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Servicification and Manufacturing Performance: Plant-Level Evidence from Indonesia, 1985–2014

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Abstract

Services are increasingly embedded in manufacturing production and exports, but their role in developing-country manufacturing remains under-examined. This paper studies servicification in Indonesian manufacturing by combining OECD TiVA evidence on services embodied in manufacturing exports with plant-level data from Indonesia's *Survei Industri* for 1985–2014. The macro evidence shows that services account for a substantial share of manufacturing export value added, reinforcing the importance of producer services for manufacturing competitiveness. The plant-level analysis focuses on purchased industrial services, a narrow but observable measure of input servicification. Industrial-service use is limited but persistent: most plants report no such purchases, while user firms tend to be larger, more import-intensive, more foreign-owned, and more export-oriented. Fixed-effects regressions show that the continuous service-input share is positively associated with gross output per worker, while its relationship with value added per worker is weaker. The extensive margin is more robust: plants that purchase industrial services have higher subsequent labour productivity, especially in gross-output terms. Results for exporting firms are positive but less robust. The findings suggest that servicification is not only a macro value-chain phenomenon but also a plant-level feature associated with manufacturing performance.

Keywords: servicification; manufacturing; services; global value chains; Indonesia; productivity; exports.
JEL codes: F14; F61; L60; L80; O14.

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1 Introduction

Services have traditionally occupied an ambiguous position in development economics. Structural transformation is usually described as a movement from agriculture to manufacturing and eventually to services (Fisher 1935; Clark 1940; Chenery and Syrquin 1975). In this framework, manufacturing is often treated as the central engine of productivity growth, export expansion, and learning, while services are viewed either as the final stage of development or as a sector prone to Baumol-type productivity constraints (Baumol 1967).

More recently, the declining capacity of manufacturing to absorb large numbers of less-skilled workers and the difficulties faced by developing countries in replicating the export-oriented industrialisation of earlier East Asian economies have prompted growing interest in services-led development (e.g., Rodrik and Sandhu (2025)). Advances in digital technology have also increased the tradability of services, particularly intermediate services supplied across borders (Baldwin et al. 2024). These developments are sometimes interpreted as indicating that services can replace manufacturing as the principal engine of development. Yet such an interpretation may draw too sharp a distinction between manufacturing-led and services-led growth (Athukorala 2024). Modern manufacturing firms rely on logistics, finance, design, information and communication technology, marketing, engineering, testing, certification, repair, data, and business services. Services are not therefore merely final consumption activities or an alternative to manufacturing. They are increasingly intermediate inputs into manufacturing production and exports, making the boundary between manufacturing-led and services-led development progressively less distinct.

This paper examines the role of services in Indonesian manufacturing. Indonesia is an important case because its policy debate continues to emphasise manufacturing revitalisation, export diversification, and participation in global value chains (GVCs). Yet the ability of manufacturing firms to compete in modern production networks depends not only on tariffs, wages, and physical capital, but also on the quality, cost, and availability of upstream producer services. Recent trade-in-value-added evidence also suggests that the contribution of services to Indonesian exports is much larger when measured in value-added terms than when measured in gross trade terms. According to the OECD's recent assessment, services account for 28 percent of Indonesia's gross exports and 30 percent of gross imports, but generate 37 percent and 49 percent of the value added embedded in gross exports and imports, respectively (OECD 2024). This reinforces the need to analyse services as an integral part of the production system rather than as a separate tertiary sector.

The paper makes three contributions. First, it uses recent OECD TiVA data to place Indonesia's manufacturing servicification in a value-chain perspective. Following the literature on services value added in manufacturing exports, the macro evidence measures

the domestic and foreign services embodied in manufacturing gross exports. Second, the paper provides plant-level evidence using Indonesia's *Survei Industri* from 1985 to 2014. The plant-level data identify purchased industrial services, allowing the paper to compare the extensive margin of servicification—whether plants buy any industrial services—with a continuous measure of the share of industrial services in total intermediate-input use. Third, the paper relates plant-level service use to manufacturing performance, including labour productivity and export outcomes.

The main empirical results are as follows. Plant-level industrial-service use is limited and concentrated: the median plant reports no purchased industrial services, and positive use is observed only among a minority of plant-year observations. However, service use is persistent, suggesting that it reflects production organisation rather than transitory reporting noise. In plant fixed-effects regressions, the lagged share of industrial services in intermediate inputs is positively associated with output per worker, but its association with value added per worker becomes statistically weak once plant controls and sector-year shocks are included. By contrast, the extensive margin is robust: plants that purchase industrial services record higher subsequent labour productivity, especially in gross-output terms. Results for exporting firms are positive but less robust, with stronger evidence for export intensity than for exporter status.

The results should be interpreted as conditional associations rather than definitive causal estimates. Purchased industrial services are firm choices, and more productive firms may be more likely to reorganise production in service-intensive ways. The empirical strategy mitigates this concern by using lagged service-use variables, plant fixed effects, year effects, sector-year effects, and controls for size, skill intensity, imported-input use, and foreign ownership. Nevertheless, the results are best read as evidence that servicification is systematically associated with plant upgrading, not as proof of a structural causal effect.

The rest of the paper proceeds as follows. Section 2 reviews the literature and develops the conceptual framework. Section 3 presents macro evidence from OECD TiVA on services embodied in manufacturing exports. Section 4 describes the plant-level data and measurement of servicification. Section 5 presents the empirical strategy. Section 6 discusses the results. Section 7 discusses policy implications, and Section 8 concludes.

2 Literature and conceptual framework

The paper relates to three strands of literature. The first is the literature on structural transformation and the changing role of services in development. In the Fisher–Clark tradition, economic development is associated with a declining agricultural share, a rising industrial share, and eventually an expansion of services (Fisher 1935; Clark 1940; Fuchs 1968). Much of the development literature has focused on industrialisation because manufacturing has historically exhibited strong productivity growth, tradability,

scale economies, and learning potential (Chenery and Syrquin 1975; Rodrik 2016). Services, by contrast, were often viewed as less dynamic, partly because of concerns about Baumol's cost disease (Baumol 1967).

More recently, the declining capacity of manufacturing to absorb large numbers of less-skilled workers has prompted growing interest in alternative development paths. Rodrik and Sandhu (2025), for example, argue that long-run development increasingly requires productivity upgrading in labour-absorbing services. In the context of India, Rajan and Lamba (2023) similarly question whether the conventional path through low-skilled, export-oriented manufacturing remains feasible, given automation, intensified international competition, and rising protectionism. Their proposed strategy combines investment in human capital and the expansion of high-skilled services with innovative, higher-skill manufacturing. At the same time, digital technologies and falling cross-border trade costs have increased the tradability of services, particularly intermediate services (Baldwin et al. 2024). Recent quantitative work also shows that globalisation in tradable services can reshape comparative advantage and alter the pace and direction of structural transformation (Lee 2026).

These developments do not necessarily imply, however, that services-led growth can simply replace manufacturing-led development. As Athukorala (2024) emphasizes, manufacturing and services remain closely interconnected in production and international trade. The conventional distinction between the two development paths may therefore be too sharp. Services can expand as independent sources of employment and exports, but they can also contribute to development through their use within manufacturing production. Servicification is one manifestation of this complementarity: it allows service-sector capabilities to support manufacturing productivity, upgrading, and export performance.

The second strand studies the servicification of manufacturing. Servicification refers to the growing role of services in manufacturing production, either through services purchased from external providers, services produced in-house by manufacturing firms, or services bundled with manufactured products. Early firm-level studies documented this process in advanced economies, including Sweden, France, and Germany (Lodefalk 2014; Crozet and Milet 2017; Boddin and Henze 2014). Services may affect manufacturing performance through several channels. They can reduce transaction costs, improve coordination, enable access to foreign markets, support product differentiation, and facilitate participation in GVCs. Knowledge-intensive business services, ICT, finance, logistics, engineering, and design can be especially important because they complement physical production and help firms meet the organisational and quality requirements of export markets.

The third strand concerns value-added trade and GVCs. Gross trade statistics understate the role of services because much service activity is embodied in goods exports. Trade-in-value-added measures show that services contribute indirectly to exports through domestic and foreign intermediate linkages (Hummels et al. 2001; Johnson and

Noguera 2012; Koopman et al. 2014; Francois et al. 2015). The OECD TiVA database provides value-added trade indicators for 76 economies over 1995–2020 (OECD 2023). For Indonesia, recent OECD work highlights that distribution, transport, finance, telecommunications, and other producer services are important sources of value added embodied in manufacturing exports (OECD 2024).

The conceptual framework is straightforward. Let plant i in industry j and year t produce output using labour, capital, material inputs, and service inputs. Services can enter production directly as purchased intermediate inputs or indirectly through broader industry linkages. The plant-level measure available in this paper captures only purchased industrial services, so it is narrower than the full concept of producer services. Nevertheless, it is informative about the degree to which plants outsource or purchase industrial-service inputs as part of production.

Two margins are important. The extensive margin captures whether a plant purchases any industrial services, measured by an indicator equal to one when reported industrial-service expenditure is positive and zero otherwise. It therefore reflects the adoption of a service-using production arrangement, rather than the absolute amount of services purchased. The second measure captures the scale of industrial-service purchases relative to the plant's total intermediate-input expenditure. Because this service-input share is defined as zero for plants that report no industrial-service purchases, it incorporates both the decision to use industrial services and variation in purchase intensity among users. The empirical analysis therefore compares results obtained from the binary service-use indicator and the continuous service-input share.

3 Macro evidence from TiVA

The starting point is the role of services in manufacturing exports. Conventional gross trade statistics understate this role because many services are not exported directly as services; instead, they are embodied in exported goods through logistics, finance, communication, business services, design, engineering, and other producer-service inputs. This is the central insight of the value-added trade literature and the recent literature on manufacturing servicification. Thangavelu et al. (2018), for example, define servicification as the share of services value added embodied in manufacturing exports, and distinguish between domestic services value added and foreign services value added in manufacturing exports.

To capture this dimension, Figure 1 uses the OECD TiVA database to measure the services value-added content of manufacturing gross exports. The figure reports the sum of domestic and foreign services value added embodied in manufacturing exports:

$$\text{Total services VA share} = \texttt{EXGR\_SERV\_DVASH} + \texttt{EXGR\_SERV\_FVASH}.$$

Both indicators are taken for manufacturing. The resulting measure captures the total services content of manufacturing exports as a share of manufacturing gross exports.

A caveat is necessary. TiVA-based indicators are useful for placing Indonesia in comparative value-chain perspective, but they should not be interpreted as exact measures of value added embodied in exports. For countries where input–output data do not separately identify imported and domestic intermediate inputs, trade-in-value-added calculations commonly rely on a proportionality assumption: imported inputs are assumed to be used in the same proportion in production for exports and production for the domestic market. Patunru and Athukorala (2023) show, using non-competitive input–output tables for Indonesia, Thailand, Malaysia, Taiwan, and Australia, that this assumption can overestimate domestic value added in exports, with the bias becoming more important as export structures shift toward manufacturing and global production networks. For this reason, Figure 1 is used as descriptive macro motivation rather than as an object of formal estimation.

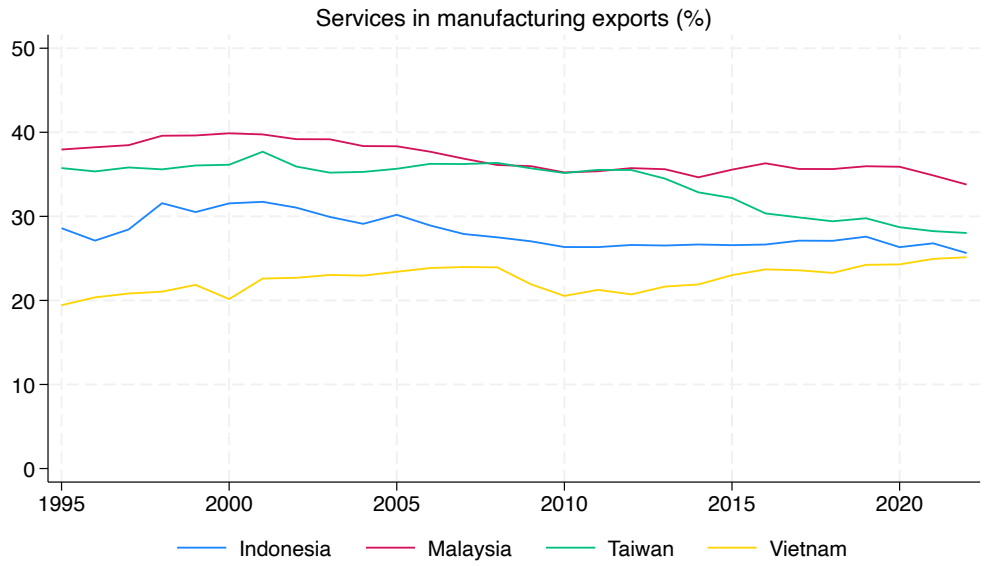

Figure 1: Services value-added content of manufacturing gross exports

Notes: Data from OECD TiVA (2023) database. The figure reports the sum of domestic and foreign services value added embodied in manufacturing gross exports. `EXGR_SERV_DVASH` is the domestic services value-added share of gross exports, and `EXGR_SERV_FVASH` is the foreign services value-added share of gross exports. Both indicators are taken for manufacturing. Values are expressed as percentages of manufacturing gross exports.

Figure 1 provides a value-chain measure of manufacturing servicification. It differs from the share of services in total exports or the gross exports of the services sector. Instead, it asks how much of the value embodied in manufacturing exports originates in services activities, whether supplied domestically or imported from abroad. This distinction is important for Indonesia because the policy debate on industrialisation often treats manufacturing and services as separate sectors, whereas modern manufacturing exports

rely increasingly on producer services.

The distinction between domestic and foreign services value added is also analytically useful. Domestic services value added reflects the contribution of national producer-service sectors to manufacturing exports. Foreign services value added captures services embodied in imported inputs used by manufacturing exporters, and is therefore related to service offshoring and participation in cross-border production networks. Thangavelu et al. (2018) show that RCEP economies tend to have lower domestic servicification but higher foreign servicification than OECD countries, indicating that Asian manufacturing exports often rely more heavily on foreign services embodied in GVCs.[1]

The updated TiVA evidence in Figure 1 is therefore used as macro motivation for the plant-level analysis. A higher total services value-added share indicates that manufacturing exports rely more heavily on services inputs and services-related value creation. Conversely, a lower or stagnant services value-added share may indicate weaker integration between manufacturing and producer services, or a manufacturing export structure that remains concentrated in lower-service-content activities.

This macro evidence does not identify which manufacturing firms use services, nor whether service use is associated with better firm performance. For that purpose, the paper turns to plant-level data from Indonesia's *Survei Industri*. The plant-level analysis examines whether manufacturing establishments that purchase industrial services differ systematically from those that do not, and whether service use is associated with productivity and export performance.

4 Plant-level data and measurement

The plant-level analysis uses Indonesia's annual manufacturing survey, *Survei Industri*, covering manufacturing establishments with at least 20 workers. The working dataset is an unbalanced panel of plant-year observations from 1985 to 2014. The panel contains plant identifiers, year, location, ownership structure, labour, output, value added, intermediate inputs, domestic and imported inputs, export share, and industry classification. The baseline industry classification uses KBLI (*Klasifikasi Baku Lapangan Industri*—Standard Classification of Industrial Sectors) codes, while ISIC (International Standard Industrial Classification) codes are retained only for descriptive comparison and robustness. KBLI and ISIC are not mechanically mixed.

The key service variable is industrial services, denoted as `iisvcu`. It is an expense item and is interpreted as purchased industrial services. This variable captures a narrow dimension of servicification. It does not include the full range of producer services that may matter for manufacturing, such as finance, logistics, telecommunications, professional services, or business services if these are reported under separate accounting categories. This limitation is important. The plant-level estimates should therefore be

[1] An earlier descriptive input–output analysis for Indonesia is provided in Patunru (2018).

read as evidence on purchased industrial services, not on the full universe of producer services.

The analysis uses three plant-level measures. The preferred continuous measure of service-input use is:

$$S_{it}^{I} = \frac{iisvcu_{it}}{iinput_{it}}, \tag{1}$$

where $iisvcu_{it}$ is purchased industrial services and $iinput_{it}$ is total intermediate inputs. In the regressions, S_{it}^{I} is expressed in percentage points and winsorised at the 99th percentile to reduce the influence of extreme ratios.

The extensive-margin measure is:

$$D_{it}^{S} = \mathbf{1}(iisvcu_{it} > 0). \tag{2}$$

A secondary continuous measure scales industrial-service purchases by gross output:

$$S_{it}^{O} = \frac{iisvcu_{it}}{output_{it}}. \tag{3}$$

The output-scaled measure is used only for robustness because the input-scaled measure is conceptually closer to servicification as a change in the composition of intermediate inputs.

The main outcomes are labour productivity, measured as log value added per worker and log output per worker, and export performance, measured using exporter status and export share. Controls include lagged employment, non-production-worker share, imported-input share, and foreign ownership share.

Tables 1–5 and Figure 2 summarise the plant-level service-use patterns. Table 1 reports sample coverage by year and shows the availability of the industrial-services variable. The service variable is observed for most years but is unavailable for 2001–2004; the service-input share is also unavailable before 1990 because the relevant intermediate-input denominator is not consistently observed. These coverage patterns are important for interpreting the regression sample.

Table 1: Sample coverage and industrial-service variables by year

Year	Plant-year obs.	Non-missing `iisvcu`	Non-missing service-input share	Service users (%)
1985	12,651	12,651	0	14.16
1986	11,462	11,462	0	14.26
1987	11,136	11,136	0	14.65
1988	14,262	14,262	0	14.82
1989	14,214	14,214	0	15.88
1990	15,777	15,777	15,739	16.52
1991	15,760	15,758	15,726	16.98
1992	16,819	16,819	16,785	17.68
1993	17,263	17,263	17,229	16.27
1994	18,010	18,010	17,974	14.83
1995	20,403	20,403	20,369	14.64
1996	21,699	21,564	21,526	15.04
1997	21,011	21,011	20,974	15.38
1998	20,003	20,003	19,968	14.70
1999	20,445	20,445	20,403	14.77
2000	20,363	20,363	20,341	14.95
2001	20,356	0	0	
2002	19,525	0	0	
2003	18,715	0	0	
2004	18,971	0	0	
2005	19,774	19,774	19,732	11.27
2006	28,201	28,201	28,190	15.00
2007	26,833	26,833	26,816	20.71
2008	24,581	24,581	24,575	17.66
2009	23,374	23,374	23,350	16.62
2010	22,312	22,312	22,297	17.22
2011	22,321	22,321	22,297	16.88
2012	22,542	22,542	22,517	22.52
2013	20,488	20,488	20,467	17.25
2014	20,262	20,262	20,259	16.71

Notes: Plant-year observations refer to manufacturing establishments in the *Survei Industri*. `iisvcu` denotes reported purchases of industrial services. The service-input share is defined as industrial services divided by intermediate inputs, `iisvcu/iinput`, and is observed only when intermediate inputs are positive and industrial-service purchases are non-missing. Service users are plants with positive reported industrial-service purchases. Industrial-service data are unavailable for 2001–2004.

Table 2 summarises the distribution of industrial-service use by period. The main pattern is zero inflation: the median intermediate-input service share is zero in all periods for which the share is observed. At the same time, the upper tail is non-trivial. The 95th and 99th percentiles show that a small subset of plants uses industrial services much more intensively than the average plant.

Table 2: Distribution of industrial-service use by period

Period	N	Users (%)	Mean int. (%)	Mean out. (%)	p50 int. (%)	p90 int. (%)	p95 int. (%)	p99 int. (%)
1985–1989	63,725	14.80	–	–	–	–	–	–
1990–1997	146,724	15.82	0.81	0.47	0.00	0.72	4.41	18.83
1998–2000	60,811	14.81	0.66	0.36	0.00	0.64	3.02	15.12
2005–2008	99,389	16.46	0.75	0.42	0.00	0.69	3.61	16.03
2009–2014	131,299	17.89	0.85	0.43	0.00	0.94	4.03	18.38

Notes: Users are plants with positive reported industrial-service purchases. Mean int. is industrial services divided by intermediate inputs, `iisvcu/iinput`. Mean out. is industrial services divided by gross output, `iisvcu/output`. The percentile columns report the distribution of the intermediate-input service share. All shares are expressed in percent. Industrial-service share variables are unavailable for 1985–1989 and 2001–2004.

Table 3 shows that service use also varies substantially across industries. The share of plants purchasing industrial services is especially high in several 2-digit KBLI industries, while other industries report little or no service use at the 90th percentile. This heterogeneity motivates the use of industry-year fixed effects in the empirical analysis.

Table 3: Industrial-service use by 2-digit KBLI industry

KBLI2	N	Users (%)	Mean int. (%)	Mean out. (%)	Median int. (%)	p90 int. (%)
31	115,532	8.52	0.14	0.08	0.00	0.00
32	97,867	20.88	1.36	0.79	0.00	2.41
33	54,767	18.10	0.74	0.42	0.00	1.35
34	18,092	22.53	1.48	0.81	0.00	2.11
35	49,645	11.94	0.28	0.15	0.00	0.10
36	35,256	19.59	1.25	0.66	0.00	5.69
37	3,025	16.30	0.65	0.36	0.00	0.50
38	42,262	18.47	1.11	0.57	0.00	1.10
39	8,528	14.87	0.83	0.42	0.00	0.74
96	18	52.94	1.57	0.92	2.41	3.19

Notes: Users are plants with positive reported industrial-service purchases. Mean int. is industrial services divided by intermediate inputs, `iisvcu/iinput`. Mean out. is industrial services divided by gross output, `iisvcu/output`. The percentile column reports the 90th percentile of the intermediate-input service share. All shares are expressed in percent. The small number of observations in KBLI2 code 96 should be interpreted cautiously.

Table 4 compares service users and non-users. Plants that purchase industrial services are larger on average and have higher export shares, foreign ownership shares, and imported-input shares. These differences suggest that service use is associated with more internationally connected plants, although service users do not have a higher non-production-worker share in the raw comparison.

Table 4: Plant characteristics by industrial-service use

Service-use status	Employment	Output	Value added	Export share (%)	Foreign share (%)	Skill share	Imported input share	N
Non-users	174.86	51.89	18.19	11.93	5.75	0.149	0.087	420,355
Users	222.72	57.71	20.21	15.79	6.90	0.141	0.118	81,474

Notes: Users are plants with positive reported industrial-service purchases. Non-users are plants with non-missing industrial-service purchases equal to zero. Output and value added are reported in million rupiah. Export share is the percentage of output exported. Foreign share is the percentage of capital owned by foreigners. Skill share is non-production workers divided by paid production and non-production workers. Imported input share is imported inputs divided by the sum of domestic and imported inputs. The table excludes 77,704 observations with missing industrial-service-use status.

Table 5 examines the persistence of service use. Persistence is high: 72.12 percent of plants that used industrial services in the previous year also use them in the current year, compared with only 5.21 percent among previous non-users. This persistence suggests that industrial-service use reflects a relatively stable feature of production organisation rather than purely transitory reporting noise.

Table 5: Transition matrix for industrial-service use

	Current service-use status	
Lagged service-use status	Non-user	User
Non-user	333,711	18,344
	(94.79)	(5.21)
User	18,937	48,977
	(27.88)	(72.12)

Notes: The table reports transitions in industrial-service use between consecutive plant-year observations. Counts are reported in the first row for each lagged status; percentages conditional on lagged status are reported in parentheses. A user is a plant with positive reported industrial-service purchases. The results show strong persistence: 72.12 percent of plants that used industrial services in the previous year also use them in the current year, compared with 5.21 percent among previous non-users.

Figure 2 visualises the industry pattern reported in Table 3. It reinforces the point that plant-level servicification is concentrated in particular industries rather than evenly distributed across manufacturing.

Taken together, the descriptive evidence shows three patterns. First, industrial-service use is limited: most plant-year observations report no industrial-service purchases. Second, service use is persistent, which suggests that it reflects production organisation rather than transitory reporting variation. Third, service users differ systematically from non-users: they tend to be larger, more import-intensive, more foreign-owned, and

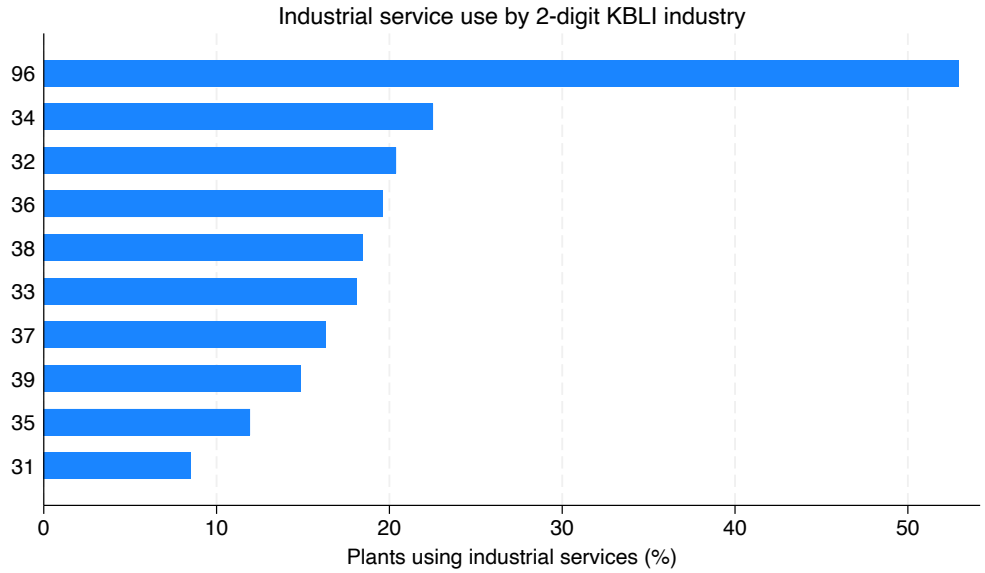

Figure 2: Industrial service use by 2-digit KBLI industry

Notes: Data from *Survei Industri*. The figure reports the share of plants with positive industrial-service purchases by 2-digit KBLI industry. Industry codes follow the KBLI classification used in the plant-level data.

more export-oriented. These patterns motivate the regression analysis below, which asks whether within-plant changes in service use are associated with subsequent productivity and export performance.

5 Empirical strategy

The baseline specification relates plant performance to lagged service use:

$$Y_{it} = \alpha_i + \delta_t + \beta S_{i,t-1} + \gamma' X_{i,t-1} + \varepsilon_{it}, \tag{4}$$

where Y_{it} is log value added per worker, log output per worker, exporter status, or export share. The variable $S_{i,t-1}$ denotes lagged service use. In the continuous-share specifications, $S_{i,t-1}$ is the lagged service-input share $S^I_{i,t-1}$. In the extensive-margin specifications, it is the lagged service-use dummy $D^S_{i,t-1}$. The continuous share is defined for both users and non-users and therefore combines variation in service-use status with variation in purchase intensity among users. The term α_i denotes plant fixed effects, and δ_t denotes year fixed effects. The vector $X_{i,t-1}$ includes lagged log employment, non-production-worker share, imported-input share, and foreign ownership share.

The preferred specification adds broad industry-year fixed effects:

$$Y_{it} = \alpha_i + \delta_t + \lambda_{k(i)t} + \beta S_{i,t-1} + \gamma' X_{i,t-1} + \varepsilon_{it}, \tag{5}$$

where $\lambda_{k(i)t}$ denotes 2-digit KBLI industry-by-year fixed effects. This absorbs time-

varying shocks common to broad manufacturing sectors, such as sector-specific demand, policy, technology, and price shocks. Standard errors are clustered at the 4-digit KBLI level.

Equation (5) is estimated separately using the continuous service-input share and the extensive-margin indicator. The extensive-margin specification is particularly important because the service-input distribution is highly zero-inflated. A positive coefficient on $D^S_{i,t-1}$ indicates that a plant performs differently in years following positive industrial-service purchases than in years following no such purchases, conditional on plant fixed effects, sector-year shocks, and controls.

These specifications are not claimed to identify a fully causal effect. Service use may respond to expected productivity, export opportunities, or organisational changes. The empirical design addresses some of this concern by using lagged service variables, plant fixed effects, and sector-year fixed effects, but unobserved time-varying shocks at the plant level may remain.

6 Results

6.1 Continuous service-input share and productivity

Table 6 presents the baseline productivity regressions using the lagged industrial-service share in intermediate inputs. The continuous service-input share is positive in all specifications. For value added per worker, however, the coefficient becomes statistically weak after controls and KBLI sector-year fixed effects are included. In the preferred specification, a one percentage point increase in the lagged service-input share is associated with roughly 0.17–0.19 percent higher value added per worker, but the estimate is not statistically significant at conventional levels.

The results are stronger for output per worker. In the KBLI-consistent regressions, a one percentage point increase in the lagged winsorised service-input share is associated with approximately 0.29–0.33 percent higher output per worker, and the estimates are statistically significant. This suggests that service-input intensity is more strongly associated with gross-output productivity than with value-added labour productivity. One interpretation is that industrial services are associated with higher throughput, outsourcing, or more complex production organisation, but that these changes do not translate one-for-one into higher value added within the plant.

Table 6: Industrial services and labour productivity

	ln value added per worker			ln output per worker	
	(1)	(2)	(3)	(4)	(5)
Lagged service-input share	0.00189	0.00185	0.00174	0.00329***	0.00294***
	(0.00115)	(0.00122)	(0.00116)	(0.00100)	(0.00094)
Lagged employment		-0.0351	-0.0395*	-0.0347	-0.0406*
		(0.0217)	(0.0215)	(0.0243)	(0.0243)
Lagged skill share		0.0496	0.0541	0.0406	0.0480
		(0.0448)	(0.0437)	(0.0428)	(0.0410)
Lagged imported-input share		0.0970***	0.115***	0.116***	0.133***
		(0.0280)	(0.0226)	(0.0214)	(0.0193)
Lagged foreign ownership share		0.00156***	0.00152***	0.00156***	0.00155***
		(0.00031)	(0.00032)	(0.00027)	(0.00028)
Plant fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
KBLI2 × year fixed effects	No	No	Yes	No	Yes
Observations	245,067	205,506	205,503	205,497	205,494
Adjusted R^2	0.767	0.754	0.756	0.826	0.828

Notes: Robust standard errors clustered at the 4-digit KBLI industry level are reported in parentheses. The lagged service-input share is the previous-year share of industrial-service purchases in intermediate inputs, winsorised at the 99th percentile and expressed in percentage points. Employment is measured as the log of total workers. Skill share is the share of non-production workers in paid production and non-production employment. Imported-input share is imported inputs divided by the sum of domestic and imported inputs. Foreign ownership share is the percentage of capital owned by foreigners. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

6.2 The extensive margin of industrial-service use

Table 7 examines whether purchasing industrial services in year $t-1$ is associated with plant performance in year t. This is the most robust plant-level result. Plants that purchase industrial services have around 3.1–3.3 percent higher value added per worker in the following year, conditional on plant fixed effects, year effects, controls, and, in the preferred specification, KBLI sector-year fixed effects. The association is even stronger for output per worker: plants that purchase industrial services have about 5.1 percent higher output per worker in the following year.

This result is consistent with the descriptive evidence that industrial-service use is rare but persistent. The binary distinction between plants that purchase industrial services and those that do not is more robustly associated with subsequent productivity than is the continuous service-input share. This pattern may reflect discrete organisational changes, such as outsourcing specialised tasks, contracting production-support services, or adopting more complex production arrangements. Because the continuous share includes both zero and positive values, however, the present analysis does not separately identify changes in purchase intensity among plants that already use industrial services.

Table 7: Industrial-service use and labour productivity

	ln value added per worker		ln output per worker	
	(1)	(2)	(3)	(4)
Lagged service-use dummy	0.0311***	0.0332***	0.0512***	0.0511***
	(0.00965)	(0.00867)	(0.00886)	(0.00824)
Lagged employment	-0.0353	-0.0398*	-0.0351	-0.0410*
	(0.0217)	(0.0214)	(0.0243)	(0.0242)
Lagged skill share	0.0496	0.0541	0.0406	0.0480
	(0.0446)	(0.0435)	(0.0426)	(0.0408)
Lagged imported-input share	0.0959***	0.114***	0.114***	0.132***
	(0.0280)	(0.0226)	(0.0212)	(0.0191)
Lagged foreign ownership share	0.00156***	0.00152***	0.00155***	0.00154***
	(0.00031)	(0.00032)	(0.00027)	(0.00028)
Plant fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
KBLI2 × year fixed effects	No	Yes	No	Yes
Observations	205,508	205,505	205,499	205,496
Adjusted R^2	0.754	0.756	0.826	0.828

Notes: Robust standard errors clustered at the 4-digit KBLI industry level are reported in parentheses. The lagged service-use dummy equals one if the plant reported positive industrial-service purchases in the previous year, and zero otherwise. Employment is measured as the log of total workers. Skill share is the share of non-production workers in paid production and non-production employment. Imported-input share is imported inputs divided by the sum of domestic and imported inputs. Foreign ownership share is the percentage of capital owned by foreigners. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

6.3 Export performance

Table 8 examines export outcomes. The coefficient on lagged service-input intensity is positive in exporter-status regressions but is not statistically significant in the KBLI-consistent sample. For export intensity, the coefficient is positive and marginally significant. In the preferred specification, a one percentage point increase in the lagged service-input share is associated with an increase in export share of about 0.04 percentage points.

These results suggest that service-input intensity may be associated with export deepening among existing exporters rather than with entry into exporting. However, the evidence is weaker than for productivity, and it should be interpreted cautiously. Exporting is highly persistent, and the fixed-effects specification identifies changes within plants over time.

6.4 Robustness checks

The appendix reports five robustness checks. First, Table A1 compares alternative measures of industrial-service use: the raw service-input share, the winsorised service-input share, and the extensive-margin service-use dummy. The results show that the raw and winsorised intensive-margin measures are positively associated with output per worker, while the extensive-margin measure is robustly associated with both value added per

Table 8: Industrial services and export performance

	Exporter status		Export share	
	(1)	(2)	(3)	(4)
Lagged service-input share	0.000479	0.000488	0.0417*	0.0417*
	(0.00032)	(0.00032)	(0.0216)	(0.0237)
Lagged employment	0.0207***	0.0209***	1.306***	1.309***
	(0.00373)	(0.00394)	(0.384)	(0.400)
Lagged skill share	-0.00760	-0.00706	-0.964	-0.877
	(0.00784)	(0.00747)	(0.592)	(0.561)
Lagged imported-input share	0.0273***	0.0273***	1.980***	2.018***
	(0.00660)	(0.00737)	(0.594)	(0.634)
Lagged foreign ownership share	0.000646***	0.000645***	0.0527***	0.0521***
	(0.00011)	(0.00011)	(0.00986)	(0.00978)
Plant fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
KBLI2 × year fixed effects	No	Yes	No	Yes
Observations	205,187	205,184	205,187	205,184
Adjusted R^2	0.504	0.512	0.546	0.556

Notes: Robust standard errors clustered at the 4-digit KBLI industry level are reported in parentheses. Exporter status is a dummy variable equal to one if the plant exports. Export share is the percentage of output exported. The lagged service-input share is the previous-year share of industrial-service purchases in intermediate inputs, winsorised at the 99th percentile and expressed in percentage points. Employment is measured as the log of total workers. Skill share is the share of non-production workers in paid production and non-production employment. Imported-input share is imported inputs divided by the sum of domestic and imported inputs. Foreign ownership share is the percentage of capital owned by foreigners. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

worker and output per worker.

Second, Table A2 estimates export regressions using the extensive-margin service-use dummy. The coefficients are positive, but weaker than the productivity results. The service-use dummy is marginally significant for exporter status only in the specification with KBLI sector-year fixed effects, and is not statistically significant for export intensity.

Third, Table A3 re-estimates the main specifications using ISIC-based industry-year fixed effects and clustering rather than KBLI-based controls. These estimates are used only as a classification robustness check, since KBLI is the baseline classification in the plant-level data. The positive association between service use and performance is broadly preserved, although the precise pattern differs from the KBLI results.

Fourth, Table A4 scales industrial-service purchases by gross output instead of intermediate inputs. The coefficient is small and statistically insignificant for value added per worker. This supports the interpretation that the relevant margin is the composition of intermediate inputs, not service purchases relative to production scale.

Fifth, Table A5 excludes observations with lagged service-input shares above 50 percent. The coefficient on the service-input share remains positive but is no longer statistically significant, suggesting that the upper tail of service-intensive users contributes to the continuous intensive-margin result.

7 Discussion and policy implications

The findings qualify the conventional distinction between manufacturing-led and services-led development. The growing economic importance of services need not imply that services are replacing manufacturing as a source of productivity growth and export development. Services can contribute to structural transformation as independent sectors of employment and exports, but they can also do so through their embodiment in manufactured products and their use as inputs into manufacturing production. The TiVA evidence illustrates the first of these manufacturing-related channels at the aggregate level, while the plant-level results provide evidence that the purchase of industrial services is systematically associated with manufacturing performance. Services-led growth and manufacturing-led development should therefore not be regarded as mutually exclusive strategies.

This interpretation complements, rather than directly contradicts, the recent literature advocating greater attention to services-led development. That literature appropriately emphasizes the declining capacity of manufacturing to absorb large numbers of less-skilled workers and the need to raise productivity in labour-absorbing services (Rodrik and Sandhu 2025). The findings here point to an additional channel that can be obscured by a sectoral manufacturing-versus-services dichotomy: service-sector capabilities can support productivity, upgrading, and exports within manufacturing itself. Servicification may therefore represent not a movement away from industrialisation, but

a change in the organisation and service content of modern industrial production.

Three implications follow for Indonesia. First, directly observed servicification appears limited and unevenly distributed at the plant level. The TiVA evidence shows that services account for an important share of the value embodied in manufacturing exports, but the *Survei Industri* data show that only a minority of plants report purchases under the industrial-services category. The aggregate role of services in manufacturing is therefore unlikely to be distributed evenly across establishments. It may be concentrated among larger, more internationally connected, or organisationally more complex plants. At the same time, the plant-level measure is narrow and does not capture all finance, logistics, telecommunications, professional, and other producer services embodied directly or indirectly in production.

Second, the binary distinction between service-using and non-service-using plants is more robustly associated with subsequent productivity than the continuous service-input share. This does not imply that simply raising service expenditure would mechanically increase productivity. Instead, positive industrial-service purchases may reflect discrete changes in production organisation, including outsourcing, maintenance contracts, quality control, specialised production support, or more complex supply-chain relationships. These organisational arrangements may contribute to higher output per worker and, more tentatively, to export performance. Because service use remains an endogenous plant choice, these results should be understood as conditional associations rather than causal policy parameters.

Third, the findings support a broader conception of industrial policy. If the competitiveness of modern manufacturing depends partly on the availability and quality of producer services, manufacturing policy should not focus exclusively on tariffs, industrial estates, downstreaming, local-content requirements, or labour costs. It should also seek to improve the cost, quality, reliability, and contestability of logistics, transport, finance, telecommunications, business services, certification, testing, engineering, and digital infrastructure. In this sense, services reform is not separate from industrial policy; it is one of its increasingly important components.

For Indonesia, this point is especially relevant because restrictions on services trade, investment, entry, and competition may raise the cost of essential inputs for manufacturing firms. Recent international databases, including the World Bank–WTO Services Trade Policy Database and Services Trade Restrictions Index, provide increasingly detailed measures of restrictions across economies and service sectors (World Bank and WTO 2025). Future research could combine these measures with manufacturing industries' dependence on particular producer services to test whether restrictions in upstream services weaken productivity, export performance, or participation in GVCs.

8 Conclusion

This paper studies servicification in Indonesian manufacturing by combining macro evidence from OECD TiVA with plant-level evidence from the *Survei Industri*. The TiVA evidence shows that services account for a substantial share of the value embodied in manufacturing exports. The plant-level evidence shows that purchased industrial services are reported by only a minority of manufacturing plants, but that service use is persistent and systematically associated with plant performance.

The most robust plant-level result concerns the binary distinction between service users and non-users. Plants that purchase industrial services have higher subsequent labour productivity, especially when productivity is measured by gross output per worker. The continuous service-input share is also positively associated with output per worker, but its relationship with value added per worker is weaker and less robust. The export results are positive but more tentative. Because the continuous share includes zero values for non-users, the analysis does not separately identify the effect of increasing purchase intensity among plants that already use industrial services.

More broadly, the findings suggest that the distinction between manufacturing-led and services-led development is overly simplistic. The rising importance of services does not necessarily indicate a displacement of manufacturing. Services can contribute to development through their direct expansion as sectors of employment and exports, but also through their use within manufacturing production and their embodiment in manufactured exports. Servicification therefore suggests that services-led growth may occur partly within and through industrial development. For policy, the relevant question is not simply whether Indonesia should promote manufacturing or services, but whether it can develop producer-service capabilities that support manufacturing productivity, upgrading, and participation in GVCs.

The analysis has several limitations. The plant-level service variable captures only purchased industrial services and does not measure the full range of producer services used directly or indirectly in manufacturing. The estimates are conditional associations rather than definitive causal effects, and the plant data end in 2014. Future work could distinguish more cleanly between entry into service use and changes in purchase intensity among existing users, and could combine plant-level data with input–output exposure measures, services regulation indicators, and more recent aggregate sources. Such work would help establish whether reforms to upstream services can causally support manufacturing upgrading and GVC participation.

A Additional tables

Table A1: Alternative measures of industrial-service use

	ln(value added per worker)			ln(output per worker)		
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged service-input share, raw	0.00155**			0.00187***		
	(0.00061)			(0.00049)		
Lagged service-input share, winsorised		0.00174			0.00294***	
		(0.00116)			(0.00094)	
Lagged service-use dummy			0.0332***			0.0511***
			(0.00867)			(0.00824)
Lagged employment	-0.0395*	-0.0395*	-0.0398*	-0.0406*	-0.0406*	-0.0410*
	(0.0215)	(0.0215)	(0.0214)	(0.0243)	(0.0243)	(0.0242)
Lagged skill share	0.0540	0.0541	0.0541	0.0479	0.0480	0.0480
	(0.0437)	(0.0437)	(0.0435)	(0.0410)	(0.0410)	(0.0408)
Lagged imported-input share	0.115***	0.115***	0.114***	0.134***	0.133***	0.132***
	(0.0226)	(0.0226)	(0.0226)	(0.0194)	(0.0193)	(0.0191)
Lagged foreign ownership share	0.00152***	0.00152***	0.00152***	0.00155***	0.00155***	0.00154***
	(0.00032)	(0.00032)	(0.00032)	(0.00028)	(0.00028)	(0.00028)
Plant fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
KBLI2 × year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	205,503	205,503	205,505	205,494	205,494	205,496
Adjusted R^2	0.756	0.756	0.756	0.828	0.828	0.828

Notes: Robust standard errors clustered at the 4-digit KBLI industry level are reported in parentheses. The raw service-input share is the previous-year share of industrial-service purchases in intermediate inputs, expressed in percentage points. The winsorised service-input share caps the raw share at the 99th percentile. The service-use dummy equals one if the plant reported positive industrial-service purchases in the previous year, and zero otherwise. All specifications include plant fixed effects, year fixed effects, and KBLI2-by-year fixed effects. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A2: Industrial-service use and export performance

	Exporter status		Export share	
	(1)	(2)	(3)	(4)
Lagged service-use dummy	0.00419	0.00486*	0.129	0.180
	(0.00291)	(0.00263)	(0.215)	(0.207)
Lagged employment	0.0207***	0.0209***	1.307***	1.309***
	(0.00373)	(0.00394)	(0.385)	(0.401)
Lagged skill share	-0.00755	-0.00701	-0.959	-0.872
	(0.00783)	(0.00746)	(0.592)	(0.560)
Lagged imported-input share	0.0272***	0.0272***	1.974***	2.012***
	(0.00659)	(0.00736)	(0.593)	(0.633)
Lagged foreign ownership share	0.000646***	0.000644***	0.0527***	0.0521***
	(0.00011)	(0.00011)	(0.00986)	(0.00978)
Plant fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
KBLI2 × year fixed effects	No	Yes	No	Yes
Observations	205,188	205,185	205,188	205,185
Adjusted R^2	0.504	0.512	0.546	0.556

Notes: Robust standard errors clustered at the 4-digit KBLI industry level are reported in parentheses. Exporter status is a dummy variable equal to one if the plant exports. Export share is the percentage of output exported. The lagged service-use dummy equals one if the plant reported positive industrial-service purchases in the previous year, and zero otherwise. Employment is measured as the log of total workers. Skill share is the share of non-production workers in paid production and non-production employment. Imported-input share is imported inputs divided by the sum of domestic and imported inputs. Foreign ownership share is the percentage of capital owned by foreigners. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A3: ISIC-based robustness checks

	ln(VA/L)	ln(output/L)	Exporter status	Export share
	(1)	(2)	(3)	(4)
Lagged service-input share	0.00234	0.00180	0.00122*	0.0211
	(0.00165)	(0.00151)	(0.00067)	(0.0511)
Lagged employment	-0.0267*	-0.0249	0.0259***	1.679***
	(0.0151)	(0.0160)	(0.00319)	(0.308)
Lagged skill share	0.127***	0.119***	-0.000516	-1.415*
	(0.0313)	(0.0352)	(0.00893)	(0.746)
Lagged imported-input share	0.0820***	0.0843***	0.0370***	3.248***
	(0.0269)	(0.0285)	(0.0107)	(1.097)
Lagged foreign ownership share	0.000337	0.000657**	0.000854***	0.0510***
	(0.00033)	(0.00031)	(0.00012)	(0.0105)
Plant fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
ISIC2 × year fixed effects	Yes	Yes	Yes	Yes
Observations	184,868	184,868	156,553	137,377
Adjusted R^2	0.735	0.783	0.652	0.669

Notes: Robust standard errors clustered at the 4-digit ISIC industry level are reported in parentheses. The lagged service-input share is the previous-year share of industrial-service purchases in intermediate inputs, winsorised at the 99th percentile and expressed in percentage points. Exporter status is a dummy variable equal to one if the plant exports. Export share is the percentage of output exported. Employment is measured as the log of total workers. Skill share is the share of non-production workers in paid production and non-production employment. Imported-input share is imported inputs divided by the sum of domestic and imported inputs. Foreign ownership share is the percentage of capital owned by foreigners. These specifications use ISIC-based industry-year fixed effects and clustering, rather than KBLI-based industry-year fixed effects and clustering. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A4: Service purchases scaled by output

	ln(value added per worker)	
	(1)	(2)
Lagged output-scaled service share	0.000140	0.000115
	(0.00217)	(0.00206)
Lagged employment	-0.0351	-0.0395*
	(0.0217)	(0.0215)
Lagged skill share	0.0497	0.0543
	(0.0448)	(0.0437)
Lagged imported-input share	0.0974***	0.116***
	(0.0282)	(0.0227)
Lagged foreign ownership share	0.00156***	0.00152***
	(0.00031)	(0.00032)
Plant fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
KBLI2 × year fixed effects	No	Yes
Observations	205,496	205,493
Adjusted R^2	0.754	0.756

Notes: Robust standard errors clustered at the 4-digit KBLI industry level are reported in parentheses. The lagged output-scaled service share is the previous-year share of industrial-service purchases in gross output, winsorised at the 99th percentile and expressed in percentage points. Employment is measured as the log of total workers. Skill share is the share of non-production workers in paid production and non-production employment. Imported-input share is imported inputs divided by the sum of domestic and imported inputs. Foreign ownership share is the percentage of capital owned by foreigners. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A5: Excluding high lagged service-input shares

	ln(value added per worker)	
	(1)	(2)
Lagged service-input share	0.00114	0.00110
	(0.00082)	(0.00077)
Lagged employment	-0.0352	-0.0396*
	(0.0217)	(0.0215)
Lagged skill share	0.0488	0.0533
	(0.0448)	(0.0437)
Lagged imported-input share	0.0971***	0.115***
	(0.0281)	(0.0227)
Lagged foreign ownership share	0.00157***	0.00153***
	(0.00031)	(0.00032)
Plant fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
KBLI2 × year fixed effects	No	Yes
Observations	205,316	205,313
Adjusted R^2	0.754	0.756

Notes: Robust standard errors clustered at the 4-digit KBLI industry level are reported in parentheses. The lagged service-input share is the previous-year share of industrial-service purchases in intermediate inputs, expressed in percentage points. The sample excludes observations with lagged service-input shares above 50 percent. Employment is measured as the log of total workers. Skill share is the share of non-production workers in paid production and non-production employment. Imported-input share is imported inputs divided by the sum of domestic and imported inputs. Foreign ownership share is the percentage of capital owned by foreigners. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

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