Session 2D: Inequality and Growth in Developing Countries
Time: Monday, August 6, 2012 PM

Paper Prepared for the 32nd General Conference of
The International Association for Research in Income and Wealth

Boston, USA, August 5-11, 2012

Has the Inflation and Growth Process Resulted the Domestic Terms of Trade in Favor of Agriculture or Industry? Evidence from Cross Country Analysis

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12/07/2012
(Preliminary - Not to be Quoted)

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Abstract

The recent events of high commodity prices and their volatility have been experienced in both the developed and low-income countries. While it is empirically interesting to examine the extent to which prices of food and raw materials (agriculture) moved in relation to energy, metals and minerals (industry), it remains equally relevant to focus on how the price of service activities like trading and financial activities have moved in comparison to commodity prices. This paper extends the basic two-sector framework of terms of trade (TOT) analysis to include the service sector and use a methodology in the national income accounting framework to construct TOT estimates at the 3-sector classification. We further examine whether the TOT for agriculture, industry and service sectors follow any pattern of movement as the per capita real income in countries progress with economic growth. The TOT effect on agriculture, industry and services are worked out during the period 1970-2010 for a sample of 15 economies, viz., Bangladesh, China, Ethiopia, India, Indonesia, Japan, Malaysia, Mexico, Nigeria, Korea, South Africa, Srilanka, Sudan, Uganda and Tanzania. Results indicate that TOT has remained favorable to services in 7 and unfavorable to agriculture in 8 economies. The analysis across economies suggests that the TOT remained favorable to either agriculture or industry in low and middle income countries, but turned favorable to services in high-income countries. Corresponding evidences also suggest that as per capita income progresses, the domestic TOT tends to favor agriculture in low income countries, but converts into favoring either industry or services for middle and high-income countries. (256 words).

Keywords: *E31, O18, R11, O50, C21.*

JEL Classification: Price Fluctuation, Sector/Regional Analysis, Impacts of Economic Growth, Country Studies, Cross-section Models.

To be Presented at the 32nd Annual Conference of International Association for Research in Income and Wealth, Boston, USA, 5-11 August 2112.

Session 2D: Inequality and Growth in Developing Countries, 6th August 2112.

1. Introduction:

Spiraling inflation has often remained a challenge for the macroeconomic management as well as for making sustainable policies for inclusive growth in developing economies. The commodity prices, which have been rising since 2003, continued to rise rapidly in 2007 and almost doubled over the past five years for food, energy and metals, before they began to fall after the economic crisis of 2008 (UNCTAD 2008, World Bank 2009). The recent inflation trends indicate that the subject of price fluctuations is beginning to comeback and we observe that the current phase is mainly concentrated in food and primary commodities. Some analyses have inferred that the previous oil price increases could have impacted on the agricultural prices through price of machinery fuels and fertilizers. Similarly, it has been argued that the financial activities of hedging and speculation (due to the commodity future exchanges) could have indirectly contributed to the commodity price developments. While a major apprehension about the current inflation revolved around food security in low and middle income countries, the acceleration of basic metals and energy prices caused by the demands in emerging markets like China happened to be the other growing concern.

Since, the commodity price inflation is likely to adjust the relative price structures of agriculture, metals or energy inputs differently in an economy; it would be very pertinent to look into the extent to which prices of aggregate industrial sector have advanced in relation to the primary sector. It is in this context that the sectoral terms of trade (hereafter TOT) emerges as a useful analytical tool to understand the relative commodity price developments in an economy.[1] But, the analysis of sectoral TOT are normally carried out in a dual economy framework consisting of agriculture and industry (non-agriculture), whereas the service prices have continued to surpass commodity prices in many economies for several years. Therefore, while it remains empirically appealing to examine the extent to which the prices of industrial commodities moved in relation to the primary commodity pries, it becomes equally relevant to focus on how the service sector' s prices developed in relation to commodity prices in an economy. The particular concern about the inappropriateness of a two-sector analysis of domestic TOT emerges in view of the fact that the commodity sector analysis of prices could address issues only for the subset of an economy. The exercise of estimating domestic TOT within the two-sector approach would therefore be insufficient to understand

[1] The sectoral terms of trade between two competing sectors are generally expressed as the relative price ratios of the two sectors, both indexed.

the nature of current inflation, and a three-sector approach would be relevant to explain the relative spreads of commodity and service price inflation in the present context.

The objective of this paper is to use an alternative methodology to construct TOT estimates at the broad 3-sector classification for a number of sample economies, and subsequently examine whether there is a pattern of TOT shift across economies with diverse levels of economic growth as indicated by their per capita real income levels. For this, we have considered those economies, where the role of domestic TOT remained historically important and was highlighted in the relevant literature, viz., Bangladesh, China (People's Republic of), Ethiopia, India, Indonesia, Japan, Malaysia, Mexico, Nigeria, Korea (Republic of), South Africa, Srilanka, Sudan, Uganda and Tanzania (United Republic of). We first use a methodology in the national income accounting framework to construct TOT estimates at the broad 3-sector classification, viz. agriculture, industry and services for these 15 economies during the period 1970-2010. Subsequently, we enquire on the pattern of TOT movements for domestic sectors across the sample economies. We classify the statistical trend of individual sectoral indices to discern the pattern of TOT movements in low, middle and high income countries. Finally, we enquire into the pattern of relationship between sectoral TOT movements and per capita real income levels, separately, for country-groups with dissimilar income levels. To discern the relationships, we use regression analysis of sectoral TOT on per capita GDP for the three classified groups of economies with low, middle and high incomes, respectively. We consequently use regression with dummy variables to study whether the relationships between sectoral TOT and per capita real GDP level vary across country-groups with diverse income levels.

The plan for the rest of this paper is as follows. We begin by briefly reviewing the literature that highlighted the role of TOT in the development process (section 2). The quantitative importance of the service sector is examined for each of the sample economies in section 3. In section 4, we provide the methodological framework, sectoral classification and data base used for the calculation of sectoral TOT measures. Subsequently, we work out estimates of TOT effects in the three major sectors for 15 sample economies in section 5. We also examine the trend direction of sectoral TOT movements, both within individual economies and in groups consisting economies classified over per capita income levels. An examination of the nature of relationship between sectoral TOT and per capita income is provided in section 6 for the three groups of economies. Section 7 summarizes the results and implications of our findings.

2. Sectoral Terms of Trade in the Developing Process:

Sectoral terms of trade (hereafter TOT), conventionally defined as the ratio of prices received to prices paid between two sectors, are often perceived as having significant implications for economic outcomes faced by developing nations. In fact, the study of TOT between agriculture and industry sectors can be described as one of the most widely researched topics in development economics. Some of the earliest references to TOT can be found in the *classical* writings of Adam Smith and David Ricardo. The *classical* economists believed that the limited possibility of *division of labor* in agriculture coupled with the twin factors of population growth and scarcity of fertile land would lead to an upward influence on *corn prices*. Latter, a contrary assertion emerged from the two separate works by Prebisch [1950] and Singer [1950], which led to the formulation of what has come to be known as the Prebisch-Singer hypothesis. The hypothesis predicted deterioration in the TOT faced by developing countries, if they concentrated on primary sector exports. However, it was Preobrazhensky [1926], who first conceived of TOT as a policy instrument to finance capital formation in the former Soviet Union. He visualized domestic TOT as a means of extracting surplus from agriculture during the early industrialization phase. The idea of *primitive socialist accumulation* in Preobrazhensky [1926] was oriented towards keeping agricultural prices low in relation to industry. Subsequently, the works of Sah and Stiglitz [1984, 1987], Andrews [1985], Rattso [1988] and Knight [1995] have renewed the interest on the notion of *price scissors*. Later, Lewis's [1954] dual economy model explicitly brought out the importance of TOT in formulating development strategies for LDCs. Lewis pointed out that deterioration in the industrial TOT can result in a drag on the industrialization process.

Though the analysis of TOT has played an important role in the study of developing economies, many aspects of this enterprise have been subject to debate. One prominent controversy is centered on the role of agricultural TOT in the development process. Thus, the domestic TOT were identified as an instrument that is used to transfer resources from agriculture during the early phase of industrialization. However, subsequently, the view that there should be an outflow of capital from agriculture to industry came to be seriously challenged. In particular Schultz [1964] argued for the importance of a positive agricultural pricing policy to transform traditional agriculture, and perceived unfavorable agricultural TOT as price distortions that adversely affect production incentives. Subsequently, these perceptions played an important role in aligning sectoral TOT with the study of aggregate agricultural supply response (Delgado and Mellor 1984, Chibber 1988, Binswanger 1990,

Schiff and Valdes 1992, Bautista and Valdes 1993, Schiff and Montenegro 1995). It may also be added that the issues surrounding adverse agricultural TOT informed the assertion that there was an inherent u*rban bias* in the policies adopted by LDCs (Lipton 1977).

The study of historical experience with TOT led transfers from agriculture has also received considerable attention in the literature (Preobrazhenski 1926, Ohkawa and Rosovsky 1960, Johnston 1966, 1970, Ishikawa 1967a, 1967b, Lee 1971, and Ellman 1975). Several country specific studies have subsequently examined the extent of net inter-sectoral resource flow (NIRF) out of agriculture during respective phases of industrialization. Among such studies, particular mention can be made of Ohkawa, Shimizu and Takamatsu [1978], Mundle and Ohkawa [1979], and Teranishi [1986] for Japan; Mundle [1977, 1981] and Mody [1979, 1981] for India; and Sheng [1992] for China. The empirical evidence on the pattern of resource transfer indicates that this process has not been uniform across countries. In relation to the successful growth experiences of east and south-east Asian economies, studies suggest that raising the agricultural productivity levels have played an important role in enabling the transfer of resources out of agriculture (Amsden 1989, Page 1994, Mommen 1996).

More recently, the discussion on trade liberalization in developing economies has also invoked attention to the role of agricultural TOT. A large number of studies have indicated that agricultural prices in developing countries are generally well below those in international markets and industrial prices are higher due to policies such as exchange rate overvaluation and restrictive import tariffs (Peterson 1979, Lutz and Scandizzo 1980, Bautista [1986], Kruger, Schiff and Valdes 1988, Kruger 1992, Schiff and Valdes 1992). It has been argued that government policies oriented towards protecting industry have reduced the price farmers receive and increased the price they pay for their intermediate and consumption purchases. It has been further suggested that trade barriers against agriculture have distorted the domestic relative price structure against agriculture. It is therefore inferred that trade liberalization and deregulation of domestic markets will lead to an improvement in agricultural TOT (Tolley et al 1982, Loo and Tower 1989, Anderson and Tyres 1990, Goldin and Winters 1992, Bautista and Valdes 1993, Kruger 1995).

It may be inferred from this brief review that the perceptions on the role of agriculture-industry TOT in the development process have not remained static. As perceptions of the development process have changed, so has the perceived role of agricultural TOT. In their latest role, sectoral TOT are viewed largely as a policy instrument to get agricultural prices "right" and, improvements in agricultural TOT are perceived to

indicate the success of an agricultural reforms programme (World Bank 2008). Some experts have in fact, viewed the events of high cereal prices in 2008 as opportunities in farmer's incentives to boost the agricultural production.

Table 1: Structure of the Economy (2010).

Country	Agriculture (% of GDP)	Industry (% of GDP)	Services (% of GDP)
Bangladesh	19	28	53
China	10	47	43
Ethiopia *	48	14	38
India	19	26	55
Indonesia	15	47	38
Japan	1	27	72
Malaysia	11	44	45
Mexico	4	34	62
Nigeria	49	37	21
People's Republic of Korea	3	39	58
South Africa	3	31	66
Srilanka	13	29	58
Sudan	24	33	43
Uganda	24	25	50
United Republic of Tanzania	28	25	47
Low Income Countries	25	25	50
Middle income Countries	10	36	55
High Income countries	1	24	75

Source: World Economic Indicators, 2012, * Data for Ethiopia refers to 2000.

3. Services as the Emerging Sector:

Having briefly reviewed the role of TOT in the development process, we now turn to the emerging concern that generated the motivation of this paper. It has been the standard practice to accomplish the analysis of TOT within a dual economy framework, where the economy is notionally bifurcated into agriculture and industry sectors. However, contemporary sectoral profiles of various countries indicate that developing economies can no longer be represented in the terms of a prototype dual economy. The growth experience

over the last fifty years or so, has led to a structural transformation of many economies – where an increasing percentage share of the GDP seems to originate from service and tertiary activities (Kuznets 1971, Chenery and Syrquin 1975, Chenery 1979, Chenery et al 1986).

This trend appears to have intensified in a number of low and middle-income countries. Table 1 provides data on the changing sectoral distribution of GDP for our sample economies as well as in economy-groups with low, middle and high per capita income levels. It can be seen that services today occupy around half the economy size even in the case for low-income countries. Since the service sector has emerged across economies, irrespective of the levels of country's per capita income, their roles need to be incorporated in the domestic TOT analysis. Given such structural change, the impact of a shift in sectoral TOT on the economy needs to be studied using a multi-sectoral accounting framework.

4. Methodology and Data:

The multi-sectoral formulation of TOT evolved in the works of Rasmussen [1957] and Olgaard [1966]. Subsequently, Bjerke [1968, 1972], Olgaard [1981] and Derksen [1980] have made use of this framework in the context of the Danish and Dutch economies. These studies, by employing the inter-industry transactions data within the national income accounting (NIA) framework, have attempted to provide measures of income gains (or losses) accruing to different domestic sectors as a result of changes in the economy's relative price structure. These effects are referred as the *"sectoral TOT effects*" on various domestic sectors in the economy, which are interpreted as gains (or losses) accruing to sector j due to changes in inter-sectoral TOT and are calculated by using the following formula:

$$\text{TOT Effect (or Gains from TOT change)}_j = \frac{1}{P_{va}}\left[X'_{va.j}\left(P_{va.j} - P_{va}\right)\right] \qquad \textbf{(1)}$$

where:

$X_{va.j}$ = sectoral gdp of the j-th sector at current prices
$X'_{va.j}$ = sectoral gdp of the j-th sector at constant prices
$P_{va.j}$ = implicit price deflator for the j-th sector, i.e., $P_{va.j} = X_{va.j} / X'_{va.j}$
P_{va} = implicit price deflator for the economy, i.e, $P_{va} = \Sigma_j X_{va.j} / \Sigma_j X'_{va.j}$

and, j runs from 1 to 3 in the case of three-sector classification, viz, j = agriculture and allied, industry and services.

The expression of TOT effect as per equation (1), fundamentally reflects the disproportionate change in implicit price of value added for the *j-th* sector vis-a-vis that of the

economy. Further, the price difference between sector *j* and the economy is assumed to be in some proportion of the *j-th* sector's real value added in the inter-sectoral TOT gain (loss) measure. This assumption implicates that sector *j* purchases commodities in correspondence with its value added output. The final expression captures the sectoral gains as the purchasing power of total GDP basket by undertaking a deflation through such price index. The detailed methodological framework and interpretations of the multi-sectoral TOT measure have been discussed in Deb [2006], while carrying out TOT analysis for the Indian economy.

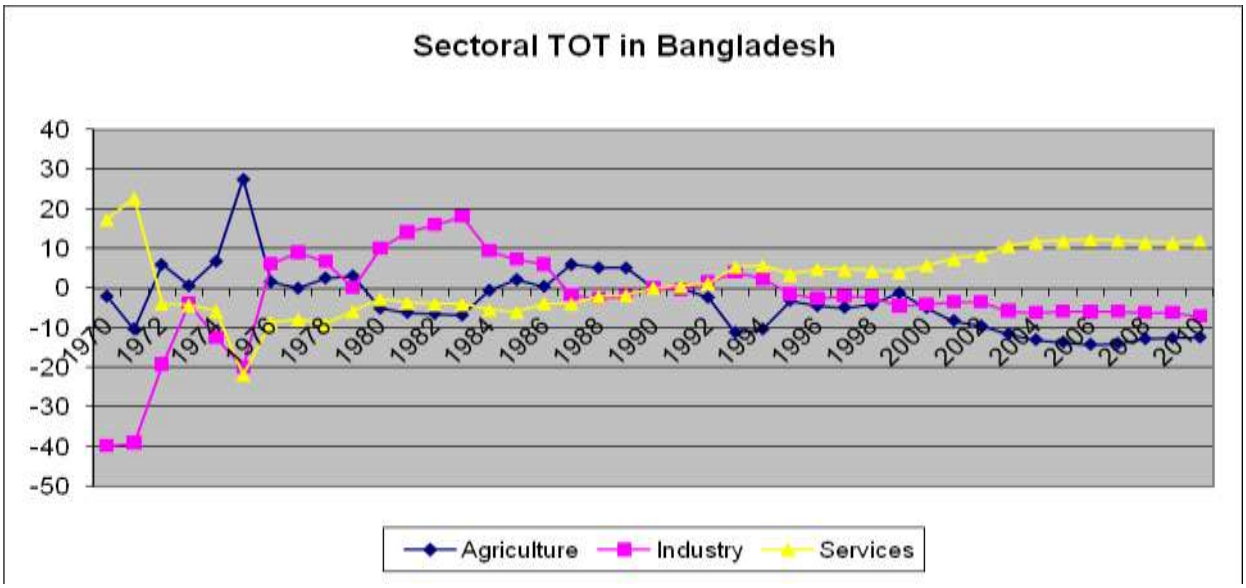
The estimate of TOT effects are defined using a broad three-sector classification of the economy consisting of i) agriculture and allied activities, ii) industry, and iii) services. Following the United Nation's International Standard Industrial Classification (ISIC), Revision 3, the agriculture and allied activities include agriculture, hunting, forestry and fishing (ISIC A and B). The industry sector is defined by aggregating mining, manufacturing, utilities and construction (ISIC C, D, E and F), whereas the services sector is comprised of wholesale & retail trade, hotels & restaurants, transport, storage & communication, financial activities, real estate & business activities, public administration, education, health, community, social & personal services and other activities (ISIC G to P).

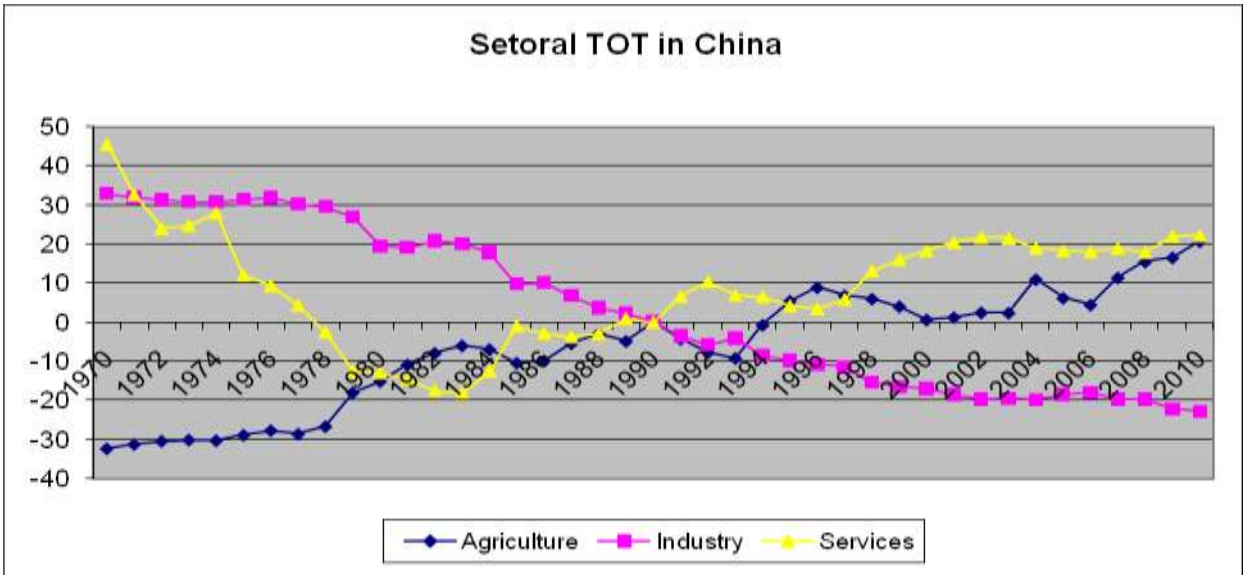
The basic data on total GDP and constituent sectors (both at current and constant prices) are collected from issues of *National Accounts Statistics*, brought out by United Nations (UN). The constant price sectoral GDP estimates, which were originally with 2005 as the base year, have been pre-adjusted so as to have a common base year which is 1990. For this, we first undertook a base-shifting of respective implicit price deflators (IPD) to 1990 and subsequently use the sectoral IPD series (with base: 1990) to deflate the current price value added estimate of respective sectors in different economies. By way of carrying out this deflation, we get comparable constant price estimates of sectoral value added in all the economies. Our data in general refers to the period 1970 to 2010, except for Ethiopia, which is available only over the span 1990 to 2010. Therefore, we actually have forty-one observation on all the economies and twenty-one observations on Ethiopia.

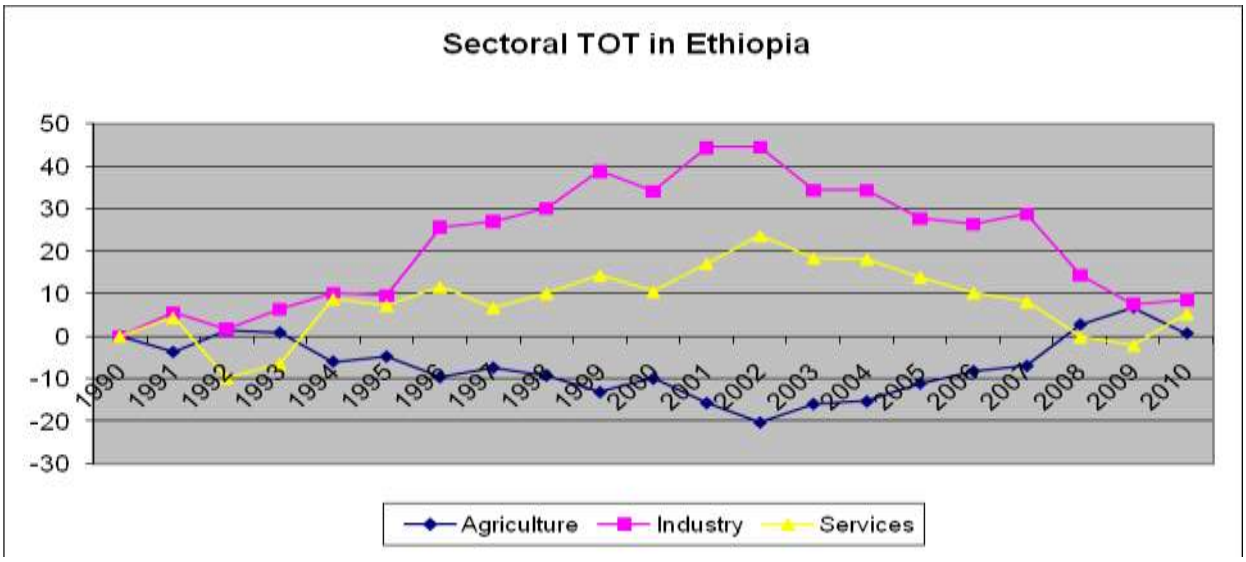
5. TOT Results:

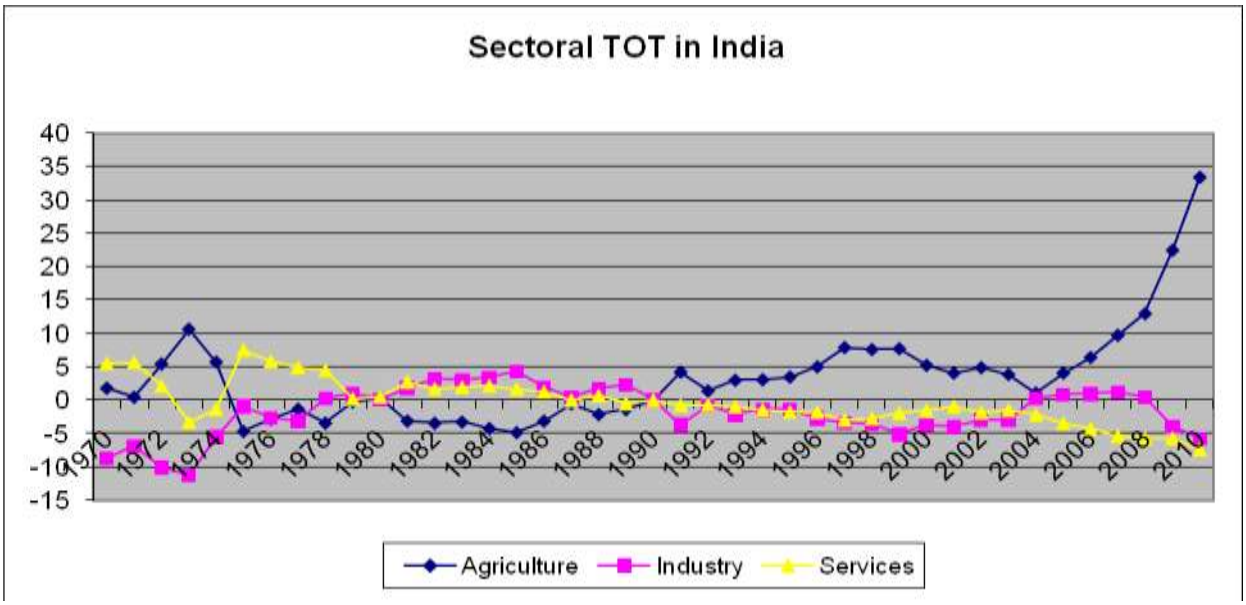
The results on sectoral TOT for fifteen diverse economies during 1970-2010 have been provided in the form of a graphical plot in Figure 1.

Figure1: Trends in Sectoral Terms of Trade








Sectoral TOT in India
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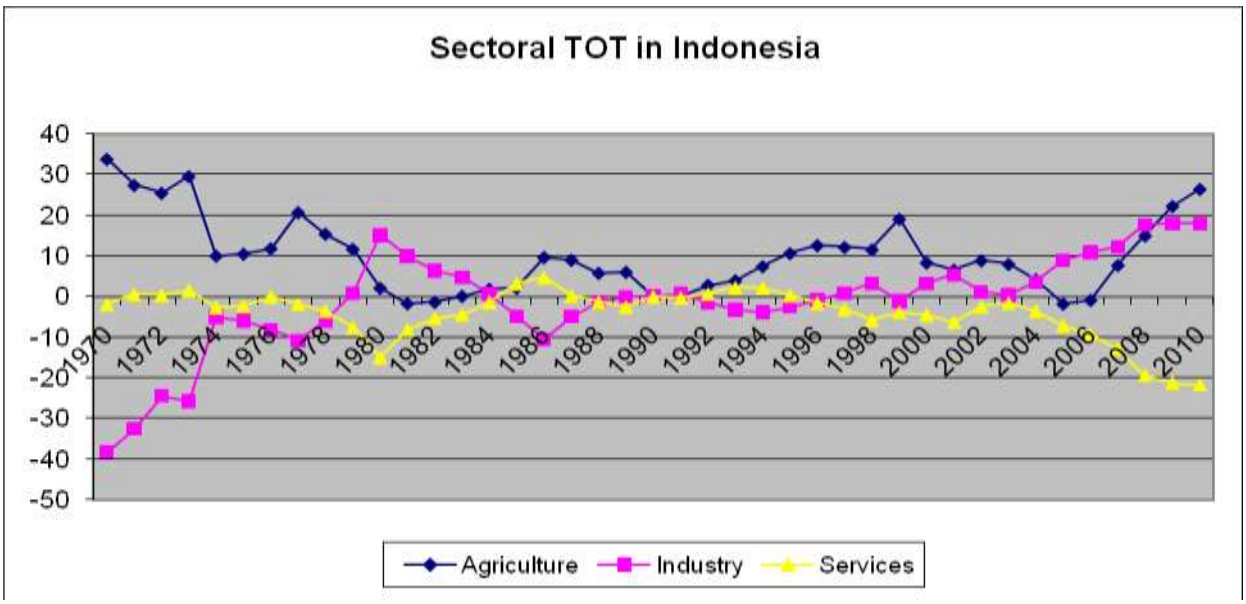
Sectoral TOT in Indonesia
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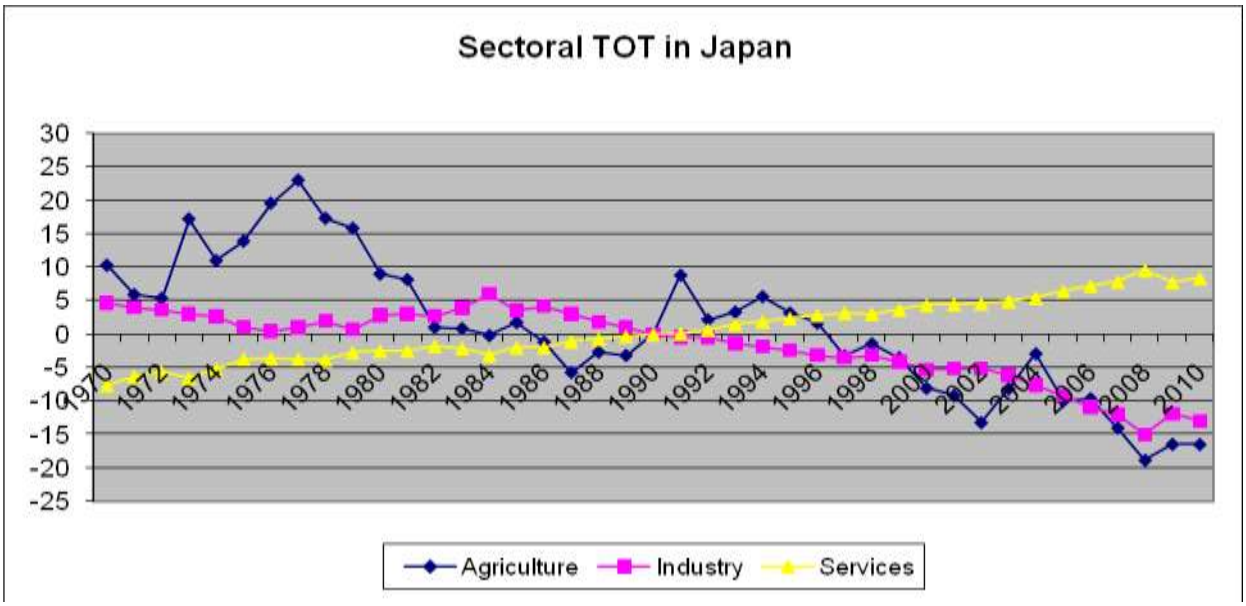
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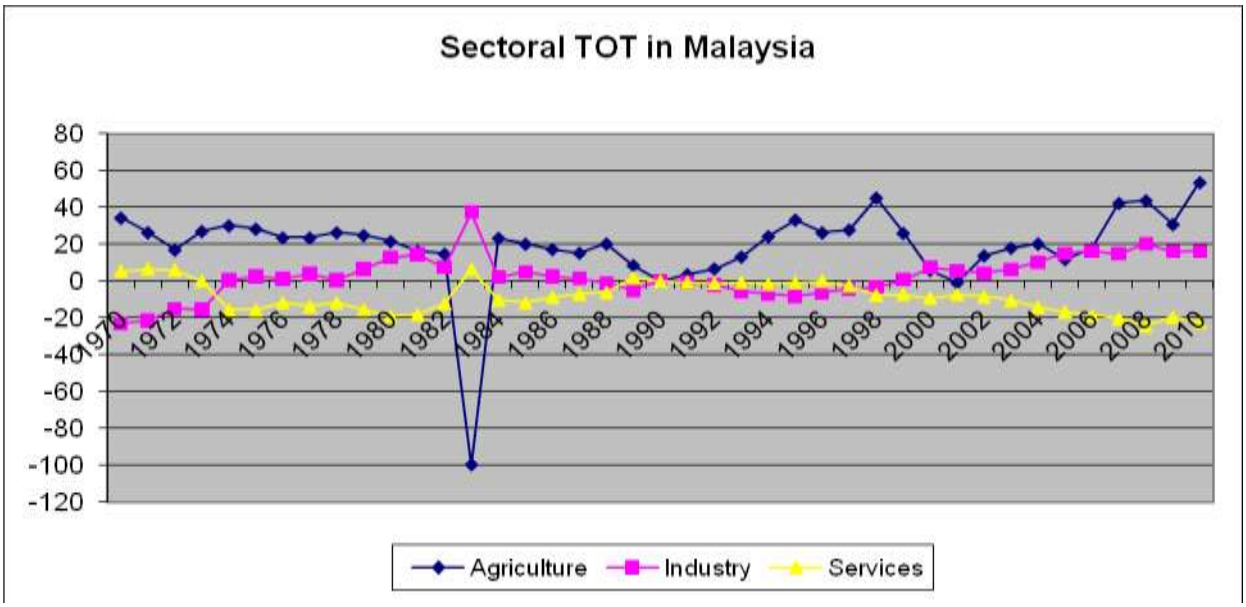
Sectoral TOT in Malaysia
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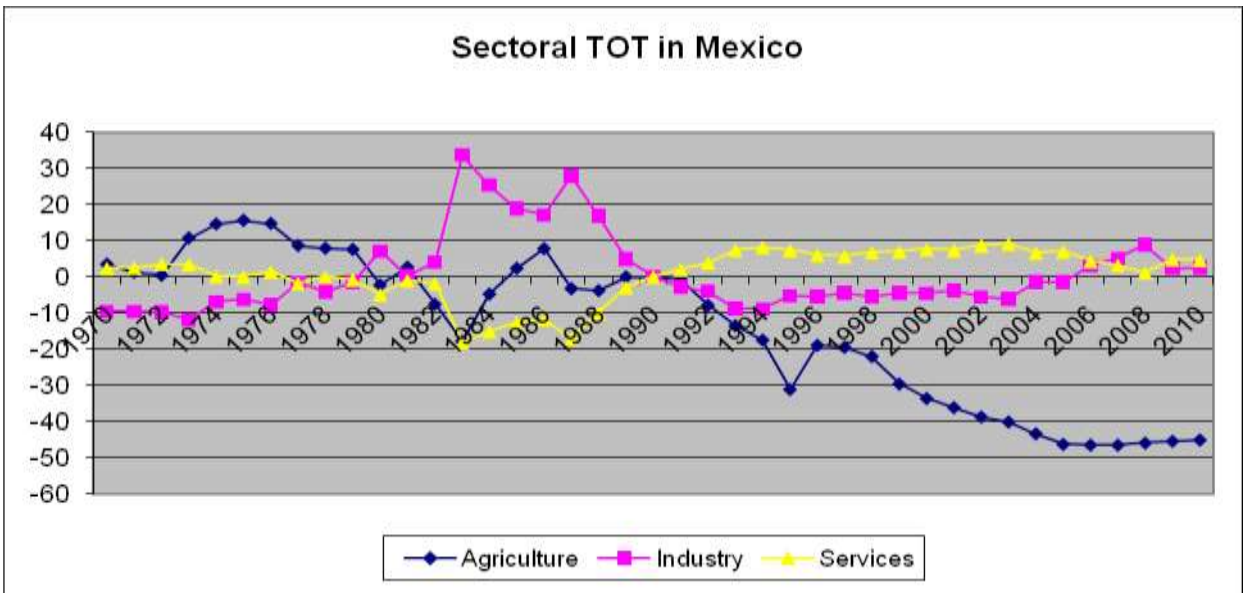
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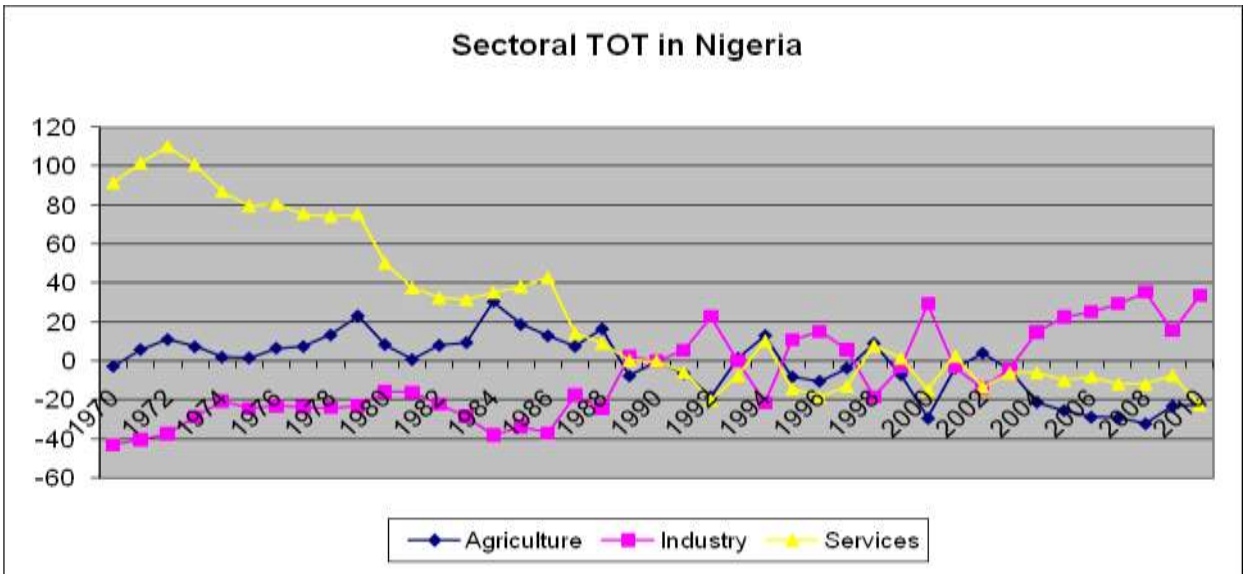
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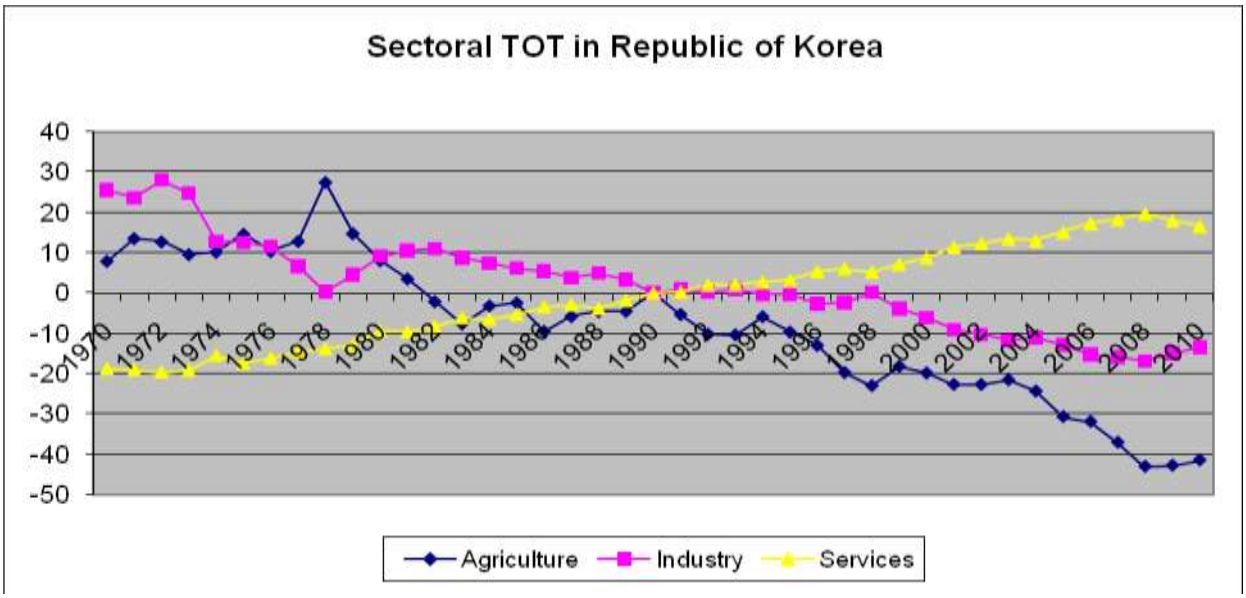
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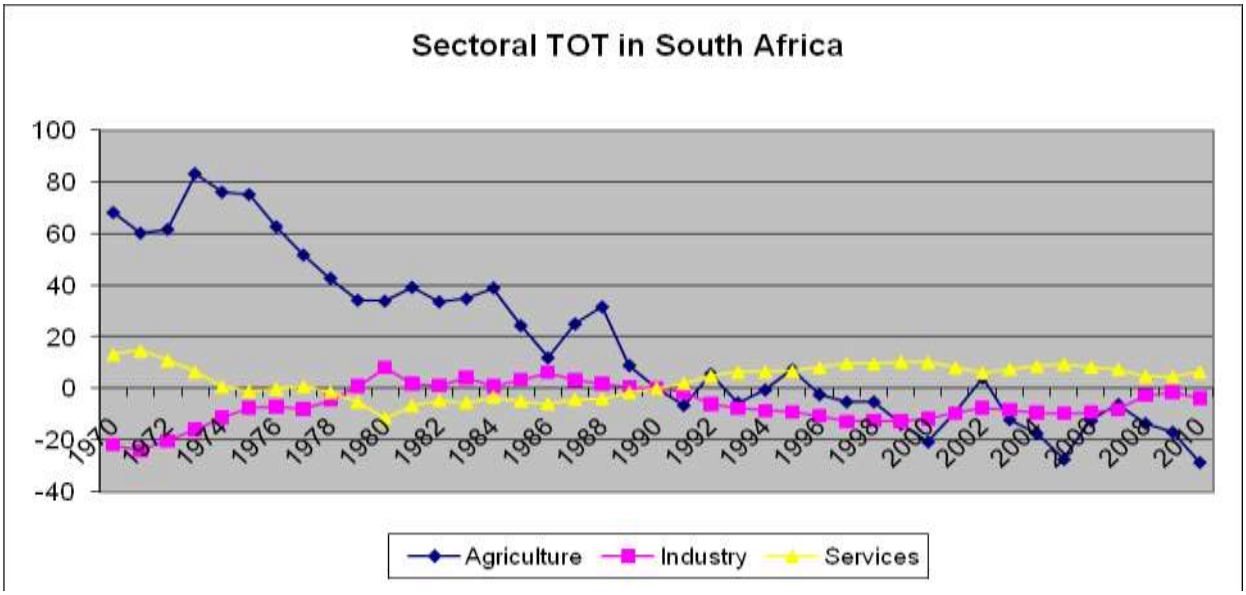
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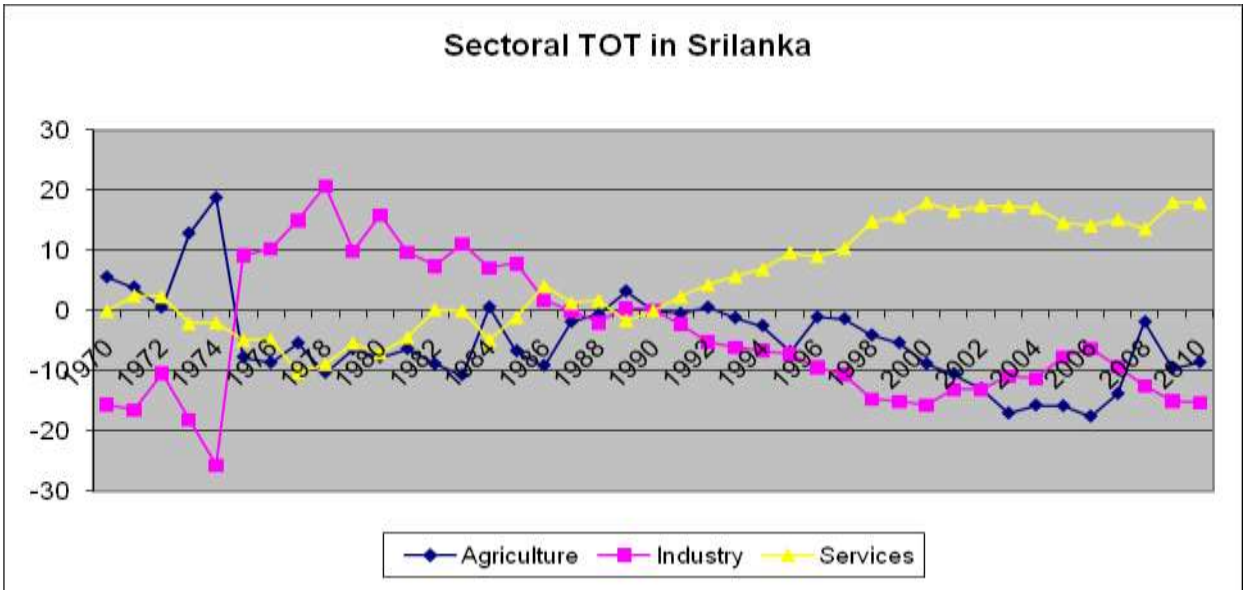
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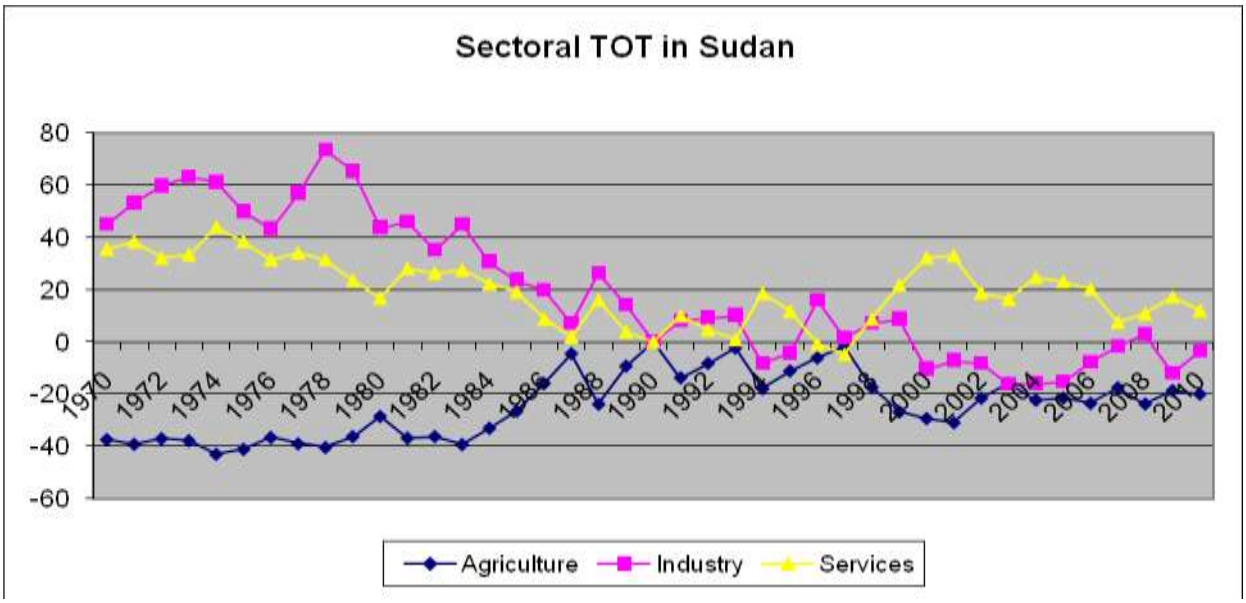
Sectoral TOT in Sudan
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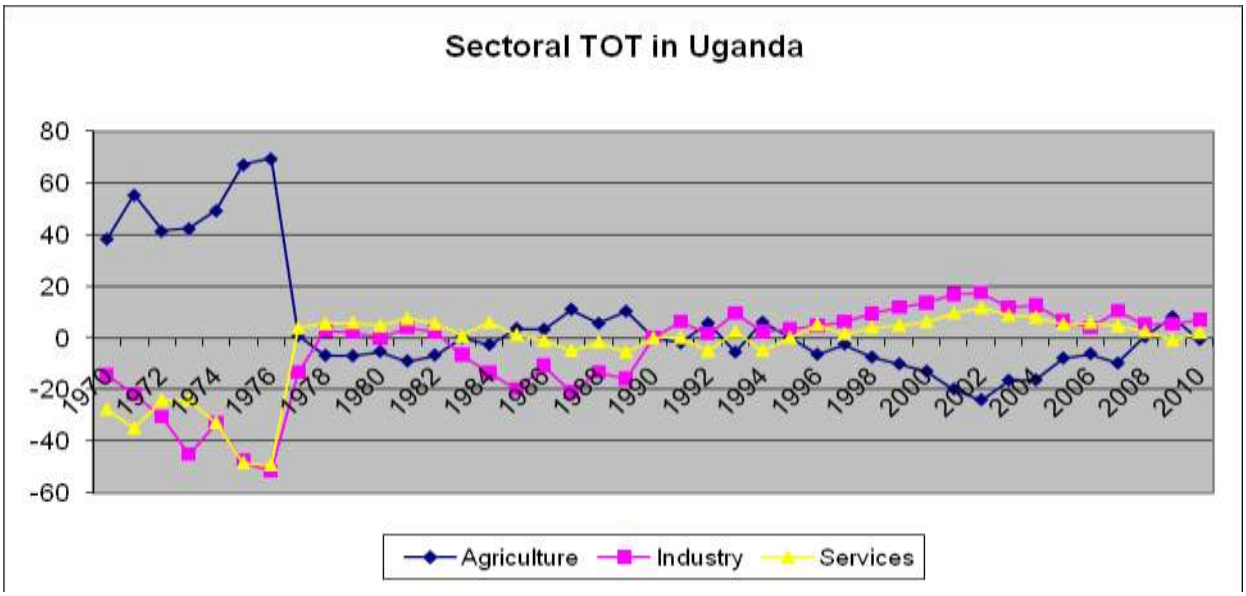
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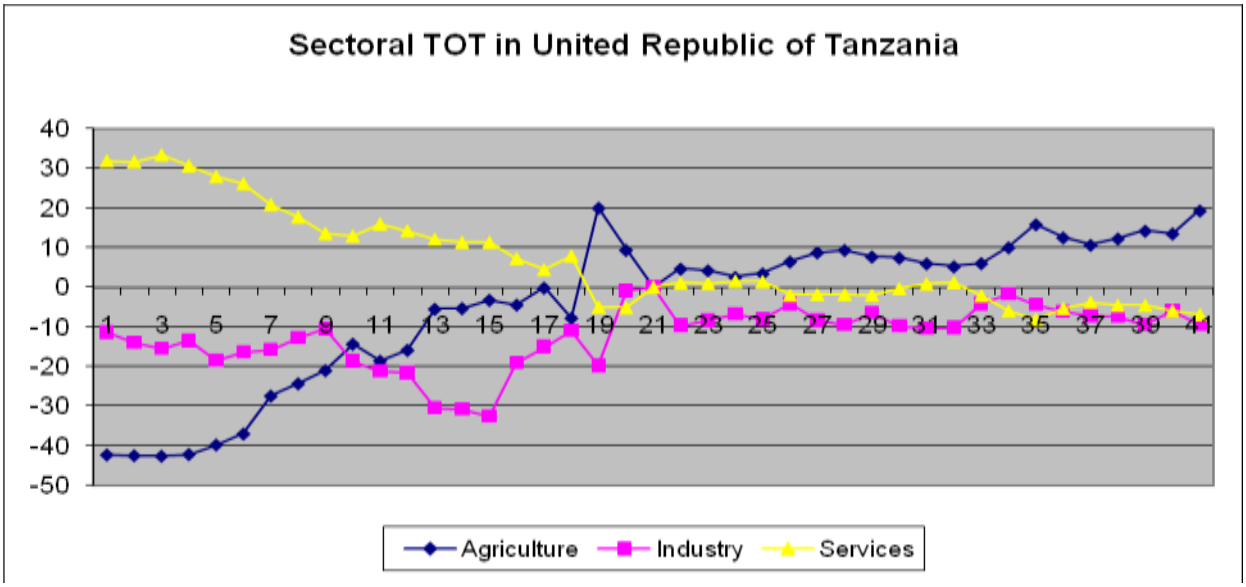
Sectoral TOT in United Republic of Tanzania
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Industry
Services

Table 2: Statistical Trend (Linear) in Sectoral TOT (1970-2010).

Countries	Agricultural TOT	Industrial TOT	Services TOT
Low Income Countries			
Bangladesh	-0.44 (-5.30)*	0.09 (0.64)	0.41 (4.34)*
Ethiopia	-0.08 (-0.29)	0.89 (1.80)*	0.39 (1.33)
Nigeria	-0.90 (-6.09)*	1.57 (9.22)*	-3.10 (-13.09)*
Sudan	0.60 (4.44)*	-2.04 (13.46)*	-0.54 (-3.79)*
Uganda	-1.26 (-5.48)*	1.09 (6.90)*	0.80 (5.00)*
Tanzania (United Republic of)	1.42 (12.59)*	0.36 (4.15)*	-0.94 (-13.62)*
Middle Income Countries			
China (People's Republic of)	1.18 (18.12)*	-1.65 (-29.77)*	0.22 (1.17)
India	0.35 (4.48)*	0.05 (1.08)	-0.23 (-9.07)*
Indonesia	-1.18 (-1.55)	0.72 (6.36)*	-0.26 (-3.55)*
Malaysia	0.24 (0.79)	0.44 (3.30)*	-0.27 (-2.56)*
Srilanka	-0.34 (-4.02)*	-0.38 (-2.83)*	0.64 (11.53)*
High Income Countries			
Japan	-0.73 (-10.10)*	-0.40 (-12.27)*	0.38 (39.78)*
Mexico	-1.59 (-14.86)*	0.04 (0.29)	0.25 (2.93)*
Korea (Republic of)	-1.39 (-18.05)*	-0.91 (-17.80)*	1.01 (62.95)*
South Africa	-2.48 (-17.02)*	0.04 (0.44)	0.19 (2.46)*

Notes:

1) The sectoral TOT is calculated using: Gain (Production)$_j$ = $\frac{1}{P_{va}}\left[X'_{va.j}\left(P_{va.j} - P_{va}\right)\right]$
2) The statistical trend is derived by linear trend analysis using the form $y = a + bt$.
3) * indicates statistical significance at 5% level of significance.
4) The sample for Ethiopia refers to a shorter period 1990-2010.

It appears that sectoral TOT in recent years have by and large remained adverse to the agricultural sector for most of the economies in our sample, viz., Bangladesh, Ethiopia, Japan, Mexico, Nigeria, Korea, South Africa, Srilanka, Sudan and Uganda. On the other hand, while adverse TOT for the industry sector can be noticed for Bangladesh, China, India, Japan, Korea, South Africa, Srilanka, Sudan and Tanzania, the economies of India, Indonesia, and Malaysia and Nigeria seem to have experienced adverse TOT towards the services sector.

5.1. Trend of Sectoral TOT:

We have noted earlier that sectoral TOT have often been perceived as having significant implications for the economic transition process, where it was visualized as a means of extracting surplus from agriculture during the early industrialization phase. In this context, we attempt to examine here the pattern of TOT movements for the domestic sectors across economies at dissimilar income levels, viz. low, middle and high per capita levels of income. The statistical trend of TOT effects during the period 1970-2010 are provided in Table 2 for the three sectors after grouping the economies according to their income levels. The classification of economies into three groups, viz., low income countries (considering the 6 economies of Bangladesh, Ethiopia, Nigeria, Sudan, Uganda and Tanzania), middle income countries (considering 5 economies of People's Republic of China, India, Indonesia, Malaysia and Srilanka), and high income countries (considering the 4 economies of Japan, Mexico, Republic of Korea and South Africa) helps us to recognize any pattern of TOT movement for domestic sectors across economies with varying per capita income levels.

The general observation that can be made from the results is that agricultural TOT over 1970-2010 have remained significantly unfavorable in three low-income countries (Bangladesh, Nigeria, Uganda), one middle income countries (Srilanka) and all the high income countries (Japan, Mexico, Korea and South Africa). On the other hand, there is evidence of a significantly improving TOT effect for agriculture in Sudan, Tanzania, China and India. We notice favorable shifts in the TOT effects for industry in Ethiopia, Nigeria, Uganda, Tanzania, Indonesia, and Malaysia and unfavorable industrial TOT effects for Sudan, China, Srilanka, Japan and Korea. The service sector results suggest that there have been a significant upward movement for the TOT effects in all the high-income countries and also in some low- and middle-income countries, viz., Bangladesh, Uganda and Srilanka. In

contrast, low- and middle income economies, viz., Nigeria, Sudan, Tanzania, India, Indonesia and Malaysia revealed a statistically significant negative trend in services TOT.

Table 3: Pattern of Sectoral TOT across Economies (1970-2010).

Statistically Significant Trend of Sectoral TOT.		
Sector	Upward (Favorable)	Downward (Unfavorable)
Agriculture & Allied	*Sudan, Tanzania, China and India.*	*Bangladesh, Nigeria, Uganda, Srilanka, Japan, Mexico, Korea and South Africa.*
Industry	*Ethiopia, Nigeria, Uganda, Tanzania, Indonesia and Malaysia.*	*Sudan, China, Srilanka, Japan and Korea.*
Services	*Bangladesh, Uganda, Srilanka, Japan, Mexico, Korea and South Africa.*	*Nigeria, Sudan, Tanzania, India, Indonesia and Malaysia.*

Note: *Based on statistically significant trend of sectoral TOT as provided in Table 2.*

Table 3 classifies the information on all the statistically significant time trend of TOT effects for three domestic sectors in different economies, where there is a clear indication of deteriorating TOT for agricultures in some of the low and middle-income countries (Bangladesh, Nigeria, Uganda and Srilanka) and all the high-income countries (Japan, Mexico, Korea and South Africa). On the other hand, it appears that TOT for services sector has improved for all the high-income countries (Japan, Mexico, Korea and South Africa) and also a few of the low and middle-income countries (Bangladesh, Uganda and Srilanka). The analysis based on the presence of statistically significant trend of sectoral TOT in economy groups suggest the occurrence of favorable industrial TOT but mixed trends for agricultural and services TOT in low income countries. In middle income countries, there is an implication of favorable agricultural TOT and unfavorable services TOT along with weak evidence for industrial TOT. Finally, the support for a favorable services TOT remains clear in the high income countries, along with unfavorable TOT to both the agriculture and industry.

6. Sectoral TOT and Per Capita Income Levels:

The sectoral transformation process that involves a transition of the economy from agriculture to non-agriculture (mostly manufactures and later services) is often considered to be an important indicator of economic development, resulting in improvements in per capita income. The growth of per-capita income is also crucially associated with systematic changes in relative prices. As regards the behavior of relative prices (or inter-sectoral TOT) in the transformation process is concerned, the explanations generally include two components, viz, the *Engel effect* and the differential productivity growth across sectors. Thus, low agricultural prices are considered to result from the shift in demand towards the non-agricultural sectors. On the other hand, the differential rates of productivity growth in sectors were considered to generate a systematic influence on relative prices from the supply side. An inverse relationship between output (or productivity) growth and price level has frequently been found to be operative in the industrial sector. The role of productivity improvements has also been highlighted with regard to the service sector's price behaviour, where it was argued that a slower productivity growth is generally responsible for the relatively faster rise in service prices. The cross-country evidence has also indicated that the price of service items move faster than that of the commodity segment as per capita income of the economy grows (Kravis, Heston and Summers 1982). It is therefore useful to analyze whether TOT movements for agriculture, industry and service sectors in countries follow any pattern as they climb up from low to middle and high income levels.

In this context, we enquire on the nature of relationship between TOT movements of different sectors in relation to the per capita real income, separately, for countries with different levels of income. We basically intend to recognize the pattern of TOT movements in agriculture, industry or services, as the per capita real income of the countries progresses with economic growth. The relationship between TOT effect for different sectors and per capita real income are first examined separately for economy groups with low, middle and high per capita income levels. Subsequently, we examine the relationship across economy groups with different levels of per capita income.

6.1 Analysis of Individual Economy-Groups: Low, Middle and High PCGDP

In this section we examine the relationship between TOT effect for agriculture, industry and services in comparison with the per capita real income, separately for economy groups with low, middle and high income levels. For this we use a "pooled" time series and cross-section

data of the economies belonging to the respective per capita income groups. Thus, 226 observations was selected for the low per capita income group by including data from Bangladesh, Ethiopia, Nigeria, Sudan, Uganda and Tanzania. Similarly, the middle income group includes 205 observations by selecting data from China, India, Indonesia, Malaysia and Srilanka. Finally, Japan, Mexico, Korea, and South Africa represented the high income group that includes 164 observations. The three equations that we estimate for each sector in this classification are as follows:

$$TOT_j = \alpha + \beta_1 PCGDP \qquad (2)$$

where, TOT_j contains data on sectoral TOT, with j = agriculture, industry, services, for low, medium and high income economies, respectively.

The results on the relationship between TOT for different sectors and per capita real income are given in Table 4 for groups of economies that are separated by their per capita income levels. The cross-section regression results are frequently subject to the problem of heteroscedasticity. The results of White's test do not reveal any major problem in these results. However, the presence of serial correlation in these equations, as is evident from the Durbin-Watson test statistics can not be ruled out. The corrections for serial correction have been made for each equation by using the Cochrane-Orcutt estimation technique. Although, we report the OLS regression results along with the Cochrane-Orcutt estimates, the interpretations are based the Cochrane-Orcutt estimation results.

In low income countries, the presence of statistically significant regression coefficient signifies that the per capita income level is positively associated with agricultural TOT and negatively associated with industrial TOT. On the contrary, the per capita income level in middle income countries is positively related with industrial TOT and negatively related with services TOT. Finally, the per capita income is found to be negatively linked with agricultural TOT in high income countries. These findings would suggest that as per capita income increases, there is a tendency for TOT to favor agriculture and turn against services in low income countries. On the other hand, the increase of per capita income in middle income countries would generate TOT to favor industry and turn against services. Finally, the rise in per capita income of high income countries would turn the TOT against agriculture.

Table 4: Regression Results of Sectoral TOT on Per Capita GDP (1970-2010).

Dependent Variables →	Agricultural TOT		Industrial TOT		Services TOT	
	(1)	(2)	(3)	(4)	(5)	(6)
Explanatory Variables ↓	*OLS*	*Cochrane-Orcutt Method*	*OLS*	*Cochrane-Orcutt Method*	*OLS*	*Cochrane-Orcutt Method*
Sample: Low Income Countries: Bangladesh, Ethiopia, Nigeria, Sudan, Uganda and Tanzania. Total Obs: 226.						
Constant	-1.38 (-7.31) *	-3.09 (-2.55) *	0.79 (3.42) *	0.64 (0.72) *	1.82 (7.55) *	2.47 (3.01) *
PCGDP	0.00003 (5.44) *	0.00009 (8.50) *	-0.00003 (-4.63) *	-0.00001 (-1.29) *	-0.00003 (-3.91) *	-0.00005 (-4.01) *
R-Squarred	0.11	0.78	0.08	0.80	0.06	0.79
R-Bar-Squarred	0.11	0.78	0.08	0.80	0.06	0.79
DW Statistic	0.31	1.98	0.24	1.98	0.24	1.99
F Statistic	29.61	156.7	21.4	220.8	15.3	171.2
White's Test Statistic for Heteroscedasticiy	5.63		0.28		0.06	
Sample: Middle Income Countries: China, India, Indonesia, Malaysia and Srilanka. Total Obs: 205.						
Constant	0.39 (2.51) *	0.69 (1.53)	-0.09 (-0.75) *	-0.70 (-1.58)	0.18 (1.83) *	0.27 (0.68)
PCGDP	0.00006 (2.03) *	0.0004 (-0.001)	-0.00003 (1.21)	0.00002 (4.88) *	-0.00007 (-3.48) *	-0.00002 (-5.67) *
R-Squarred	0.02	0.43	0.07	0.73	0.05	0.83
R-Bar-Squarred	0.02	0.42	0.02	0.72	0.05	0.83
DW Statistic	0.72	2.00	0.28	1.98	0.18	1.98
F Statistic	4.13	30.01	1.47	109.1	12.10	242.3
White's Test Statistic for Heteroscedasticiy	2.18		3.05		2.23	
Sample: High Income Countries: Japan, Mexico, Korea and South Africa. Total Obs: 164.						
Constant	0.57 (2.14) *	1.06 (0.53)	-0.003 (-0.03)	-0.34 (-0.79)	-0.11 (-1.24)	0.17 (0.46)
PCGDP	-0.00002 (-4.88) *	0.00005 (-12.33) *	-0.00004 (-2.63) *	0.00003 (1.57)	-0.00006 (4.80) *	0.00002 (1.19)
R-Squarred	0.12	0.88	0.04	0.80	0.12	0.87
R-Bar-Squarred	0.12	0.88	0.04	0.80	0.12	0.87
DW Statistic	0.18	1.97	0.23	1.98	0.16	1.98
F Statistic	23.8	407.9	6.93	217.4	24.02	348.8
White's Test Statistic for Heteroscedasticiy	3.00		2.34		2.40	

Note: * indicates statistical significance at 5% level of significance.

6.2 Analysis across Economy-Groups with Diverse PCGDP Levels:

Finally, we use regression analysis to discern the relationship between TOT for different sectors and per capita real income across economies, by using appropriate dummy variables for the groups of economies with low, middle and high income. The pooled data set of forty-one time series observations on fifteen economies has been prepared by using the standard technique of poling the time series and cross-section data employing appropriate sets of intercept and slope dummies. For this we grouped the fifteen economies in three categories, viz., low-income economies consisting of Bangladesh, Ethiopia, Nigeria, Sudan, Uganda and Tanzania, middle-income economies consisting of China, India, Indonesia, Malaysia and Srilanka, and high-income economies consisting of Japan, Mexico, Korea and South Africa. Thus, by using the low-income economies as the benchmark in the analysis, the two intercept dummies d_M and d_H have been used for the middle-income and high-income economies respectively, as:

d_M = 1, for observations on middle-income economies or 0, otherwise, and

d_H = 1, for observations on high-income economies or 0, otherwise,

and the two slope dummies used for different groups of economies are defined in similar way. Thus, the regression equation that we estimate for each sector is as follows:

$$TOT_j = \alpha + \beta_1 PCGDP + \gamma_1 d_M + \gamma_2 d_H + \beta_2 d_M PCGDP + \beta_3 d_H PCGDP \qquad (3)$$

where, TOT_j contains data on sectoral TOT, with j = agriculture, industry and services, for all the economies with different income groups.

The results on the relationship between TOT effect and per capita real GDP for different sectors pooled over different economy groups with low, middle and high per capita income levels are provided in Table 5. We find that the regression coefficient of per capita income is statistically significant for agricultural TOT in all the income groups, but they turn negative for middle and high income countries. While the positive coefficient in low income countries would signify that TOT would favor agriculture as per capita income increases, the negative coefficient in middle and high income countries would indicate the opposite. The industry sector results indicate that regression coefficient of per capita income is negative for low income countries, but turns positive for high and middle income countries. This would

suggest that TOT would go against industry as per capita income increases in low income countries, but turn favorable to industry in middle and high income countries. Finally, the regression coefficient of per capita income on services TOT can be seen to be negative in both the low and middle income countries and positive in high income countries. The service sector results would therefore denote that as per capita income increases TOT would remain unfavorable to the sector in low and middle income countries, but turn favorable in high income countries.

Table 5: Regression Results of Sectoral TOT on Per Capita GDP (1970-2010), Pooled Regression across Low, Middle and High Income Economies.

Dependent Variables →	Agricultural TOT		Industrial TOT		Services TOT	
	(1)	(2)	(3)	(4)	(5)	(6)
Explanatory Variables ↓	*OLS*	*Cochrane-Orcutt Method*	*OLS*	*Cochrane-Orcutt Method*	*OLS*	*Cochrane-Orcutt Method*
Constant	-1.38 (-6.75) *	-2.09 (-1.72) *	0.79 (4.56) *	-2.70 (-1.99) *	1.82 (10.74) *	1.29 (1.56) *
PCGDP	0.00003 (5.02) *	0.00010 (8.09) *	-0.00003 (-6.16) *	-0.00016 (-1.59) *	-0.00003 (-5.56) *	-0.00063 (-6.87) *
Dummy $_{\text{Middle Income}}$	14.19 (6.52) *	8.05 (0.83)	-7.10 (-3.83) *	26.23 (3.00) *	-13.07 (-7.23) *	8.62 (1.21)
Dummy $_{\text{High Income}}$	15.59 (6.54) *	30.77 (2.63) *	-6.36 (-3.14) *	39.91 (3.54) *	-15.46 (-7.81) *	-13.77 (-1.66) *
Dummy $_{\text{Middle}}$ × PCGDP	-0.00003 (-0.72)	-0.00011 (-8.09) *	0.00003 (6.21) *	0.00018 (1.79) *	0.00003 (5.41) *	0.00062 (6.67) *
Dummy $_{\text{High}}$ × PCGDP	-0.00003 (-11.75) *	-0.00012 (-8.45) *	0.00003 (6.08) *	0.00017 (1.62) *	0.00003 (5.66) *	0.00064 (6.88) *
R-Squarred	0.13	0.75	0.07	0.79	0.13	0.82
R-Bar-Squarred	0.13	0.74	0.06	0.78	0.13	0.82
DW Statistic	0.38	1.99	0.25	1.99	0.24	1.99
F Statistic	18.90	190.21	8.59	266.8	18.11	332.0

Note: * indicates statistical significance at 5% level of significance.

7. Summary and Implications:

The key focus of this paper has been to consider the role of service sector into the domestic terms of trade (TOT) analysis. We have utilized a methodology in the national income accounting framework to construct domestic TOT estimates at the 3-sector classification, consisting of agriculture, industry and services. The advantage of using the multi-sectoral approach in TOT measurement happens to be that the same methodology can be used to generate consistent and comparable set of sectoral TOT estimates across different economies. Thus, we have worked out the TOT effect on agriculture, industry and services during the period 1970-2010 for a sample of 15 economies, viz., Bangladesh, China, Ethiopia, India, Indonesia, Japan, Malaysia, Mexico, Nigeria, Korea, South Africa, Srilanka, Sudan, Uganda and Tanzania. The country-wise estimates of TOT have subsequently been used for recognizing whether TOT movements for agriculture, industry and service sectors follow any pattern as the countries climb up from low to middle and high income levels.

It may be kept in mind that the standard two-sector TOT analysis between agriculture and industry presumes an adverse agricultural TOT to necessarily imply favorable industrial TOT, and vice versa. However, the present TOT analysis based on including the third services sector may reveal favorable TOT to services and not the industry segment of the economy. In fact, our results have indicated positive services TOT in eight economies along with negative agricultural TOT in nine economies out of fifteen in our sample. Subsequently, we examined whether the pattern of sectoral TOT movements remained different across economies with diverse per capita incomes, viz., countries with low, middle and high income levels. For this, the sample economies with diverse per capita real incomes were classified in 3 standard categories, viz. low, middle and high income countries and then analyzed for the pattern of TOT movements for domestic sectors across economy groups. The trend analysis of sectoral TOT for the sample economies denote that agricultural TOT remained mixed in low income countries, favorable in middle income countries and distinctly unfavorable in high income countries. Similar analysis indicates the trend of industrial TOT to be favorable in low income countries, mixed in middle income countries and unfavorable in high income countries. In the case of service sector, the trend of TOT remained mixed in low income countries, unfavorable in middle income countries and noticeably favorable in high income countries. Finally, we provide the follow-up analysis to enquire the nature of relationship between TOT for different domestic sectors and per capita income levels. The relationship between TOT effect and per capita real GDP for different sectors are first examined,

separately, for economy groups with low, middle and high per capita income levels. Consequently, we examine the relationship across the three economy-groups with low, middle and high income levels, by employing appropriate intercept and slope dummies in the regression equation. These results provide some useful insights in discerning the patterns of domestic TOT movements for agriculture, industry and service sectors, as countries move up from low to middle and high per capita income levels.

We found that as per capita income progressed, TOT remained favorable to agriculture in low income countries but turned against agricultures in middle and high income countries. Turning to the patterns in industrial TOT, we observe a negative association with the per capita income in low-income countries. The relationship, however, is positive for the middle and high-income countries, as revealed by the statistical significance of the relevant slope dummies. Finally, the association between the per capita income level and TOT in services sector turned out to be negative for the low and middle income countries, but significantly positive for the high-income countries. These regression results lead us to conclude that there are indications of a pattern in sectoral TOT movements in a representative economy. Our empirical analysis for the time period 1970-2010, covering a diverse set of economies from different income levels suggests that the domestic TOT turned favorable to the agricultural segment and unfavorable to both the industry and service at initial levels of economic growth. But, domestic TOT became favorable to the both industry and services as the growth level caught up to the middle and high income levels and concurrently unfavorable to agriculture.

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