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Structural Transformation in an Open Economy with Trade in all Three Sectors: Statistical Evidence from India

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Keywords

labour allocation, modelling utility, sectoral TFP, India's sectoral productivities.

Abstract

In this term paper, an extension of the labour allocation model as presented by Kei-MuYi (2013) will be discussed. This term paper is divided into two parts. First, an extension of the the existing model will be discussed, in which, trade in services will also be included while modelling utility, comparative advantage, sectoral TFP and labour allocation. In the second part, data from India backing the results of the above model will be presented. From the data of India's sectoral productivities, sectoral labour shares, trade shares and trade costs, conclusions about the predominant sectors will be drawn.

Introduction

In a closed economy, the structural transformation of the economy is embarked upon two factors, namely, push and pull. Historically, in the pre-World War era, pull factors have dominated, i.e., the relative prices and productivities of manufacturing and agriculture where such that the labour was pulled into the manufacturing sector. However after the two World Wars, push factors have been dominating. This has been the case for most of the Western countries that have been undergoing structural change before the two Wars. However, for majority of the countries which started structural transformation after the Wars, they had to deal with a much more liberal and open world. Amidst this competitive environment of the liberal world order, trade too started to contribute in the GDP share of individual countries and hence to their sectoral productivity growths.

To prove this empirically, much of the work has been done by Timothy Uy, Kei-Mu Yi, Jing Zhang in a 2013 paper- Structural change in an open economy. The basic premise of the above mentioned paper is that the labour allocation of a sector is a direct sum of net sectoral export share and sectoral expenditure of the country. This on comparison with the closed economy model, which accounts only the expenditure channel, gave better results authenticating the new below mentioned model.

$l_i = X_i + N_i$

i= agriculture, manufacturing (Open Economy Model)

where, X_i is sectoral expenditure of a country on sector i and N_i is net export share

Though the above mentioned model include trade in intermediaries, the trade is limited to just two sectors- agriculture and manufacturing. Whereas, for low wage countries like India, services sector trade contribute largely to the GDP, and hence impacts the labour allocation. This can be backed by the Indian data, highlighting the changes in structural transformation after 1990s. It is important to note that India undertook major steps to liberalise its economy in 1991. Though this liberalisation was a consequence of a looming double deficit, it has transformed India's sectoral trade and productivity growths.

Open Economy Model:

Production Function:

$$Y_{ik}(z) = A_{ik}(z)L_{ik}(z)^{\lambda_k}\left[\Pi_{n=a,m,s} M_{ikn}^{\gamma_{kn}}(z)\right]^{1-\lambda_k}$$

Where, i= Country 1, 2; Sector k= a, m, s; $A_{ik}(z)$ denotes exogenous productivity; $L_{ik}(z)$ denotes labor; $M_{ikn}(z)$ denotes sector-n composite goods used as intermediates in the production of the sector k good; [0<z<1];

λ_k denotes the value-added share in production ; γ_{kn} denotes the share of intermediate inputs sourced from sector n.

For a tradable product, the price in country i would be the minimum of { price of product produced within country i, product exported from country j}

Price of product exported from country j to i=> $p_{ijk}= t_{ijk}v_{jk}/A_{jk}$, where t_{ijk} is the trade cost and v_{jk}/A_{jk}- the product cost in country j. Further, this t_{ijk} and TFP impacts π_{ijk}- which is the probability of country i spending on sector k goods from country j.

Preferences:

For country i, the Utility function is:

$$U(C_{ia}, C_{im}, C_{is}) = \left[\omega_a^{1/\epsilon}(C_{ia}-\bar{C}_a)^{(\epsilon-1)/\epsilon} + \omega_m^{1/\epsilon}(C_{im}-\bar{C}_m)^{(\epsilon-1)/\epsilon} + \omega_s^{1/\epsilon}(C_{is}-\bar{C}_s)^{(\epsilon-1)/\epsilon}\right]^{\epsilon/(\epsilon-1)},$$

where C_{ik} represents the sectoral consumption, ω_k the sectoral preferences and e the elasticity of substitution.
If e>1, composite goods are substitutes
e<1, composite goods are complements.

Household maximises its utility with respect to budget : $P_{ia}C_{ia}+P_{im}C_{im}+P_{is}C_{is}=w_i$

Equilibrium:

Total Labour = $L_i=L_{ia}+L_{im}+L_{is}$

We next characterize the market clearing condition:

$$Q_{ik}=C_{ik}+\sum_{n=a,m,s}(1-\lambda_n)\gamma_{nk}\sum_{j=1,2}\pi_{jn}P_{jn}Q_{jn}/P_{ik}$$

Q_{ik} here is the sum of the quantity demanded for:

- Domestic final consumption, C_{ik}
- Intermediate inputs in production of domestic tradable goods (term 2)
- The three important features of the model:
- Allows trade in intermediaries, as most of the trade happens in intermediaries.
- Allows two-way linkages across sectors.
- Allows trade in services sector.

Labour Allocation:

Income from a country's sector-k = Expenditure of both countries on goods from sector-k, i.e.,

$w_1L_{1k}= \pi_{11k}P_{1k}C_{1k}+ \pi_{21k}P_{2k}C_{2k}$

Where π_{21k} is the probability of country 1 spending on sector k goods from country 2.

On substituting π_{11k} with 1- π_{12k} and dividing the above mentioned equation with wage w_1,

$$l_{1k} = X_{1k} + \frac{\pi_{21k}X_{2k}w_2L_2 - \pi_{12k}X_{1k}w_1L_1}{w_1L_1} = X_{1k} + N_{1k},$$

$$\hat{l}_{ikt} = \frac{X_{ikt}}{l_{ikt}}\hat{X}_{ikt} + \frac{N_{ikt}}{l_{ikt}}\hat{N}_{ikt},$$

Where, i=a,m,s

The above two equations represent the fact that the sectoral labour depends on two channels: Sectoral Expenditure(X) and Net Sectoral Exports(N).

Comparative Advantage:

Country i has a comparative advantage in services if and only if $A_{is}/(A_{js}/\pi_{ijs}) > A_{ik}/(A_{jk}/\pi_{ijk})$ {k= a,m}

The above condition includes the relative productivity and trade costs involved in the three tradable sectors. Therefore, if this is the case then $\pi_{11s} > \pi_{11k}$, i.e., the share of country i's expenditure on domestically produced services is higher than that of domestically produced manufacturing or agricultural goods.

Also, it is assumed hereafter that each country runs a net export surplus in its sector of comparative advantage. Hence, labor shares are directly affected by patterns of specialization induced by trade.

Statistical evidence from India:

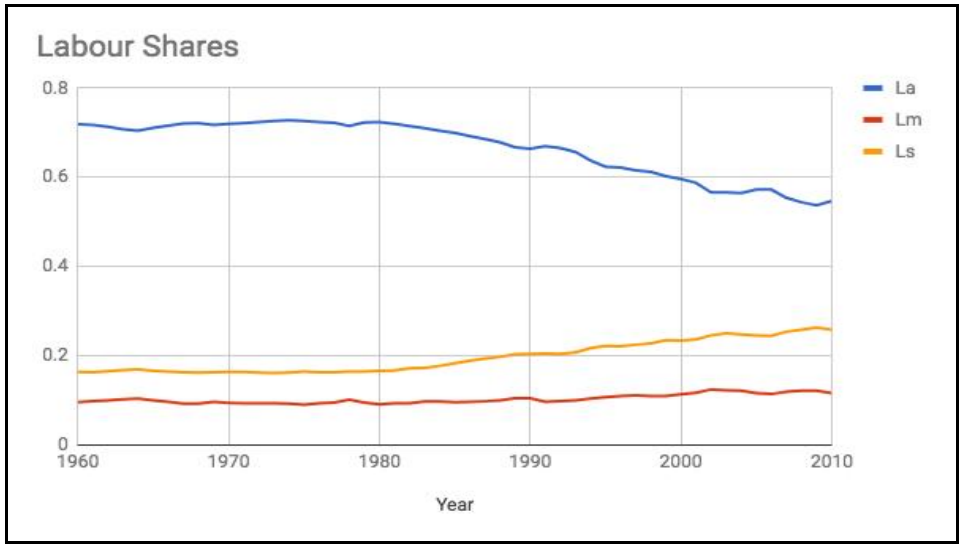

Fig.1 Labour Shares- India

While the absolute labour has more than doubled in the past 5 decades, it is important to note that the changes in labour shares have been sharp only after the mid-1980s. The biggest gainer of the declined agricultural labour share has being the services sector and a miniscule gain in manufacturing labour share is also observed. This change was more evident post-2010, when the agricultural labour reduced in absolute terms for the first time in the history of independent India.

a) Expenditure Channel:

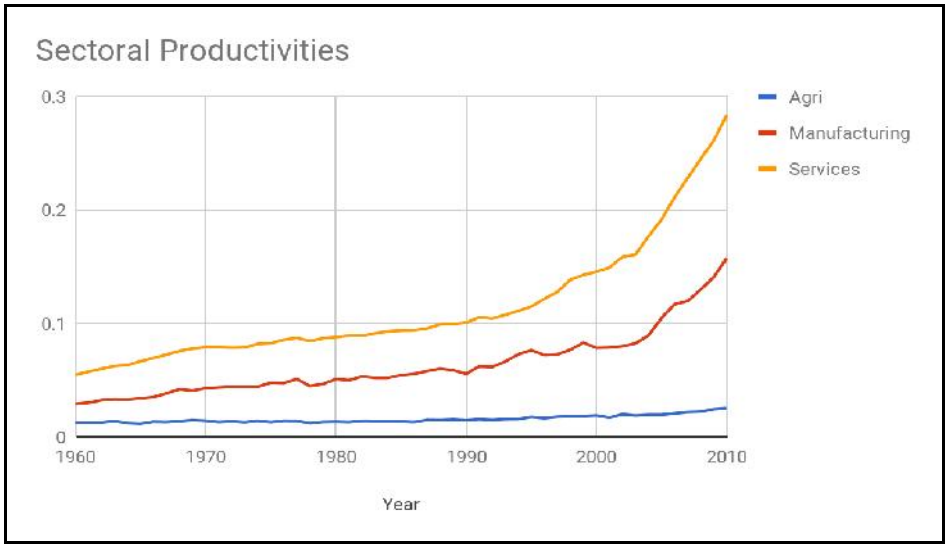

Fig. 2 Sectoral Productivities- India (Output in Billion Rupees/Population in 1000s)

Here as well, a different trend in the increasing productivities is visible after 1991. The same can be attributed to India's economic reforms which opened Indian markets to foreign trade and capital, increasing competitiveness, efficiency, and capital stock.

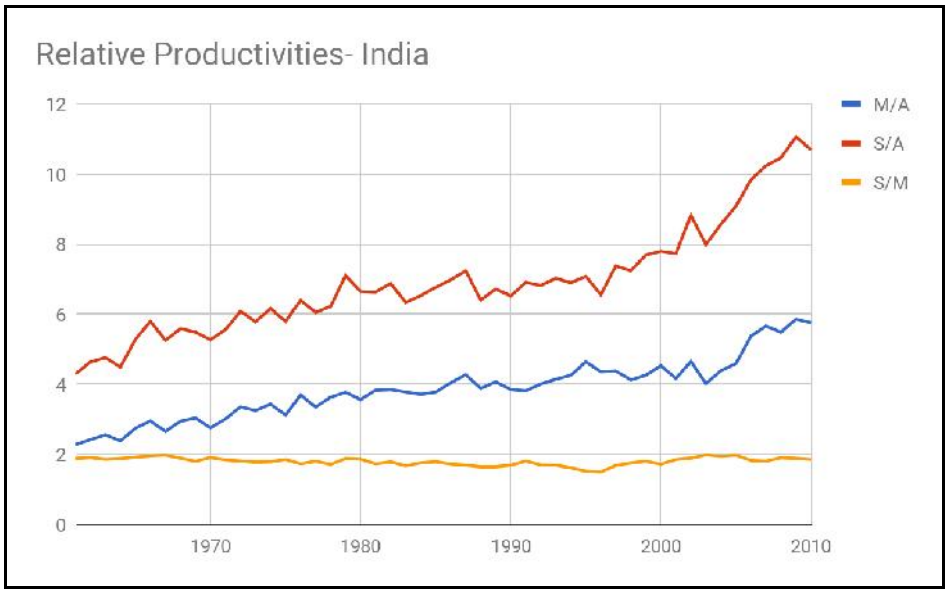

Fig 3. Relative Sectoral Productivities- India

The relative sectoral productivity show two things. First, the sector which has better productivity historically, i.e, Services. Second, the relative growth of the productivities, which is similar for Manufacturing and Services sector in India.

It is clearly evident from the above two plots that the services sector has been outperforming both the manufacturing sector and the agricultural sector in terms of productivity. And taking productivity as a measure of structural transformation[2], it can be concluded that the 'Expenditure Channel' (as defined above) has been favouring India's services sector and to the manufacturing sector in almost similar pattern, with the former performing better. Whereas, agricultural sector has been suffering in terms of relative productivity growth.

b) Net Exports Channel:

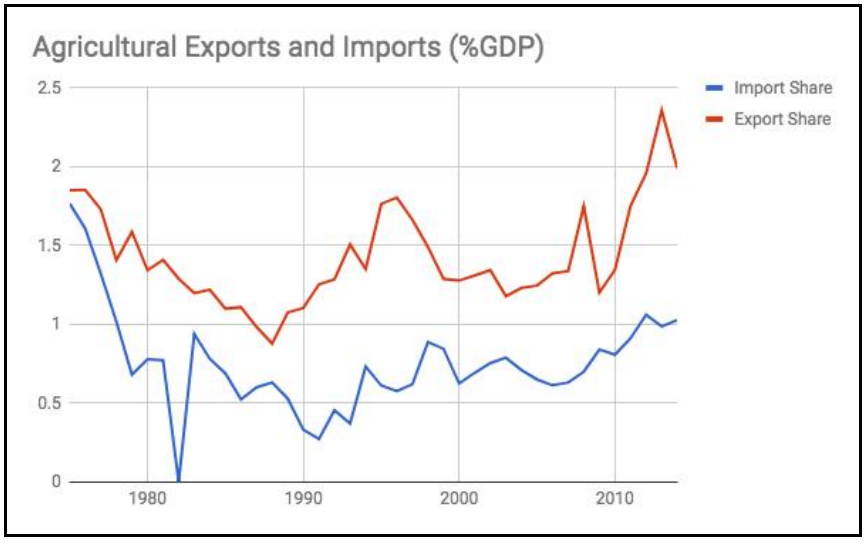

Fig 4. Agricultural Import and Export with the Entire World (%GDP)

Agricultural exports and imports data includes commodities: 0-12, 22, 26, 29, 41, 42 of HS classification, i.e., Live animals, Meat and meat preparations, Dairy products and eggs,Fish and fish preparations, Cereals and cereal preparations, Fruit and vegetables, Sugar, sugar preparations and honey, Coffee, tea, cocoa, spices & manufacs., Feed. Stuff for animals excl. Unmilled cereals, Miscellaneous food preparations, Beverages, Tobacco and tobacco manufactures, Oil seeds, oil nuts and oil kernels, Textile fibres, not manufactured, and waste, Crude animal and vegetable materials, Animal oils and fats, Fixed vegetable oils and fats. It is evident from above that India has a comparative advantage in the agricultural trade and has a trade surplus (average 1% historically).

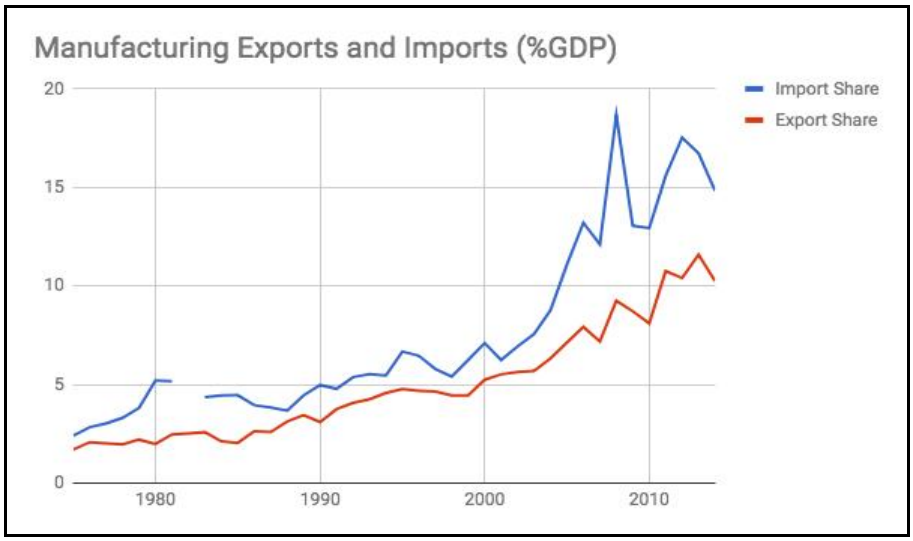

Fig 5. Manufacturing Import and Export with the Entire World (%GDP)

Manufacturing exports and imports data includes commodities: Firearms of war and ammunition, Miscellaneous manufactured articles, Scientific & control instruments, photogr gds, clocks, Footwear, Clothing, Travel goods, handbags and similar articles, Furniture, Sanitary, plumbing, heating and lighting, Transport equipment, Electrical machinery, apparatus and appliances, Machinery, other than electric, Manufactures of metal, Textile yarn, fabrics, made up articles, etc., Wood and cork manufactures excluding furniture, Rubber manufactures, Leather products, Chemical materials and products, Plastic materials, Explosives and pyrotechnic products, Fertilizers, Perfume materials, toilet & cleansing preptions, Medicinal and pharmaceutical products, processed Animal and vegetable oils and fats, Petroleum and petroleum products, Pulp and paper. In the recent past, India's (manufacturing) trade deficit has been ranging between 4%-8%.

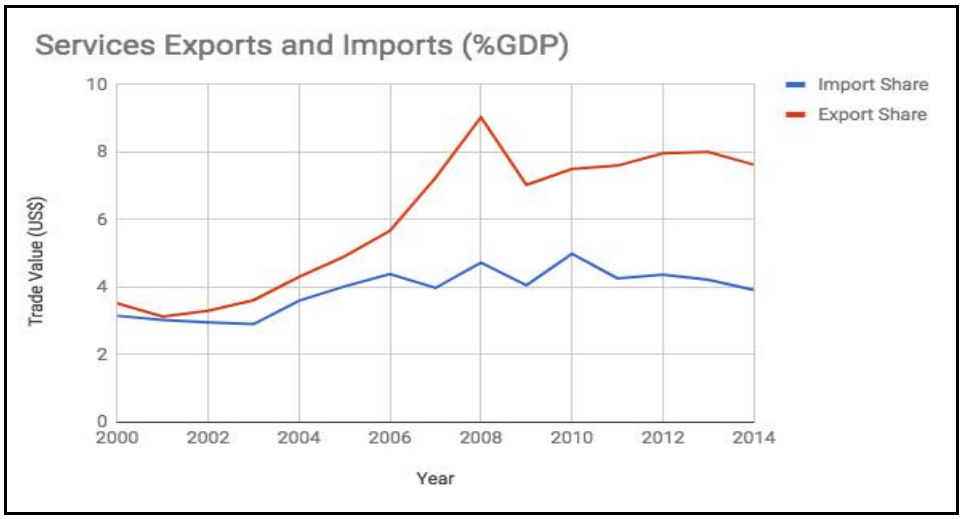

Fig 6. Services Import and Export with the Entire World (%GDP)

In the last two decades India has developed a huge trade surplus in the services sector. In theoretical terms it can be concluded that this might be due a comparative advantage of India in services sector. Assuming the trade surplus as the measure of the comparative advantage, India's services sector has comparative advantage over agriculture(small surplus) followed by a distant manufacturing (large deficit).

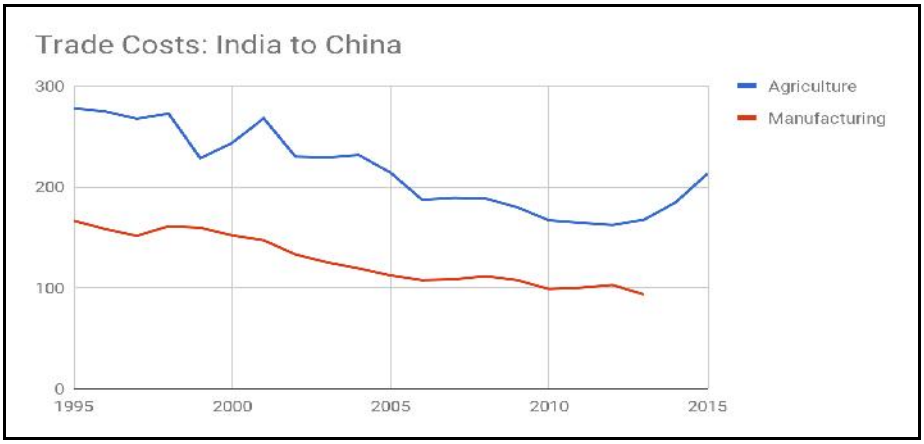

Fig 7 a)

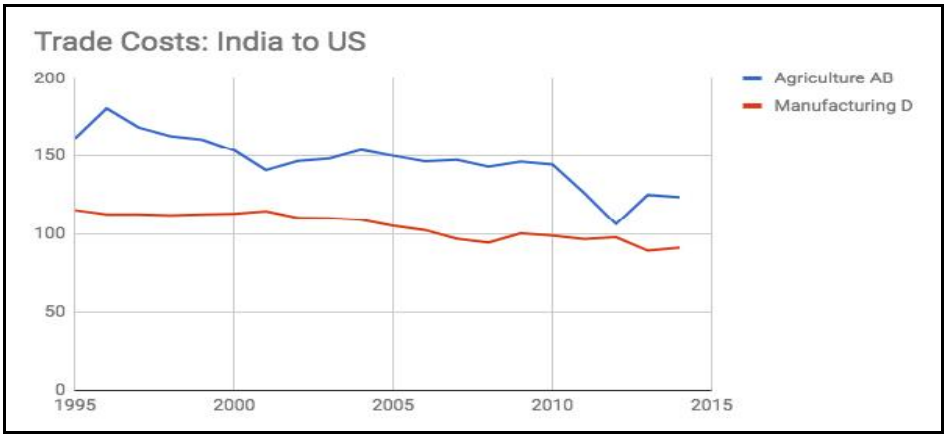

Fig 7 b)

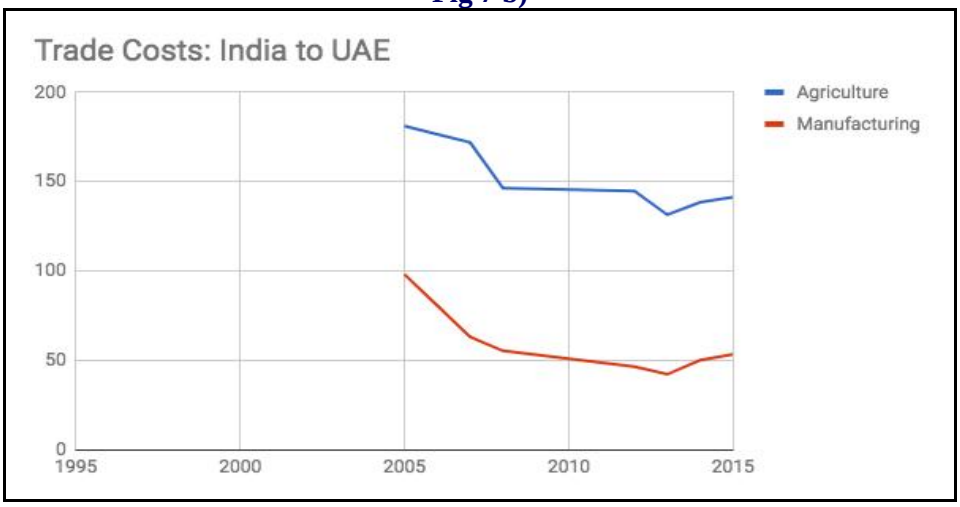

Fig 7 c)

Fig 7. Trade Costs: India and China, US, UAE (30% Indian Trade with the 3 countries)

The aggregate import-export trade costs with major trading partners have been on a decline. This has made the it easier for countries to import and export products from India. Separate data on import costs and export costs would have given us better insight into the role of trade costs in the Net Export Channel. As the data is not available, for the rest of the part let's assume that the export costs and import costs show same pattern in all three sectors and hence has miniscule impact on labour allocation.

Conclusion:

It is evident from India's trade data that, services sector is a major player. Hence, while considering an open economy model, it would wise to consider the role of the same. Also, using the above mentioned theory, it can be concluded that the services sector has an advantage in both of the two channels, i.e., Expenditure and Net Export. These two channels negate their impact on the manufacturing sector. Whereas for the agricultural sector, the expenditure channel pose a huge negative impact and the export channel a slight plus. The same can be concluded from the table made below:

Sector	Expenditure Channel Impact	Net Export Channel Impact	Variables	Labour Share Impact
Agriculture	-a	+b	a>>>b	Decreasing rapidly
Manufacturing	+c	-d	c>=d	Slight Increase
Services	+e	+f	e>=c, f>>b	Increasing rapidly

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[2] American Economic Journal, Structural Change Out of Agriculture: Labor Push versus Labor Pull (2011).

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