Revisiting Factor Proportions in the Indian Economy – A Study with Focus on Tradable Sectors

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Abstract: Factor productivity is traditionally studied through the measurement of factor intensity for sectors of the economy. However, this measurement is restricted to their direct use within the sector ignoring their embeddedness in upstream sectors. Therefore, an underestimation of the factor intensities across economic sectors cannot be ruled out if evaluated using direct factor contents alone. An a priori external influence on demand (through exports) and investment (through FDI), is expected to shape the allocation of production and subsequent factor demand. Thus, this article examines the structural coherence of factor proportions with output, exports and FDI, separately for each tradable sector. Likewise for factor intensities, tradables are often studied in isolation from their interaction with the non-tradables. Using of Semi Input-Output (SIO) modelling, the factor proportions (K-to-L) show a significant underestimation of the capital intensity for the economy when compared with direct proportions. Although

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the output and export distributions are largely aligned with factor endowments, the distribution of FDI is skewed towards sectors with high capital proportions. Thus, FDI is unlikely to be solution to employment generation without re-orienting and enhancing the existing skills.

Keywords: Factor proportion, tradables, Input-Output, labour intensive, FDI, India, KLEMS.

1. Introduction

The opening up of Indian economy offered an opportunity for domestic industries to access modern and more sophisticated technologies at one level and Foreign Direct Investment (FDI) flows at another. At the same time, the existing domestic capital intensive industries also picked up on their technology upgradation drive to stay competitive against the imports, further strengthening their proportion of capital relative to labour. Therefore, it is highly likely to expect a general increase in the number of capital intensive sectors when compared with a national benchmark figure. The traditional labour intensive sectors such as textiles also witnessed a gradual technology upgradation through the use of modern spinning machinery, which had a labour displacing effect. All this suggests a general increase in capital proportion even in the not so capital intensive sectors (ILO, 2018, Rathee, 2016). Capital incentives through one time capital subsidises and reduced credit rates contributed to higher capital proportions in specific industries (Gulhane and Turukmane, 2017).

It is in this context that makes it useful to assess India's factor proportion for a most recent time period. However, measurement of factor requirements is prima facie based on the direct factor proportion which makes the assessment partial in nature due to exclusion of the interactive effects. It is required to take into account the interactions of different linkages into the production process. The present article makes a novel attempt by expanding the scope of measurement to include the indirect effects of factor

use, which remain unaccounted otherwise. With the common expectation of FDI to be market seeking – both domestic as well as global market through the host countries' export partners – the focus is on tradable sectors of the economy which are more probable to capital expansion in both new and existing firms, through either of the two channels of investment viz. domestic and foreign. However, the method used here does take into account the interactions of the producing sectors with the non-trading sectors. This provides total factor proportion of the production process which is more meaningful.

Our basic motivation is to find how sector-wise factor proportions are placed in an open and market driven Indian economy. To provide a better perspective we analyse factor proportions vis-a-vis output, export and FDI for the latest available year of 2013-2014. By making use of the Semi-Input-Output (SIO) modelling of Tinbergen (1967), we are able to account for the direct and indirect factor proportions in the economy which in provides general equilibrium sense to the analysis. Keeping a focus on India's tradable sectors, the analysis makes a key contribution through widening the scope of measurement for factor proportions by including interaction effects of the producing sectors.

2. On factor proportion and measurement issues

The background dates back to H-O Theory (HOT) of international trade which attributes trade to difference in relative factor abundance between partner countries. A scrutiny of the HOT sparked the famous Leontief paradox (1953) where his findings on the US economy confronted HOT as a capital abundant economy was found exporting labour surplus products. Later, attempting to solve the paradox, Vanek (1968) visualised international trade as disguised trade of factors embodied in the basket of goods traded. His contribution through Heckscher-Ohlin-Vanek (HOV) theorem drifted focus from

trade in goods to trade in factors of production embodied in the goods traded, emphasising that a country exports its abundant factor. Validity of HOV has been tested by researchers including Leamner (1984) who found the theorem to hold good. Others such as Srivastava (2012) also found that factors are a source of world trade pattern, further highlighting the need to design policy relating to factor improvements.

Recognising that factor intensity is determined not only at the last stage of production, Riedel (1974) uses Input-Output (IO) framework to additionally account for factor requirements at each intermediate stage, measuring factor proportions through the labour-output ratio.[4] Although, direct factor requirements are relevant for allocations across production and trade flows, total factor intensities are relevant for net trade balance of factors in the traded products (Baldwin, 1971). Likewise, Hamilton and Sevensson (1983) also mandate to consider total factor intensities of traded goods to account for direct factor inputs in producing the non-traded goods which are in turn used in production of the traded goods of an economy.

Indirect requirement for factors of production are also emphasised by others (Aladdin and Tisdell, 1988). Ignoring their effect, it has been argued, tends to underestimate the factor requirements particularly of industries with high proportionate consumption of intermediate products. Significant differences between the factor intensity of upstream industries in comparison to the using industry also introduces a bias in the estimates of factor content.

Different metrics have been used for measuring factor proportions, the choice essentially suited for a specific purpose. In India, the initial Five Year Plan used capital-

[4] The phrases factor proportion and factor intensity are used interchangeably.

output ratio to estimate the capital requirement for a corresponding macroeconomic growth in the overall economy (Sen, 1956). Riedel (1974), and Rashid and Bashir (2000) also measure factor intensity for Taiwan using factor content per unit output.

However, the value added based measures are accepted more widely. In a study of comparative advantage of sectors of the Australian economy, Karunaratne (1996) expressed factor intensities per unit of value added rather than output. Mano and Castillo (2015) also refer to the value added based measure for productivity in traded and non-traded goods. Both Coondoo et al. (1993) and Kathuria et al. (2010) use gross value added measure to compute labour productivity. The value added measure is also preferred for the industries witnessing outsourcing, since the phenomenon impacts labour use without affecting the gross output (Cobbold, 2003).

A strand of literature shows differential productivity levels between tradables and non-tradables. In a recent work, Mano and Castillo (2015) show a generally low productivity among the Asian tradable sectors in China and India, comparison with the European and other OECD countries. The authors also note less heterogeneity in the productivity levels of non-traded sectors. Over time, India is observed to have recorded an increase in productivity of both sectors, although productivity in traded sectors has increased over time, a negative differential between traded and non-traded sectors is noted for India.

3. Methodological approach – Semi-Input-Output Model

The expansion of output for a given sector entails factor requirements that are estimated based on the factor proportion of the corresponding sector. However, measurement of factor requirements based on the direct factor proportion which makes the assessment partial in nature due to exclusion of the interactive effects with other sectors of the economy. An approach to expand the scope of measurement is to include the indirect

effects so that the factor requirements, both explicit and implicit, of the additional activity are known. While the direct factor requirements are measured proportionate to the capacity expansion of the sector, the indirect effects account for factor usage in the sectors which supply output for intermediate use in the given sector. The IO model proposed by Leontief is equipped to capture the interactive effects of intermediates and using sectors. However, Tinbergen (1967) has argued for a distinction criterion among sectors of the economy to facilitate development planning in phases. He emphasises that national sectors (which cannot be traded) must be expanded in accordance with domestic demand; while stating that factor returns are more determining in the case of expansion in international (that is tradable) sectors (Tinbergen (1967): 99). While tradables have a greater economic contribution, both internally and externally, the output expansion of non-tradables is rather limited with no opportunity to market the surplus. Thus, growth and investment policies are more likely to prioritise in the tradable sectors due to their attractiveness in terms of their for value added potential form market expansion.

Tinbergen proposed a formulation of the IO, referred as the Semi-Input-Output (SIO) Method. By virtue of the distinction between tradable and non-tradable sectors, the SIO is considered to be more focussed on tradables while also maintaining the spirit of a general equilibrium analysis through inclusion of indirect quantities of multiple orders. We introduce details of the SIO method as follows.

The conventional I-O model represents interactions among the *m* sectors through a system of linear equations corresponding to each sector of the economy. The domestic output of a given sector can be disposed as intermediate use, final demand or traded. Generally, the trade components are subsumed in aggregate final demand. However, given our specific focus on tradables, we show the trade component distinct from other

components of final demand viz., private final consumption, government final consumption, gross fixed capital formation and change in inventories, for a given year. Intermediate use is represented through a matrix of intersectoral transactions while the sector-wise output (X_i), final demand (D_i) and trade (B_i) are represented through column vectors as shown in Equation (1).

$$\begin{bmatrix} x_1 \\ \vdots \\ x_m \end{bmatrix} = \begin{bmatrix} x_{1,1} & \cdots & x_{1,m} \\ \vdots & \ddots & \vdots \\ x_{1,m} & \cdots & x_{m,m} \end{bmatrix} \begin{bmatrix} x_1 \\ \vdots \\ x_m \end{bmatrix} + \begin{bmatrix} d_1 \\ \vdots \\ d_m \end{bmatrix} + \begin{bmatrix} b_1 \\ \vdots \\ b_m \end{bmatrix} \dots\dots (1)$$

where x_i, d_i and b_i denote the output, domestic final demand and net trade and for the i^{th} sector of the economy, i=1,....,m. The Equation (1) can be compactly written as follows:

$$X = AX + D + B \dots\dots (2)$$

$$\text{Or, } X = AX + D + (X - M) \dots\dots (3)$$

Where the column vectors X, D, and B represent output, final demand and net trade. The intersectoral flows are given by the square matrix A of dimension *m*.

Given our focus on factor proportion of the tradable sectors, which are likely to receive more foreign investments than the non-tradables, we re-arrange the *m* sectors so that the *t* tradables are placed above the *n* non-tradables of the economy (t+n=m). Thus, the elements of the matrices in Equation (1) are ordered as shown in Equation (4).

$$\begin{bmatrix} x_1 \\ \vdots \\ x_t \\ x_{t+1} \\ \vdots \\ x_{t+n} \end{bmatrix} = \left[\begin{array}{ccc|ccc} x_{1,1} & \cdots & x_{1,t} & x_{1,t+1} & \cdots & x_{1,n} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ x_{t,1} & & x_{t,t} & x_{t,t+1} & & x_{t,n} \\ \hline x_{t+1,1} & & x_{t+1,t} & x_{t+1,t+1} & & x_{t+1,n} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ x_{t+n,1} & \dots & x_{t+n,t} & x_{t+n,t+1} & \cdots & x_{t+n,t+n} \end{array}\right] \begin{bmatrix} x_1 \\ \vdots \\ x_n \\ x_{n+1} \\ \vdots \\ x_{n+t} \end{bmatrix} + \begin{bmatrix} d_1 \\ \vdots \\ d_n \\ d_{n+1} \\ \vdots \\ d_{n+t} \end{bmatrix} + \begin{bmatrix} b_1 \\ \vdots \\ b_n \\ b_{n+1} \\ \vdots \\ b_{n+t} \end{bmatrix} \dots\dots (4)$$

In effect, we have partitioned the system of *m* equation into two segments, one each for tradables and non-tradable sectors as shown in Equation (5).

$$\begin{bmatrix} X_t \\ X_n \end{bmatrix} = \begin{bmatrix} A_{t,t} & A_{t,n} \\ A_{n,t} & A_{n,n} \end{bmatrix} \begin{bmatrix} X_t \\ X_n \end{bmatrix} + \begin{bmatrix} D_t \\ D_n \end{bmatrix} + \begin{bmatrix} B_t \\ B_n \end{bmatrix} \dots\dots (5)$$

The intersectoral interactions and the components of final demand and trade can now be expressed as:

$$X_t = A_{t,t}X_t + A_{t,n}X_n + D_t + B_t \ldots\ldots (6)$$

and

$$X_n = A_{n,t}X_t + A_{n,n}X_n + D_n + B_n \ldots\ldots (7)$$

According to Equation (6), the output of a tradable sector is dependent upon its intermediate use within tradables, intermediate use by non-tradables, its final demand and traded components which can be re-arranged as shown in Equation (8).

$$X_t = \underbrace{A_{t,t}X_t}_{interactive\ effect\ of\ intermediate\ tradabales\ on\ tradables} + \underbrace{D_t + B_t}_{Final\ demand\ effects\ of\ expansion\ in\ tradables} + \underbrace{A_{t,n}X_n}_{interactive\ effect\ of\ intermediate\ non-tradabales\ on\ tradables} \ldots\ldots (8)$$

In estimating the interactive effects of non-tradables ($A_{t,n}$) on the tradables, through their intermediate use *emphasised*, the final demand and trade components of the tradable sector will not have a contribution and are therefore dropped from the specification. Thus, any loss of generality Equation (8) can be rewritten as:

$$X_t = A_{t,t}X_t + A_{t,n}X_n \ldots\ldots (9)$$

Equation (9) is reformulated to express the complementary effect of expansion in the non-tradables on the tradables ($A_{t,n}$) through the interaction with the total requirement coefficient matrix of the tradables given by $(I\text{-}A_{t,t})^{-1}$.Thus, we express the indirect effects as:

$$X_t = (I - A_{t,t})^{-1}A_{t,n}X_n \ldots\ldots (10)$$

The output vector X_n takes the value of an identity vector since we are interested in assessing the effects for a unit of expansion. Thus, the right hand side of Equation (10)

represents the complementarily effect of non-tradable in increasing the output of a tradable sector. It follows that the interaction of indirect expansion in output with direct factor proportion of tradables, F_t, provides the factors required indirectly by a tradable sector on account of use of a non-tradable. Thus, total factor proportion for tradabales, F_T, is expressed as sum of the direct and indirect proportion as shown in Equation (11).

$$F_T = F_t + F_t\ (I - A_{t,t})^{-1} A_{t,n} I_n \ldots\ldots (11)$$

The Equation (11) embodies the spirit of SIO which maintains a focus on the tradables; while simultaneously taking into consideration their interaction with the non-tradable sectors of the economy. In fact, the inclusion of interaction between tradables and non-tradables completes the roundaboutness of the production process. Since tradables depend on the intermediate use of non-tradables, this leads to demand generation for the non-tradables which also make use of different factors of production, e.g capital and labour. Thus in an open economy, international competition in the tradable sector can (indirectly) impact non-tradable sectors and consequently their factor use. The inclusion of this interaction impact is strength of the SIO framework. The application of SIO method for measuring factor proportions is useful to account for factor proportions used at the intermediate stage, which remain ignored otherwise.

4. Data, Time frame and Sector classification

While the IO Transaction Tables are available for up to 2007-2008, the Central Statistical Organisation (CSO) provides the Supply Use Tables (SUTs) for the later years of 2011-2012 and 2012-2013. Although the SUTs are asymmetric due to difference in number of commodities and industries, the data available in SUTs is more granular for flows between commodities and industries. However, the SIO analysis requires a symmetric and balanced matrix of commodity transactions in the form a matrix of flows across commodities. We make use of the IOTT for the latest available

year of 2013-2014 which is based on SUTs for the aforementioned years (Singh and Saluja, 2016). For sector-wise factor proportions, the Reserve Bank of India (RBI) provides KLEMS database for measuring productivity at the industry level (Das et al., 2017).[5] The factor proportions are computed as the ratio share of capital in value added to labour income in value added for the corresponding year, 2013-2014.

The 27 KLEMS database sectors are classified into a sub-set of eighteen (18) tradable sectors and nine non-tradable sectors (Table 1). The categorisation of tradables is designed keeping in mind that the output of tradables sectors is exportable (as commodity or service) and are more likely recipients of capital and foreign investment. Among the sectors of analysis, the tradable nature of manufacturing, agriculture and mining output is by virtue of their exposure to international competition through trade and investment (in some cases). Financial services, business services are also considered tradable sectors for the analysis. Education is another tradable in view of the element of foreign fee-paying students considered as exports of education services. The education sector also includes trainings and online courses which have an international element. On the other side, non-tradables include non-market services such as public administration and health (largely a public sector service). The electricity, gas and water supply is considered non-tradable owing to the predominantly domestic generation driven by domestic demand. Transport and storage is classified as non-tradable as most sub-sectors within such as road transport; postal, courier and delivery services; and warehousing and storage services are not marked with significant international competition. The construction sector is another non-tradable due to its domestically driven demand. The post and telecommunication sector uses large amounts of domestic

[5] KLEMS stands for capital (K), labour (L), energy (E), materials (M) and service (S) inputs.

fixed capital investment which is not subject to foreign competition; hence the sector is considered non-tradable for analysis. Similarly, hotels and restaurant; and trade are classified as non-tradable due to the largely domestic demand.

Table 1– Classification of sectors

	Sector description*	Tradable (T)/ Non-Tradable (N)
C1	Agriculture, Hunting, Forestry and Fishing	T
C2	Mining and Quarrying	T
C3	Food Products, Beverages and Tobacco	T
C4	Textiles, Textile Products, Leather and Footwear	T
C5	Wood and Products of wood	T
C6	Pulp, Paper, Paper products, printing and Publishing	T
C7	Coke, Refined Petroleum Products and Nuclear fuel	T
C8	Chemicals and Chemical Products	T
C9	Rubber and Plastic Products	T
C10	Other Non-Metallic Mineral Products	T
C11	Basic Metals and Fabricated Metal Products	T
C12	Machinery, nec.	T
C13	Electrical and Optical Equipment	T
C14	Transport Equipment	T
C15	Manufacturing, nec; recycling	T
C16	Electricity, Gas and Water Supply	N
C17	Construction	N
C18	Trade	N
C19	Hotels and Restaurants	N
C20	Transport and Storage	N
C21	Post and Telecommunication	N
C22	Financial Services	T
C23	Business Service	T
C24	Public Administration and Defense; Compulsory Social Security	N
C25	Education	T
C26	Health and Social Work	N
C27	Other services	N

*Description as used in RBI, KLEMS database.
Note: The table provides classification of the sectors into tradable and non-tradable sectors.
Source: Authors' classification of tradable and non-tradable based on the tradability of the sector output.

The data on FDI is sourced from the Department of Industrial Policy and Promotion, Ministry of Commerce and Industry for the year 2013.

The following three propositions are examined at sector-level for the tradable sectors:

(1) Is the total factor proportion systematically different from direct factor proportion,

(2) What is the magnitude of the difference between total and direct factor proportions, and

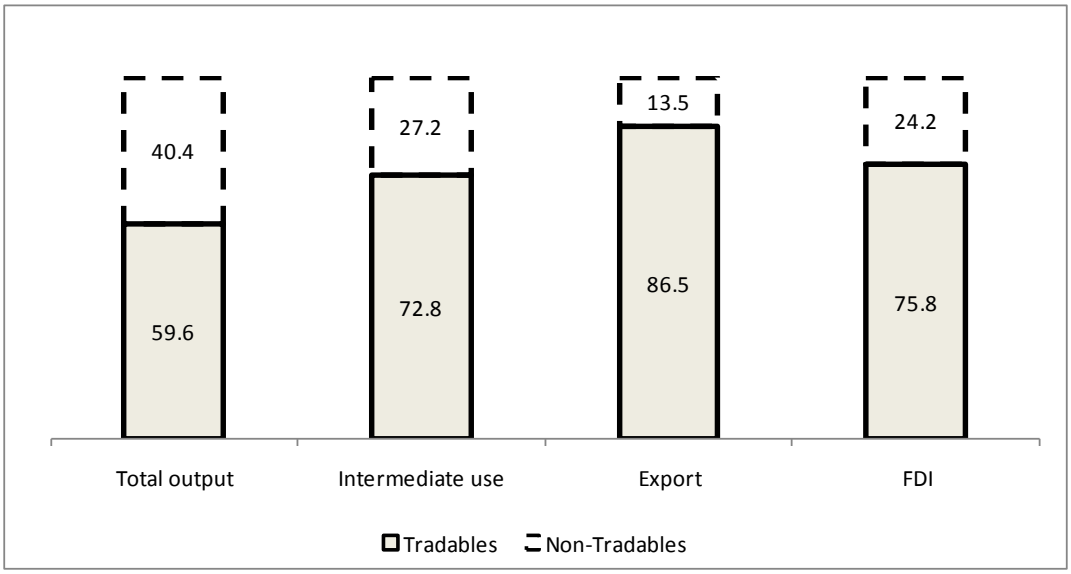
(3) How are factor proportions aligned with the patterns of production, export and foreign investment.

5. Predominance of tradable sectors

The importance of tradables is recognised through their greater contribution compared with the contribution of non-tradables in each of the key indicators of structure of the economy – total output, intermediate use into production activities, exports and foreign direct investment (FDI) (Figure 1). While output and intermediate use are more representative of the internal structure of the economy, the tradable and non-tradable distribution of exports is important to consider because external demand can be an important driver of the economy. Since the non-tradables serve only the domestic market, their output share is limited as the related surplus cannot be exported. Accordingly, growth and investment polices focus on tradables to maintain their attractiveness. Although total domestic output is jointly determined by tradables and non-tradables, the value added from expansion in non-tradables is essentially proportionate to the domestic spending on the same. This is in contrast to the expansion potential of tradables which have the capacity to generate more revenue due to their higher income elasticity. Furthermore, a boost in tradables has a multiplier effect on the output of the relatively more protected and the less traded non-tradables. Thus, performance of tradables is important not only to pay for the import bill but also for

output expansion in the economy. However, while maintaining focus on tradable sectors of the economy, it is also necessary to take into account their interactive effects with the non-tradables given the roundaboutness of the production process where the tradables depend on inputs from the non-tradables. The inclusion of this interaction, in estimating the factor proportions, is the mainstay of present analysis.

Figure 1 – Significance of tradables in Indian economy, 2013-2014 (% share)



Note: each column provides the percentage distribution of the indicator between the tradables and non-tradables.
Source: Authors' computations.

6. Underestimation in factor proportions

The magnitude of underestimation is identified by comparing direct factor proportions with total factor proportions, which additionally include the indirect factor proportions. This makes it necessary to account for the indirect factor proportions so as to improve the estimates of (total) factor proportions. Since the assessment of factor proportions is relative among sectors, a necessary benchmark ratio is chosen as the average of all tradable sectors. Taking cognizance of the complementarities generated by the tradable sectors on the non-tradable sectors the average K-to-L ratio for the tradable sector appreciates notably from 1.74 (based on direct intensities only) to 2.19 with inclusion of the linkage effects (Table 2). The higher magnitude of factor

proportion is indicative of greater capital use in the economy than normally understood. On an average, total factor proportion for the tradable sector is underestimated by 23.9% of the direct factor proportions.

Interestingly, the standard deviations of total factor proportions are higher than those of the direct proportions indicating a higher dispersion across the sectors with regard to factor proportions. Similarly, a higher CV of factor proportions compared with the CV of direct factor proportions signifies the importance of total factor proportions through improved measurement of capital over a wider range across the tradables.

Table 2 – Sector-wise factor proportions for tradable sectors, 2013-2014

S.No	Sector name	Factor proportion (K-to-L)				
		Total		Direct		Indirect as % of Direct
1	Agriculture and allied	1.26	(14)	0.84	(16)	49.3
2	Mining	4.82	(2)	2.85	(4)	68.9
3	Processed food	1.79	(11)	1.51	(11)	18.4
4	Textile and leather	1.31	(13)	1.27	(13)	3.1
5	Wood products	1.14	(16)	1.11	(14)	2.1
6	Paper, printing and publishing	1.17	(15)	1.04	(15)	11.9
7	Coke and petroleum products	33.73	(1)	19.55	(1)	72.5
8	Chemical products	4.78	(3)	3.30	(2)	45.1
9	Rubber and plastics	2.39	(8)	2.20	(7)	8.6
10	Non-metallic mineral products	2.50	(7)	2.26	(6)	10.8
11	Basic metal products	4.19	(4)	2.91	(3)	44.1
12	Machinery nec	1.96	(9)	1.91	(9)	2.5
13	Electrical equipment	1.92	(10)	1.61	(10)	19.2
14	Transport equipment	2.62	(6)	2.39	(5)	9.8
15	Manufacturing nec	0.67	(17)	0.63	(17)	6.9
16	Financial service	2.66	(5)	2.05	(8)	29.7
17	Business service	1.63	(12)	1.30	(12)	25.6
18	Education	0.43	(18)	0.43	(18)	1.1
	Mean	2.19		1.74		23.9
	Standard deviation (s.d)*	1.32		0.84		
	Coefficient of variation (CV) (%)*	60.3		48.0		
	Min	0.43		0.43		1.11
	Max*	4.82		3.30		72.5

Notes: 1. Figures in parenthesis are the ranks among tradables.
2. Refer Table 1 for detailed sector descriptions.
3. Table provides the total and direct factor proportions for sectors. Total factor proportions include direct and indirect factor use.
4. The mean, s.d, CV, Min, Max are computed for 17 of the 18 tradable sectors; excluding coke and petroleum products sector is excluded as an outlier.

Source: Authors' computations.

A comparison of factor proportions against the corresponding output adds perspective to the analysis. The domestic output is relatively concentrated into the sectors with high labour intensity such as agriculture and allied, processed food, textile and leather, and business service (Table 3). At the same time, output contributions of few capital intensive sectors are also noted to be high. These include coke and petroleum products, chemical products, basic metal products, and financial service.

Table 3 – Factor proportions and structure of the Indian economy, 2013-2014

		Factor proportion (K-to-L)	Distribution (%)		
S.No	Sector name		Output	Exports	FDI
1	Agriculture and allied	1.26	17.9	6.6	1.1
2	Mining	4.82	3.9	1.0	0.2
3	Processed food	1.79	8.1	3.2	29.1
4	Textile and leather	1.31	6.0	8.6	0.9
5	Wood products	1.14	0.9	0.0	0.0
6	Paper, printing and publishing	1.17	1.2	0.4	0.9
7	Coke and petroleum products	33.73	12.4	14.2	0.7
8	Chemical products	4.78	6.3	7.1	15.7
9	Rubber and plastics	2.39	1.8	2.0	2.6
10	Non-metallic mineral products	2.50	2.2	0.3	2.8
11	Basic metal products	4.19	9.1	6.0	2.8
12	Machinery nec	1.96	2.8	3.2	7.3
13	Electrical equipment	1.92	2.3	3.2	3.1
14	Transport equipment	2.62	4.5	5.2	10.4
15	Manufacturing nec	0.67	4.0	10.6	3.1
16	Financial service	2.66	6.1	2.4	11.6
17	Business service	1.63	7.3	25.9	6.1
18	Education	0.43	3.2	0.2	1.5

Note: Table presents factor proportions vis-a-vis the structure of the economy, assessed in terms of sector-wise shares of output, exports and FDI.
Source: Authors' computations.

7. Capital proportions of labour intensive sectors

We, indeed, find higher (total) capital proportions even for the traditionally labour intensive sectors. For instance, labour intensive food processing activities (commodity sector C3 in Table 1) such as manufacture of tobacco products and manufacture of macroni, noodles, etc are noted to have capital proportions which are 18.4% more than normally assessed. An underestimation of that magnitude (almost of the order of one-fifth) for a labour intensive sector, which is also largely unorganised

and employs unskilled labour, is suggestive of the fact that employment generation in the labour intensive sectors will also demand more capital than estimated through measuring only their direct factor proportions. Likewise, is the case for textile and leather sector (C4) which also includes unskilled labour intensive activities related to manufacture of textiles, handbags, footwear, and ropes. Also in focus are the labour using services allied to the printing and publishing sectors (C6) due to an underestimation of the K-to-L proportion by more than 10%. Similarly, the capital requirements of yet another labour intensive activity, namely, the manufacture of refractory and non-refractory clay and ceramic products, included within the non-metallic mineral products sector (C10) is likely to be underestimated by about 10.8%. As a labour intensive activity, manufacture of structural metal products, included in the basic metal products sector (C11) is found to have the highest level of underestimated factor proportions. The capital proportion in relatively low value transport equipment (C11) such as bicycles are also underestimated by almost 10%. At the same time, the high value added but skilled labour intensive products such as gems and jewellery would fall short of capital by 6.9% as assessed from the proportions for miscellaneous manufacturing sector (C15) which is also inclusive of production of sports goods which use unskilled labour.

8. Factor proportions and external performance

The sectors of high export significance are the ones with relatively lower capital proportions which are s essentially labour intensive sectors. The strong export presence of coke and petroleum sector is an exception. The export significance of the coke sector, which also has the highest proportion of capital, is due to healthy performance of the refinery business in India with increasing domestic surplus benefiting from commission of new and brown-field expansions despite an increasing domestic demand. Increasing

demand from neighbouring countries such as Pakistan, Vietnam, Africa, Australia has also contributed to significant exports from India. Not surprisingly, the business services sector represents magnificent 22.4 % exports from a labour intensive tradable sector, which includes services such as accounting, computer related, legal and renting of machinery and equipment. Significant export shares are observed for labour intensive manufacturing including the textiles, and other manufacturing. The latter category is a composite of high value items such as gems and jewellery and imitation items and novelties, as well as low value products such as toys, presentation articles, costumes, stationary articles, and sports goods among others; all of which are labour intensive manufacturing. The primary exports from the labour intensive agriculture sector account for another 6.6 % share.

9. Factor proportions of FDI dominating sectors

Key FDI receiving sectors of the Indian economy include services (financial and banking), computer software & hardware, drugs & pharmaceuticals, chemicals (other than fertilizers), automobile industry, metallurgical industries, petroleum & natural gas, food processing industries, electrical equipments, cement and gypsum products, industrial machinery, miscellaneous mechanical & engineering industries, and consultancy services ; each having a cumulative share above 1%.[6] Within these, as many as eight sectors have K-to-L proportions above the national benchmark. These include financial services, drugs & pharmaceuticals, chemicals (other than fertilizers), automobile industry, metallurgical industries – both ferrous and non-ferrous separately, petroleum & natural gas, and cement and gypsum products. Thus, relating the FDI shares and sector-wise factor proportions, few sectors with high capital

[6] Refers to the shares in cumulative FDI during April 2000 and December 2013.

proportions are observed to have received greater shares of FDI which perhaps suggests that a clear pattern between FDI and factor proportions is rather absent, unlike as in the case of output and exports. The sector-wise distribution of FDI showing a concentration into high capital proportion sectors indicates the capital intensive nature of FDI despite the a priori labour endowments of India.

Clearly, India's labour intensive sectors have failed to woo foreign investors. In contrast, much of the FDI is concentrated into sectors with high capital proportions. Even more important is to note that the before mentioned FDI dominating sectors are among the sectors with highest proportions of indirect factor proportions; further reinforcing the capital intensive nature of their operations (refer Table 2). Furthermore, in view of their strong indirect use of capital it is unlikely that they will contribute much to employment generation in labour intensive sectors or otherwise.

Our observations on FDI centering into sectors with high capital proportions are broadly in sync with Sen (2008) who notes a small amount of FDI directed to labour intensive sectors of the economy. The sector-wise distribution of FDI shows high proportions into the chemical products, transport equipment, and financial services, all of which have high capital proportions. The affinity of FDI with sectors which are not necessarily labour intensive is unexpected at the first instance which we explicate as follows. The import substituting industrialisation of the pre-reform period emphasised on domestic production (Luis, 1999). This has been helpful in encouraging indigenous manufacturing of capital-intensive industries. Later, the trade reforms of 1990s targeted liberalisation of capital and intermediate goods through gradual tariff reductions. The resulting decline in the price of capital goods, which continued through the 2000s, distorted prices in favour of capital intensive manufacturing which encouraged substitution of capital for labour (Sen, 2014). The issue of high effective prices of hiring

labour in post reform period and evidently more likely to be impacting large sized firms, has also been investigated in Gupta et al. (2008). Since it is the large sized organised manufacturing where much of the manufacturing FDI is oriented; the price differentials further encouraged foreign investment into sectors which had higher proportions of capital. The relative high prices of labour also impacted FDI which is most likely to be efficiency seeking. In fact the unwillingness of investors to come forward for labour intensive activities, even in the states with progressive labour laws such as Gujarat, has been an issue of continued concern (Panagariya, 2017). The lack of interest in labour intensive activities also perhaps has to do with the relatively low price of capital over time. While the incentives for adoption of machine driven production lowered labour intensity of the manufacturing, though inadvertently; at the same time, the labour intensive sectors failed to allure FDI given the stringent labour regulations which prevent easy exit in times of dip in global demand. Further, the crowding-in effect of public investment on private investment, of which FDI is a component, has also contributed to greater investment, particularly in light of India's infrastructure deficit (Bahal et al., 2018). This further clarifies on the attractiveness of FDI into sectors such as the financial services, including banking and insurance services, which are much required to finance the huge construction projects.[7] Our findings on the concentration of FDI into capital intensive sectors are also in sync with the Balasubramanyam and Sapsford (2007) who clarify that the nature of FDI was more process oriented and therefore requires the availability of skilled manpower with tertiary levels of education in scientific and engineering fields. These factor requirements are spatially different

[7] Construction, by itself is a non-tradable sector. However, its indirect effect is captured through interactions with the tradables.

from those of the labour intensive sectors in the present structure. India's investing partners such as the EU, Japan, US chose to invest in chemicals, transport equipment and high-end engineering which had the skill availability to quickly adapt process technology and know-how to suit local factors and markets. Another plausible explanation for the predominance of capital intensive sectors in FDI distribution is due to the preferential choice of acquisition (whether initially or later) as a mode of investment in an already existing setup of private companies. This proposition is further supported by Wei and Balasubramanyam (2015) who directly emphasise on the FDI draft of capital intensive manufacturing not only due to the existing structural bias but also attribute it to the availability of managerial skills adept for capital intensive technologies which require less supervision with the engagement of fewer but skilled workers. They rather show a cold-shoulder to the role of labour rigidities in driving FDI away from labour intensive activities and toward capital intensive sectors.

10. Conclusions

The importance of structural coherence with factor endowment has been highlighted for economic growth by economic literature (Che, 2012). Therefore the problem of factor proportions is central to achieving long term and sustainable growth. The findings underscore the need to include indirect factor usage while estimating sector-wise factor proportions. The results show that the total factor proportions exceed notably by 24% from the direct factor proportions which are estimated from the factor inputs at the final stage only. Taking cognizance of the complementarities generated by the tradable sectors on the non-tradable sectors the average K-to-L ratio for the tradable sector appreciates notably. Eight of the 18 tradables arenoted to have capital proportions in excess of the benchmark taking into account the interactions with the non-tradable sectors.

The analysis provides few major insights. First, the underestimation of factor proportions, if only the direct factor usage is taken into consideration, is systematic although with varying magnitude across tradable sectors. Second, even the traditionally labour intensive sectors are noted to have higher proportions of capital than normally recognized. Third, the output and export distribution of the tradable sectors is largely aligned with the factor endowments. Fourth, the distribution of FDI in tradables is skewed towards sectors with high capital proportions. Fifth, and most importantly, the FDI dominating sectors are also the ones which have high indirect use of capital. On one hand, this implies greater capital requirements. On the other hand, it indicates that FDI may not be the panacea for employment generation due to the relatively low proportion of labour in FDI dominating activities which are largely classified as tradable sectors,

Our findings are aligned with the earlier works of Balasubramanyam and Sapsford (2007) and Sen (2008) who have noted the capital intensive nature of Indian manufacturing and also the FDI orientation towards capital intensive sectors. Despite India's a priori endowments of unskilled labour, the significance of capital intensive sectors in manufacturing FDI is on account of the existing set up of capital intensive manufacturing which in turn is due to price differentials. Also, the capital intensive industries require employing managerial expertise, which is the readily available domestically. This explains the weak employment effects of FDI in Indian economy, in contrast to China.

To conclude, the domestic output as well as exports of the tradables are concentrated in sectors with relatively high portions of labour compared to capital. However, the inverted factor linkage with sector-wise FDI highlights the efficiency seeking nature of the foreign investment which tends to maximise gains through operating in existing

industries that have only benefited from price distortions. Also, the availability of experienced managers by virtue of the existing operations both in public and private sector is an added advantage meeting the skill requirements of capital intensive sectors.

The present dominance of some high technology sectors, although noteworthy, seems to have been achieved through compromising focus on the competitive strengths in terms of labour. Perhaps, this has been due to the pressing need to upgrade into high technology sectors to match international trends.

Although we have sincerely attempted to capture the roundaboutness in production structure issues, the scope of the present research prevents us from simultaneously dealing with non-tradables. Nonetheless, we are mindful of the limited scope and suggest future work in this direction. Also, it will be useful to study the inter-temporal changes in factor proportions.

From a policy perspective, the results suggest that with the present orientation, FDI is unlikely to be the solution to employment generation problem with the existing skill set. On the other hand, a constant skill up gradation of the labour force needs to be pursued to prepare labour force for flexible employment into the capital intensive sectors. To the extent that factor proportions are an important determinant of the production and trade structures, the FDI concentration into sectors with high capital proportions is expected to shift the production and trade patterns into these sectors, as predicted by Romalis (2004). This only underscores the need to upgrade and diversify the existing skill base so as to improve employment outcomes in the economy. Simultaneously, the labour intensive sectors are likely to catch an FDI eye if select successful examples are available to emulate or extend, like has been the case for capital intensive sectors. With rising capital intensity of the labour intensive sectors, a different supply of labour is needed which is better trained and also mobile across sectors. In the times of fast

changing technology, the issue of labour intensive employment has turned more towards the efficiency which also includes flexibility to quickly adapt to newer technologies. Here, the skill development mission can be handy in re-orienting and enhancing the existing set of skills.

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