value of total demand for the i^{th} good in sector j, q_{ij} is multiplied with p_{ij} to obtain X_{ij}.

β represents marginal cost

Total Cost is hence given by:

$$C_j = w(f + \beta q_j)$$

Where $w\ represents$ wages.

Profits are therefore given by:

$$\pi_j = p_j\, q_j - w(f + \beta q_j)$$

Profit maximization leads to:

$$p_j = \left(\frac{\sigma}{\sigma - 1}\right)\beta$$

Where $w\ is\ normalised\ to\ 1$.

Thus, profit maximization by firms leads one to the standard result, wherein prices for each variety are a constant mark-up on marginal costs (β). Similar, to the standard model, marginal cost is a function of the firm's productivity (φ), but here in addition to the productivity measure, marginal cost can also be considered as a function of embodied services used in the production. It is understood that in a monopolistic competition model, prices are a constant mark-up over marginal costs, and this is a key feature of how firms set their prices. In the present model, therefore, the use of services will have not separate effect on prices unless it is explicitly modelled in the cost function. Accordingly, based on Johnson (2012) framework, it is assumed that marginal costs are increasing with use of services.3 The following functional form of the marginal cost function is therefore considered. Here δ also represents embodied services for expositional simplicity.

$$MC = \beta = \frac{w_i}{\varphi_i}\ \delta_i^{\lambda}$$

$Where\ \lambda\ is\ the\ elasticity\ of\ cost\ with\ respect\ to\ embodied\ services$.

[3] Services such as transport, storage, communication, finance, electricity etc. are embodied services and constitute a part of inter-firm transactions.

$$Thus, \qquad p_j = \left(\frac{\sigma}{\sigma - 1}\right)\frac{w_i}{\varphi_i}\delta_i^{\lambda}$$

Which yields the following result:

$$X_{ij} = \left(\frac{w_i}{\varphi_i}\right)\delta_i^{\eta} P_j^{\sigma-1}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} E \qquad (2)$$

$Where\ \eta = (\sigma - 1)(\gamma - \lambda).$

Here η represents the elasticity of firm-level exports with respect to services. Since $\sigma > 1$, a positive value of η implies that investment in services pays, since consumer's marginal valuation for services exceeds its marginal cost to producers. In other words, marginal valuation of services to consumers γ exceeds the marginal cost of services to producers λ and is an essential condition for investment in services to pay off. This is also required for ensuring that $\eta > 0$. This characterization of elasticity of firm-level exports with respect to services is similar to the framework developed by Crozet et al. (2012) in the context of quality.

4. Methodology and Data

The empirical model estimated in the paper for verifying the proposed hypotheses follows from equation (2) derived in the earlier section. Accordingly, exports in equation (3) are defined as a function of productivity of the firm(φ), services that are embedded and embodied in the product (δ), prices(P)4, total expenditure on all varieties (E) (firm size used as a suitable proxy), and other firm-level controls originating from the literature on firm export behaviour (e.g., capital intensity, foreign ownership etc.).

$$X_{ij} = f\left(\frac{Y}{L}, SI, Size\ of\ the\ firm, other firm\ level\ controls\right) \quad (3)$$

Where,

Y/L $represents\ Labour\ productivity$ $(or\ Total\ Factor\ Productivity)$

SI $represents\ Services\ inputs\ intensity$

A positive relationship is expected to emerge between the use of service inputs and exports in alignment with the literature that has been reviewed in the paper. This association can be intuitively understood to emerge from the following undercurrent. Firstly, use of service inputs directly enhances exports as service categories such as logistics improve the coordination between production and sales, use of services such as after sales services / customisation services enable firms to differentiate products by combining services with the merchandise and in certain cases services act as binding link between domestic firms and GVCs and so on. Secondly, as the productivity of service-producing firms improves, services are provided in a cost-efficient manner and this has a favourable spill-over benefit on the downstream user industries, including the manufacturing sector. As a result, the productivity of manufacturing firms is enhanced, which is well established in the literature that more productive firms generally export more (self-selection hypotheses) (Melitz, 2003). Arnold et al (2016) explored this productivity linkage in the context of India and

[4] Prices have not been included in the empirical form that has been tested since the focus is on whether use of services input can be a determinant of manufacturing exports, irrespective of prices.

the Czech Republic in two separate studies. More recently Hoekman and Shepherd (2017) also investigated this linkage in the context of developing countries using the WBES dataset. This interlinkage is however not explored in the present paper.

The current paper empirically estimates the influence of services input usage on export volumes and the decision to enter export markets for user manufacturing enterprises. The empirical analysis is conducted using the WBES database for about 120 developing countries over the period 2010 to 2019. The major characteristic of the WBES data is that some countries are surveyed over multiple years while observations on some others are included for only one year. In this kind of standardized dataset, it is very difficult to ascertain if a specific firm is included several times or not. WBES assigns anonymous identifiers in each survey to every individual firm. In that sense the WBES data cannot be characterized as a pure panel form. The empirical analysis controls for firm-level variables and country-year-sector fixed effects that can arise due to clustering of firms at sector and country level. The unobserved cluster effects arising due to the presence of firms in the same sector and country-year pairs, are expected to be correlated with the explanatory variables as these are all firm-specific variables. Thus, a fixed effect transformation is used to eliminate cluster-specific fixed effects. The different cluster sizes create no problem, since the analysis is demeaning within each cluster to eliminate fixed effects. The same process is repeated for all the clusters.

The WBES October 2020 Version contains information on several variables for about 160,000 firms. As the paper focuses on LMICs, firms incorporated in all high-income countries were excluded from the analysis. The analysis was conducted for 60,707 manufacturing firms. The International Standard Industrial Classification (ISIC) code-wise5 decomposition of the selected manufacturing sectors at the 2-digit level is noted in Annex 1. The variables used in the empirical estimation are constructed from the raw data obtained from the WBES dataset and are summarized in Annex 2. Figures 1 to 4 in Annex 3 present the scatter plots between: (1) exports and productivity, (2) exports and services use, (3) exports and capital intensity, and (4) exports and firm size, for the manufacturing

[5] Manufacturing Sector (based on ISIC 3.1) is composed of ISIC 15 to ISIC 37.

firms located in LMICs that are included in the sample. A positive association among all the aforementioned variables can be discerned from the scatter plots.

5. Estimation Results

5.1 Services and Export Behaviour

Based on the proposed model in equation (3), the following regression equation can be used for estimating firm-level manufacturing exports:

$$Exports_{fcst} = b + b_1(\frac{y}{l})_{fcst} + b_2(SI)_{fcst} + b_3 Size_{fcst} + b_4 firm\ level\ controls_{fcst} + fe_{cst} + e_{fcst} \quad (4)$$

Where f indicates firm, c indicates country, s indicates sector, t denotes the time dimension, fe is the country-sector-year fixed effects and e represents the error term. As indicated by the theoretical model, productivity (measured here as labour productivity6) of manufacturing firms, size (number of employees), and services input intensity (SII) are all expected to have a positive relation with firm-level exports. The firm-level controls considered in the current context include capital intensity and whether the firm has more than 50 per cent foreign ownership (an indicator of access to foreign technology and managerial know-how).

The critical variable under study in Equation (4) is the SII, measured as the proportion of service input costs to aggregate costs. One issue of concern with the WBES data set is that it does not report a detailed breakdown of services input costs, as explicit data is available only for communication and transport services. However, the data set includes qualitative information on some variables which can be used as indicators of services input usage, such as, computer and connectivity related services, financial services, R&D services, legal & related services etc. By making use of this data, dummy variables capturing various services used by manufacturing firms can be constructed. Access to email and website can be seen as a proxy for procurement of IT services (access to a service crucial

[6] The WBES data set does not permit the computation of total factor productivity and hence labour productivity, which is defined as total sales per employee, is used as a suitable proxy.

for firms to overcome informational barrier to enter the export market); access to foreign technical collaboration proxies for R & D related services; time spent on dealing with government rules and regulations by the top management reflects the regulatory environment in the country and proxies for legal and related services used by the firm; and access to foreign financial services is captured though a variable reflecting foreign ownership in the firm.

The results of a simple OLS regression with cluster robust standard error based on Equation (4) are presented in Table 5. Model (1) includes capital intensity as a dependent variable, while in Model (2) the variable has been dropped. This step has been undertaken for testing multicollinearity amongst the explanatory variables and it is noted that labour productivity and capital intensity are correlated. This correlation is intuitively expected as capital intensity plays a positive role in impacting the labour productivity of a firm. Use of total factor productivity instead of labour productivity could have addressed the issue, but the reported variables in WBES data set do not permit computation of total factor productivity. In the presence of multicollinearity, both labour productivity and capital intensity cannot be included as explanatory variables. To resolve the problem, capital intensity has been dropped in other model specifications. The coefficient of SII however is not affected due to the omission of capital intensity from the regression models.

It can be seen from the results of Model (2) that all variables including productivity, size, SII and firm level controls are significant, and bear expected signs. SII is significant at the 1 per cent level, indicating that one unit increase in services input intensity leads to a 0.5 per cent increase in exports. The results indicate that SII plays a positive and significant role in impacting the export behaviour of manufacturing firms. This result empirically supports the contention of the theoretical propositions.

Table 5: Use of Services and Export Behaviour of Manufacturing Firms (Intensive Margin)

Variables	(1)	(2)	(3)	(4)	(5)
Manufacturing productivity	0.967***	0.975***	0.981***	0.984***	0.982***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Services input intensity	0.004*	0.005***	0.005***	0.035*	
	(0.09)	(0.01)	(0.00)	(0.10)	
Size	1.031***	1.024***	1.036***	1.029***	1.029***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Foreign ownership	0.333***	0.307***		0.264***	0.282***
	(0.00)	(0.00)		(0.00)	(0.00)
Capital intensity	-0.007				
	(-0.92)				
Email				0.018	0.004
				(0.74)	(0.94)
Website				-0.092***	-0.088***
				(0.00)	(0.00)
Foreign technical collaboration				0.004	0.01
				(0.87)	(0.66)
Time spent on govt. regulations				0.001	0.001**
				(0.17)	(0.05)
Constant	3.603***	3.568***	3.472***	3.414***	3.414***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	8,117	15,582	15,582	10,799	11,403
R^2	0.876	0.891	0.889	0.892	0.894

Source: Author's estimation

Note:

1. OLS regression with robust standard error clustered by country-year-sector. Both models include country-year-sector fixed effects.
2. Figures in brackets represent p-values.
3. Significance is represented in the following manner: *** (1%), ** (5%) and * (10%) significance level.

In Models (4) and (5), the dummy variables capturing other services are introduced. Certain explanatory variables added to capture the other service categories turn out to be insignificant. Interestingly, the dummy variable capturing the presence of a website is negative and significant at a 1 percent level of significance. In Model (4), when services input intensity is included along with other service variables, the coefficient increases substantially (one unit increase in SII leading to a 3.5 percent increase in exports), while it is found to be significant at a 10 percent level. From this result, it seems that categories other than transport and communication services are not significant in determining export volumes of existing exporter firms in developing countries (intensive margin).

Some other variables that could have affected export performance, but have not been modelled due to data unavailability, include managerial ability, quality of labour, macroeconomic environment, regulatory and institutional setup etc. These variables, in turn, also affect labour productivity. Hence, all these excluded variables are captured in the error term which is likely to be correlated with labour productivity. These omitted variables could be a source of endogeneity in the model. In order to correct for the possible endogeneity and also to verify the empirical results obtained in the earlier model, an alternate empirical formulation is used. In the alternate approach labour productivity of manufacturing firms is instrumented by productivity of services firms located in the same region. But as a first step, the choice of instrument is ascertained, and using a simple OLS regression with cluster robust standard errors, it is verified that the productivity of manufacturing and services firms are positively related and that this relation is due to the use of services inputs by manufacturing firms7. Based on this result, labour productivity of manufacturing firms is instrumented by the average region-wise productivity of services firms, SII, and the interaction term between regional services productivity and services input intensity, similar to the approach followed by Hoekman and Shepherd (2017). As the number of instruments (three) is greater than the endogenous variable (one),

[7] The following model has been estimated for this exercise:

$$\log\left(\frac{y}{l}\right)^{mft}_{fcrst} = b + b_1 \log\left(\frac{y}{l}\right)^{svs}_{fcrst} + b_2(SI)_{fcst} + b_3 Interact_{fcrst} + b_4 firm\ level\ controls_{fcst} + fe_{cst} + e_{fcrst}$$

a Two Stage Least Squares (2SLS) or a two-step Generalised Method of Moment (GMM) estimator can be used for the for instrumental variable estimation. The following regression equation is used for this purpose:

$$\log(Exp)_{fcrst} = b + b_1 \log\left(\frac{y}{l}\right)_{fcsrt} + b_2 Size_{fsct} + b_3 firm\ level\ controls_{fcst} + fe_{cst} + e_{fcrst} \quad (5)$$

Table 6: Instrumental Variable Approach - Firm level Manufacturing Exports with Instrumented Manufacturing Productivity

Explanatory Variables	**Log (Mft. Exports) – Dependent Variable**
Log Mft Productivity	0.579***
	(0.000)
Log Total Employees	1.057***
	(0.000)
Log Capital Intensity	0.056**
	(0.03)
Foreign (Dummy)	0.46***
	(0.000)
Observations	7403
LM statistic:	*20.03*
Chi-sq.(3) P-val =	*0.0002*
Cragg-Donald Wald F statistic:	*16.891*
(Wald F statistic):	*8.30*
Stock-Yogo weak ID test critical values:	*13.91*
Hansen J statistic:	*2.833*
Chi-sq.(2) P-val =	*0.2379*
Endogeneity test of endogenous regressors:	*7.320*
Chi-sq(1) P-val =	*0.0068*

Source: Author's estimation

Note:

1. 2-Step GMM Estimation with robust standard error clustered by country-year-sector.
2. Log (labour productivity) is instrumented by log (services productivity), services input intensity and interaction term. Country-year-sector fixed effects have been included.
3. Figures in brackets represent p-values.
4. Significance is represented in the following manner: *** (1%), ** (5%) and * (10%) significance level.

A two-step panel GMM estimator is considered here to be more efficient than the 2SLS approach. Table 6 reports the results of the two-step panel GMM estimation using the user-written command xtivreg28 in Stata (Schaffer, 2010). As estimation of the standard 2SLS model also led to similar results, they have not been reported in the paper. Utilizing the various tests reported, it is observed that the model under consideration is identified as the null hypothesis of under-identification is rejected. Therefore, the null hypothesis that the instruments are weak is also rejected. As can be seen from Table 6, based on Hansen's J statistic[9], it is reconfirmed that valid instruments have been used in the model. The instruments are also found to be strongly correlated with the instrumented variable. The results also indicate that all the regressors, including the firm-level controls (i.e., foreign ownership and capital intensity) included in the model, are positive and statistically significant. Finally, firm-level labour productivity of manufacturing firms is found to be positive and significant at a 1 percent level of significance. The regression results empirically ascertain the proposition of the theoretical model, confirming that services input usage has a positive and significant impact at the intensive margin, i.e., on the actual export behaviour of manufacturing firms.

5.2 Services and Probability of Exporting

The influence of service input use on the probability of exporting of service end-user manufacturing firms is taken up next. In this case, a probability model (Linear Probability Model, Probit, and Logit) is used to analyze how SII impacts the probability of exporting. The basic model reported in Equation (6) is identical to Equation (4), wherein the actual export behaviour of manufacturing firms is studied. The only difference between the two

[8] xtivreg2 command in Stata executes IV/GMM estimation of fixed effects and first difference panel data models with the possibility of endogenous regressors. This command reports tests for both under identification as well as for weak identification. This is a user written command which allows GMM estimation of fixed effects.

[9] Stata also reports Sargan Hansen test for overidentifying restrictions. The null hypothesis in this test is a joint hypothesis that the instruments are valid.

models is that the value of exports has been replaced now with the probability of exporting.10 Thus, the revised model for estimation is as follows:

$$Prob.\ of\ exports_{fsct} = b + b_1\left(\frac{y}{l}\right)_{fsct} + b_2 SI_{fcst} + b_3 Size_{fcst} + b_4 firm\ level\ contrls_{fcst} + fe_{cst} + e_{fsct} \quad (6)$$

The results of the LPM and Logit model are presented in Table 7. The results of the Probit model are however not presented in the table, as they were found to be very similar to the LPM and Logit model specification results. Similar to the previous model, the regressions include country-sector-year fixed effects to control for omitted variables, which are specific to each sector in each country and are estimated with cluster robust standard errors.11

As done earlier while analyzing the intensive margin, in order to correct for multicollinearity, capital intensity is excluded as an explanatory variable in one of the formulations of the model. It is evident from the results that labour productivity of manufacturing firms, SII, size, and foreign ownership all have the expected positive sign and are also statistically significant in both the LPM (Model 1) and the Logit (Model 4) model specifications. In order to capture the effect of a change in the explanatory variables on the probability of exporting, the coefficient are converted to the log of odds-to-odds ratio12. Regarding the important variable of interest (SII), it is observed that for a unit increase in services input intensity, the odds of exporting versus not exporting increase by a factor of 1.008. From this, it appears that when the full sample of firms are considered,

[10] A dummy variable is constructed wherein firms that have positive exports are assigned value 1, while those that do not export are assigned the value 0.

[11] *xtlogit, fe* does not present itself with the *robust* option in Stata and therefore in case of logit models cluster robust standard errors are not estimated.

[12] Obtained by using logit model specification in Stata 16.

instead of using a subset of exporting firms, the impact of the use of services on the decision to export appears to be quite small. Nevertheless, the coefficient is positive and significant at a 1 percent level of significance, underlining the contextuality of servicification in today's context.

As a robustness check and to address the concern that only transport and communication services are explicitly included in SII, along similar lines with the intensive margin analysis, additional qualitative data from the WBES is utilized by constructing dummy variables capturing various services used by the manufacturing firms. The entire model is re-estimated using the additional dummy variables and controlling for fixed effects with cluster robust standard errors. The results are presented in Table 7. Similar to the previous models, it is observed that in the LPM (Models 1, 2 & 3), all explanatory variables, i.e., the constructed services dummy variables (IT services, R&D services, Legal and related services) and SII, positively contribute to the variability of the export dummy, as they are significant.

The Logit regression results (Models 4, 5 & 6) involving the export dummy on productivity, size, and services variables corroborates the results obtained from the LPM regression. All the explanatory variables are positive and statistically significant. Firm productivity and size have a positive effect on the probability of exporting, which is similar to the result obtained in the previous model (where export intensity was the dependent variable). While the importance of servicification on manufacturing exports is well established in the empirical literature (Kelle, 2013; Lodefalk, 2013; Crozet & Milet, 2017; Hoekman & Shepherd, 2017), the confirmation on the positive and significant role of the constructed dummy variables related to IT services, financial services, R&D services, legal and related services on the probability of exporting is of crucial policy importance (Pant and Chakraborty, 2024). Interpreting the coefficients of the logit model in terms of odds ratio, it is observed that for a unit increase in labour productivity, the odds of exporting versus not exporting increase by a factor of 1.20. Similarly, a unit increase in size increases the odds of exporting by1.81 times. Interestingly, odds of exporting by the foreign-owned firms are found to be 2.51 times that of non-foreign owned firms, which underlines the role of foreign technical collaborations and network connections in export decisions.

Table 7: Use of Services and Probability of Manufacturing Firms

(Extensive Margin)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Manufacturing productivity	0.028***	0.023***	0.024***	0.233***	0.199***	0.187***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Services input intensity	0.0009***		0.0007***	0.009***	0.007***	
	(0.00)		(0.00)	(0.01)	(0.00)	
Size	0.106***	0.089***	0.088***	0.730***	0.597***	0.595***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Foreign ownership	0.182***	0.171***	0.171***	0.991***	0.926***	0.920***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Email		0.014***	0.013***		0.722***	0.728***
		(0.00)	(0.00)		(0.00)	(0.00)
Website		0.092***	0.090***		0.703***	0.715***
		(0.00)	(0.00)		(0.00)	(0.00)
Foreign technical collaboration		0.044***	0.047***		0.252***	0.240***
		(0.00)	(0.00)		(0.00)	(0.00)
Time spent on govt. regulations		0.0004***	0.0004***		0.004***	0.004***
		(0.00)	(0.00)		(0.00)	(0.00)
Constant	-0.539***	-0.493***	-0.507***			
	(0.00)	(0.00)	(0.00)			
Observations	51,516	39,118	37,559	46,966	37,747	35,257
R^2	0.156	0.183	0.181			

Source: Author's estimation

Note:

1. LPM and Logit regressions have been estimated with country-year-sector fixed effects. Models (1), (2) & (3) show Linear Probability Model (LPM) results. Models (4), (5) & (6) show Logit Model results.
2. Robust standard error clustered by country-year-sector for LPM regression. Xtlogit command in Stata does not permit robust standard errors.
3. Figures in brackets represent p-values.
4. Significance is represented in the following manner: *** (1%), ** (5%) and * (10%) significance level.

Interestingly, odds of exporting by firms that have a website are 2.04 times that of firms that do not have a website, which emphasize the role of assessing IT services in export decisions. Similarly, the coefficients in other categorical variables also illustrate the role of SII in export facilitation. Clearly, it is evident that the use of different types of services has a positive and significant impact on the export decision (extensive margin) of manufacturing firms from developing countries.

It may be remembered that the dummy variables capturing IT services, financial services, R&D services, legal and related services did not exhibit a significant effect on the export behaviour (intensive margin) of firms (Table 5). This absence of relationship could be explained by the fact that the intensive margin analysis considers only the exporting firms, whereas in the extensive margin analysis, all firms, whether exporting or not, are considered. Services such as IT services, R&D services, availability of foreign finance, and legal and related services contribute significantly to reduce the market access barriers that are typically associated with entering new foreign markets, and hence, they emerge as significant in the extensive margin analysis. However, in the case of existing exporters, who have already overcome the initial costs of entering the foreign market by using these very services, these barriers conversely may not emerge as significant. This result aligns with the findings of Benz et al. (2020), which confirmed that trade barriers in the services sector affect smaller and less productive firms, as well as first-time exporters, more significantly than the corresponding influence on larger, more productive firms with prior experience of engagement in international business operations.

6. Summary and Conclusion

The literature explaining the increasing use of services inputs usage by manufacturing firms underlines several reasons for deepening of this trend. Some of the significant factors explaining servicification includes: (1) to enhance productivity for participating in GVCs and to differentiate products from competitors as access to better quality services increases the value of the produced commodity to potential consumers (e.g., adding maintenance and repair services to products enhances the value of the product); (2) to enter new markets and overcome market access barriers (e.g., procuring legal and related services helps firms to comply with stringent regulations prevailing in the export market); and (3) due to the increasing digitization of manufacturing (Arnold et al., 2011; Baldwin et al., 2015; Miroudot & Cadestin, 2017; Mercer-Blackman & Ablaza, 2019; Benz et al., 2020). While several studies have examined these aspects in the context of high-income countries, the evidence from the perspective of developing countries is relatively nascent. The current paper attempts to theoretically explain the phenomenon and then empirically estimates the same for manufacturing firms located in LMICs.

The proposed theoretical framework in the paper adapts the existing theoretical literature, relying mainly on firms' heterogeneity in productivity, and considers both embodied and embedded services as a source of heterogeneity. The resultant export supply function obtained is a function of services and other standard variables, such as productivity, capital intensity, size of the firm etc. India, a leading developing country, has so far witnessed an interesting transition in both manufacturing and services sector exports and their relationships with foreign direct investment (FDI) flows (Chakraborty et al., 2013; Chakraborty et al., 2017). The growth in the service sector creates opportunities for their augmented usage as inputs in manufacturing exports. The empirical analysis in the paper focuses on the effect of services input usage on actual export behaviour and probability of exporting in the Indian context, in line with the proposed theoretical framework. In both cases, a substantial impact of SII is witnessed, thereby verifying that services input usage can be a source of firm heterogeneity, manifesting in differing productivity levels and export performance. The analysis presented in the paper, therefore, lends credence to the hypothesis that increasingly manufacturing firms from the South are getting 'serviced'.

A few interesting policy implications emerge from the analysis. First, efficiency-enhancing reforms in services, especially in input or producer services, might have a strong potential for promoting manufacturing competitiveness and productivity. Services are often considered the binding link in GVCs. For instance, intermediate input related services like logistics and transportation services and supply chain management services can significantly facilitate the geographical dispersion of GVCs. Therefore, implementation of efficiency-enhancing reforms in services, along with calculated entry in trade agreements that capitalize on the comparative and competitive advantage of participating countries, can integrate developing countries more effectively with existing and emerging GVCs.

Second, in the current context, industry 4.0 is likely to further intensify the already emerging servicification trend, and consequently, reforms in services appear to be the norm rather than exception. While consulting on the course of future reforms for input services (or producer services), policymakers in developing countries must involve stakeholders from both the services and the manufacturing sectors. In other words, a consolidated view on the course of reforms must be adopted, as the post-reform business climate is likely to impact both the input-producing services segments and the end-user manufacturing sector firms with equal intensity.

Finally, while entering into multilateral, regional, or bilateral trade negotiations, it is essential to consider the services sector related reform commitments (both the usual and GATS-Plus ones) as efficiency and productivity-enhancing future input components for the domestic manufacturing sector. Any gap in the provision of producer service categories (i.e., shortfall between demand and supply) needs to be filled in by the corresponding imports, until they can be efficiently provided domestically. This new approach of looking at services reforms is particularly important for developing countries as they lie on the initial stages of their growth path.

The empirical results bear crucial implications for Indian service sectors as well. A number of studies have underlined the influence of SII on Indian manufacturing sector performance with help of CMIE data. Judging the influence of servicification on intensive and extensive margins, Pant and Chakraborty (forthcoming) confirmed the prevailing

positive relationship. The analysis also noted the positive influence of SII both for the low-tech and mid-to-hi-tech sectors separately at the disaggregated industry level. Employing two distinct formulations of servicification measure, namely, comprehensive and GVC-facilitating services, Pant and Chakraborty (2023) observed that both measures bear a strong influence on productivity in the Indian context, with the latter exerting a stronger impact. Goldar and Banga (2017) noted that while SII favourably impact export performance of Indian manufacturing firms, imported service usage is found to bear a higher impact on export intensity as compared to corresponding domestic service varieties. The existing literature also underlines the importance of service sector reforms on manufacturing performance. Using firm-level data, Arnold et al. (2016) confirmed that policy reforms in key producer services such as financial and telecommunication result in enhanced productivity of the end-user manufacturing sectors. Bas (2013) concluded that reforms in telecommunications, banking, energy, and transports services etc. in the mid-1990s led to a favourable outcome on merchandise goods exporting user manufacturing firms. Given the empirical evidence on potential growth repercussions of SII with respect to manufacturing productivity and exports, during future regional trade agreement negotiations India needs to consider the mode and category wise service trade reform question with an open mind, while cautiously managing any potential challenges and pitfalls.

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Annex

Annex 1: ISIC Code-wise listing of Manufacturing Firms in the Dataset

ISIC Code 3.1	Frequency	Percentage
15	12,862	21.19
16	250	0.41
17	4,124	6.79
18	6,448	10.62
19	1,473	2.43
20	1,732	2.85
21	937	1.54
22	2,320	3.82
23	176	0.29
24	4,447	7.33
25	3,850	6.34
26	4,707	7.75
27	1,765	2.91
28	4,991	8.22
29	3,487	5.74
30	33	0.05
31	1,817	2.99
32	287	0.47
33	356	0.59
34	1,265	2.08
35	208	0.34
36	3,009	4.96
37	163	0.27
Total	**60,707**	**100**

Source: Author's construction using the WBES Dataset (World Bank, undated)

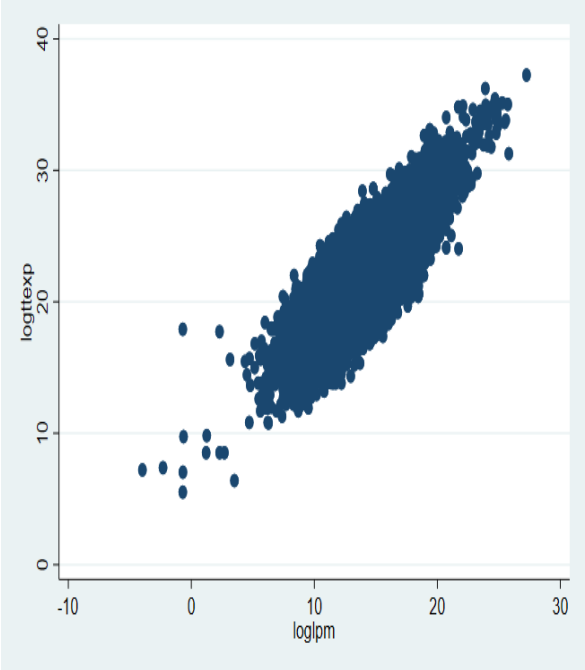
Annex 2: Construction of variables from WBES database

Variables used	***Explanation***
Exports	Log (Manufactured Exports) Manufactured Exports = Direct Exports + Indirect Exports (*d3b and d3c in WBES database*)
Export status	Dummy variable = 1 for firms which have positive exports *(d3c in WBES database)*
Manufacturing Productivity	Log (Manufacturing Productivity) Manufacturing Productivity = Total Sales / Total Employees (*d2, l1 and l6 in WBES database*)
Services Productivity	Log (Services Productivity) Services Productivity = Region wise average of (Total Sales / Total Employees) of services firms (*a2x, ISIC, d2, l1 and l6 in WBES database)*
Services Input Intensity (SI)	Services Input Intensity (SI) SI = Annual cost of services inputs (communication and transport) / Annual total input costs (*n2a to n2h in WBES database)*
Size	Log (Total Employees) Total Employees = permanent full time employees + full time temporary workers (*l1 and l6 in WBES database*)
Capital Intensity	Log (Capital Intensity) Capital Intensity = Capital expenditure (vehicles + land + machinery + building + equipment + IT) / Total employees *(l1, l6, n5a, n5b, and n5c in WBES database)*
Foreign Ownership	Dummy variable = 1 for firms which were more than 50% foreign owned *(b2b in WBES database)*
Interaction term	Services input Intensity * Regional Services Productivity
Email	Dummy variable = 1 for firms that use email *(c22a in WBES database)*
Website	Dummy variable = 1 for firms that use website *(c22b in WBES database)*
Foreign Technical Collaboration	Dummy variable = 1 for firms that have technical collaboration. *(e6 in WBES database)*
Time spent on Govt. regulations.	Percentage of senior management's time spent dealing with regulations. *(j2 in WBES database)*

Source: Author's construction using the WBES Dataset (World Bank, undated)

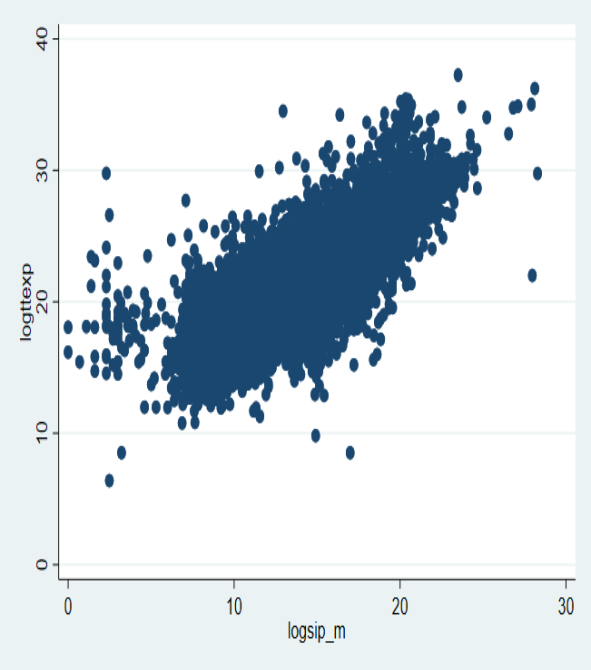
Annex 3: Firm level analysis for LMICs included in the sample

Fig 1: Scatter Plot Log(Exports) and Log (Productivity) in Manufacturing



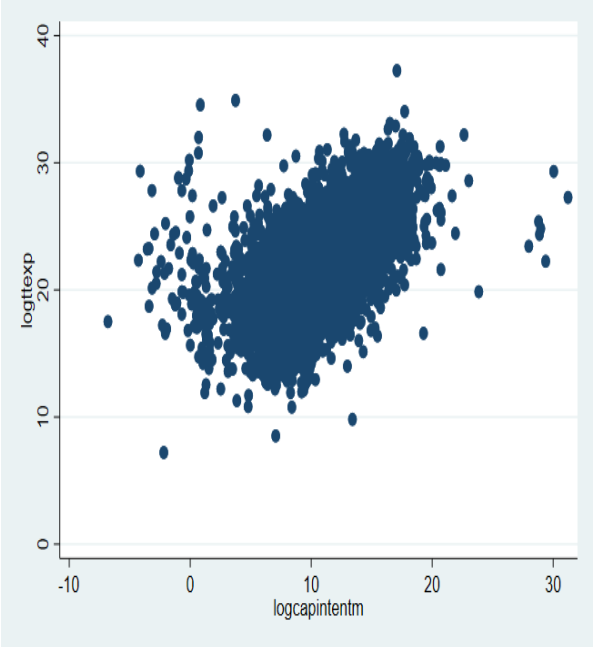
Source: Author's construction

Fig 2: Scatter Plot Log(Exports) and Log(Services Use) in Manufacturing



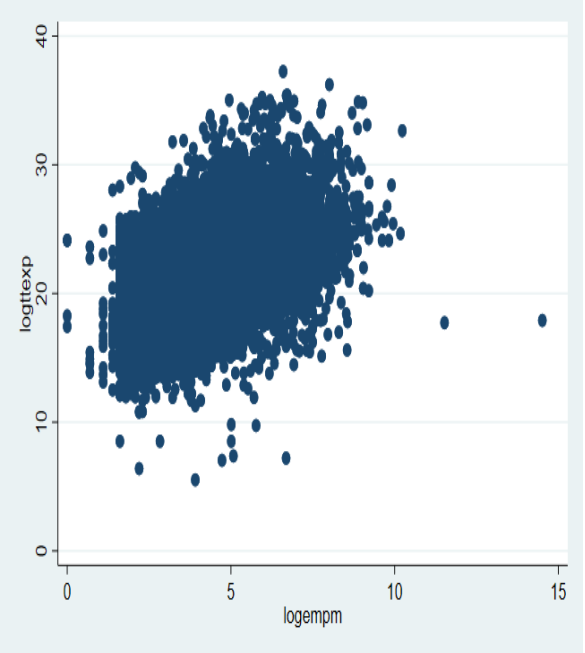
Source: Author's construction

Fig 3: Scatter Plot Log(Exports) and Log(Capital Intensity) in Manufacturing



Source: Author's construction

Fig 4: Scatter Plot Log(Exports) and Log(Size) in Manufacturing



Source: Author's construction

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