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Structural Change, Growth and the Increasing Service Trade in Low and Middle Income Countries

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Abstract: This paper explains the increasing service export in low and middle-income countries of the world and tries to relate it with structural change and pattern of growth. The authors have constructed a theoretical model to derive hypotheses and estimated empirical results from panel regressions based on data from 34 low and middle-income countries. The theoretical results show that productivity differences caused by endogenous technological innovations and human capital formation lead to a reallocation of resources and structural change. As a result, the relative prices of the goods change. This paper shows that the growing service export is the reflection of industrial backwardness due to lack of capital, technological innovation and infrastructure. The results of panel regression also reveal that service sector-led growth and investment in human capital formation have a significant effect on service export while expenditure on Research and Development (R&D) is so low in such countries that it has no effect on per capita income, industrial growth and service export. As investment in human capital formation is high and R&D expenditure is low, the developing countries experience unbalanced growth with an increasing share of services in gross domestic product (GDP) and export.

***Keywords*:** service sector growth, foreign direct investment, R&D expenditure, technological innovations, human capital, comparative advantage

JEL Codes: F0, F1, F2, F6

1. Introduction

The increasing share of services in export of low and medium income countries in the last 2-3 decades, has become an important phenomenon in international trade. This trend has a direct relationship with structural change and service sector growth in such countries. After the establishment of World Trade Organization (WTO) and trade liberalization in the 1990s the volume of trade and free movement of capital and labour across countries have increased manifold. In conventional trade theories a country will export those commodities in which it has a comparative advantage. The comparative advantage arises from factor abundance or technological superiority in production function. The rise of the service economy from a global perspective has become a new development in recent times. The rise in the proportion of services in total export in low and middle-income countries may be due to service-led growth in these countries or due to various constraints towards industrialisation. The services which are prominent in the trade list are transport, travel

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and tourism, finance and insurance, education, health, consultancy and business-related services. The expansion of service export related to information technology (IT) requires some special mention in countries like India which makes huge exports of IT services.

The World Development Report of the World Bank found that total service exports in low-and middle-income countries increased by 629% in the period from 1996 to 2022, against 423% growth of service exports in the whole world in the same period. That means the export of services has risen at a higher rate in developing and emerging countries than in developed countries. The developing countries have mostly achieved a high rate of growth largely banking on service sector growth whereas their performance in the industrial sector is not so bright. The share of services in GDP in such countries is nearly 60% or above whereas their share of industry in GDP is around 20-25%. In China which is now considered as the global hub of manufacturing the picture is totally different. The service export in China has increased nearly 17 times in the period from 1996 to 2022 whereas its merchandise export has increased 23 times in the same period. India, another large and emerging country in the world, has achieved remarkable GDP growth in the last three decades. But its share of industry in GDP is only around 24% whereas 62% of its GDP is contributed by services. At the global level, the growth rate of export of services in the period from 2008 to 2018 is 49.13% whereas in merchandise export this growth rate is 20.88% only. This indicates that service trade has increased significantly in the world but in the developing countries service export has been more prominent. Now, the question is: is it due to the expansion of services or because of failure in industrial front?

We may relate this pattern of trade to structural change and the nature of growth in low-and middle-income countries. The structural change requires that the share of agriculture in GDP will decline and the industrial sector will become relatively more important with respect to income and employment. In the final stage when the country is at an advanced stage of development, the service sector will occupy the highest position. However many countries could not follow this conventional pattern of change. They have switched over to service sector growth directly from agriculture skipping the stage of industrialisation. Gollin (2018) raises the question of whether structural change can take place without sufficient industrialisation. Much of the literature suggests that the manufacturing or industrial stage is necessary for growth although in practice many developing countries are directly moving to the services with little or no industrialization. It is being questioned whether such growth is capable of solving the problems of unemployment, poverty and inequality or if such growth is sustainable in the long run. In fact, most of these countries are not in a position to accelerate industrial growth due to a lack of capital investment and technological innovations in the face of stiff competition in the global market. Naturally, they are placing more emphasis on service sector growth. The essence of structural transformation is that labour will be transferred from low-productive agriculture to the more productive industrial sector (Lewis, 1954; Harris & Todaro, 1970; McMillan & Rodrik, 2011; Bender, 2012; Aggarwal & Kumar, 2015). Hoekman and Mattoo (2013), on the other hand, focus on the channels through which service trade can enhance productivity and increase the comparative advantage in service trade. In the existing literature, there are very few theoretical studies on structural change incorporating three sectors of the economy-agriculture, industry and services (Laitner, 2000; Kongsamut et al., 2001). Most of the theoretical models on structural change have considered both intermediate and final goods sectors (Zhang, 2015; Ngai & Pissarides, 2007; Buera & Kaboski, 2009; Acemoglu & Guerrieri, 2008; Baumol, 1967). The structural change has been defined as the change in the share of labour employment in a sector depending on total factor productivity (TFP) differences (Ngai & Pissarides, 2007; Baumol, 1967; Buera & Kaboski, 2009; Zhang, 2015). The existing studies have assumed exogenous technological progress and identical production function in all the sectors and most of the sectors are producing intermediate goods. In contrast, the present study will assume different production functions in different sectors and focus on the productivity differences among sectors caused by endogenous technological innovations and human capital formation to explain structural transformation.

Thomas (2016) has shown in the Indian context that in the post-reform period the major services like construction, transport and business-related services have the strongest backward linkages and they can act as engines of export-led growth. Marjit et al. (2020) have shown that structural transformation has taken place in India largely banking on service sector growth. Das and Sarma (2021) have explained the significant role played by service exports in India in the era of globalization. They have shown that the most crucial role played by the export of services is the balancing of the current account deficit in the event of a huge deficit in merchandise trade. Sermcheep (2019) has examined the effect of service exports on economic growth in the Association of Southeast Asian Nations (ASEAN) countries from 1980 to 2014

and has found evidence of service export-led growth in these countries. Although goods exports maintain a significant and robust role as a growth-enhancing factor in ASEAN, the direction of the policy of growth towards service sector has made the export of services increasingly significant as a new engine of growth in the region. Priyankara (2018) has examined the long-run relationship between service exports and economic growth in Sri Lanka. The study finds that policies to encourage services exports could be an important driver of growth for the country. Gabriele (2006) explores the nexus between GDP growth and the two components of total exports with its focus mainly on the service export in developing and transitional economies. The study also finds that the growth-enhancing effects of service export as a whole appear to be declining in the 1990s. This study further notes that export-oriented service activities in developing countries are under the control of foreign agents. Sasmal and Sasmal (2023) have examined the role of the public sector in the formation of human capital which has a significant impact on service sector growth and export of services.

Against this backdrop, the main purpose of this study is to see how the export pattern is related to the nature of structural transformation and economic growth in a country. It is also to check whether the growing export of services is the result of a lack of industrialisation in developing countries. The objectives of this paper are: (1) to explain the factors which are mainly responsible for the increasing service export in low and middle-income countries, (2) to examine whether the increasing service export in low and middle-income countries are related to the structural change and economic growth and (3) to check whether the growing service export in the developing countries is the reflection of the constraints to industrialisation in the country. The hypotheses of this study can be stated as: (i) The increasing service export is the result of service sector led growth of the economy, (ii) The formation of human capital facilitates service sector growth and promotes service export, (iii) Lack of sufficient R&D expenditure and necessary infrastructure are the main hindrances to industrial growth in developing countries and (iv) The domestic capital formation and foreign direct investment accelerate economic growth in the developing countries.

This paper attempts to find answers to the above questions by empirical evidence and theoretical results. The whole work has been arranged in the following way: A theoretical framework has been constructed in section 2 to explain the nature of structural change and economic growth incorporating endogenous technological innovations and human capital formation. The data and methodology have been discussed in section 3. The empirical results have been presented and analysed in section 4. Section 5 gives the conclusions and policy implications.

2. The theoretical tramework

Before proceeding to explain empirically the structural change, growth of the service sector and export of services, a theoretical framework has been built up in this section following the existing literature. In a two-country, two-commodity model, the trade will take place only when the relative prices of the commodities are different in two countries i.e.,

$$\left(\frac{P_X}{P_Y}\right)^H \neq \left(\frac{P_X}{P_Y}\right)^F .$$

Where H and F are home and foreign countries respectively, X and Y are the two commodities and P_X and P_Y are their respective prices (Caves et al., 2004; Jones, 1965). The change in the composition of domestic production as a result of structural change leads to a change in the relative prices of the commodities. This has a link with comparative advantage and pattern of trade. The present study constructs a theoretical model where the economy is divided into three final goods sectors-agriculture, industry and services. It has incorporated the effects of endogenous technological progress and human capital formation into the model along the lines of Lucas (1988) and Romer (1990). The productivity differences in different sectors caused by endogenous technological innovations and human capital formation have been used to explain the transfer of labour and capital from one sector to another leading to structural change (For details see Appendix-I).

2.1 *Structural change*

Ngai and Pissarides (2007) and Zhang (2015) have defined structural change as the state in which labour share changes at least in one intermediate sector. The present study wants to show not only a change in labour share but also there will be a change in the composition of GDP due to the reallocation of capital and labour across sectors.

The total supply of labour is L (in efficiency terms) and labour used in ith sector is L_i. Then labour share in the ith sector is $L_i/L = n_i$, $i = 1, 2, 3$. The share of capital in a particular sector can be defined in a similar fashion. The output in the ith sector is X_i and its price is P_i. The total value of output in the economy is $\sum_{i=1}^{3} P_i X_i$. Now, the output share of ith sector is $p_i X_i / \sum p_i X_i = x_i$. Here we define structural changes in terms of change in labour share (n_i), capital share (K_i / K) and also in output share (x_i). Here, technological progress generates higher efficiency in the production of the industrial sector and the formation of human capital is helpful for service sector growth.

Now, capital or labour will move to that sector where its productivity and factor price are higher. For capital, in equilibrium, $VMP_K^1 = VMP_K^2 = VMP_K^3$ (see Appendix-I).

VMP_K in sector 2 from (A3) in Appendix-I is:

$$P_2 \cdot A_2' \left(\frac{T}{L}\right)^{\alpha_2} \left(\frac{K}{L}\right)^{\beta_2} \left(\frac{L}{K}\right). \tag{1}$$

VMP_K in sector 3 from (A4) is:

$$P_3 \cdot A_3' \left(\frac{T}{L}\right)^{\alpha_3} \left(\frac{K}{L}\right)^{\beta_3} \left(\frac{L}{K}\right). \tag{2}$$

In equilibrium,

$$P_2 \cdot A_2' \left(\frac{T}{L}\right)^{\alpha_2} \left(K/L\right)^{\beta_2} = P_3 A_3' \left(\frac{T}{L}\right)^{\alpha_3} \left(\frac{K}{L}\right)^{\beta_3}. \tag{3}$$

Now, as a result of technological progress at a higher rate compared to human capital formation, if the productivity of K rises in sector 2 (since $\alpha_2 > \alpha_3$) then

$$P_3 \cdot A_3' \left(\frac{T}{L}\right)^{\alpha_3} \left(\frac{K}{L}\right)^{\beta_3} < P_2 \cdot A_2' \left(\frac{T}{L}\right)^{\alpha_2} \cdot \left(\frac{K}{L}\right)^{\beta_2}. \tag{4}$$

Then capital will move from Sector 3 to Sector 2. Similarly, labour will also move to Sector 2 from Sector 3 in order to get higher wages. Thus, the size of the industrial sector will expand causing the decline of the service sector. According to Rybczynsky's theorem (Jones, 1965) also as technology expands, the technology-intensive sector will expand and other sectors will shrink to release factors for the expansion of the technology-intensive sector. So, here sectors X_1 and X_3 will decline to make way for the expansion of sector X_2 (industrial sector).

The opposite result will follow when the formation of human capital (H) takes place at a higher rate than technological progress (T). Since the service sector is human capital-intensive compared to other sectors, this sector will expand and other sectors will shrink. As a result, n_3 and K_3/K will be higher.

The price ratio of two sectors is:

$$\frac{P_i}{P_j} = \frac{A'_j \left(\frac{T}{L}\right)^{\alpha_j} \left(\frac{K}{L}\right)^{\beta_j}}{A'_i \left(\frac{T}{L}\right)^{\alpha_i} \left(\frac{K}{L}\right)^{\beta_i}}, \tag{5}$$

where $i \neq j$.

(5) can be written as:

$$\left(P_i \big/ P_j\right) = \frac{A'_j}{A'_i} \left(\frac{T}{L}\right)^{\alpha_j - \alpha_i} \left(\frac{K}{L}\right)^{\beta_j - \beta_i}. \tag{6}$$

Taking a log of (6) and differentiating w.r.t. time we get:

$$\left(\frac{\dot{p}_i}{p_i} - \frac{\dot{p}_j}{p_j}\right) = \left(\alpha_j - \alpha_i\right)\left\{\frac{\dot{T}}{T} - \frac{\dot{H}}{H}\right\} + \left(\beta_j - \beta_i\right)\frac{\dot{k}}{k}. \tag{7}$$

Here, $k = K \big/ L$ Since $\left(w \big/ r\right)$ is the same for all sectors, k will be also the same in these sectors. So, $\frac{\dot{k}_j}{k_j} = 0, \frac{\dot{k}_i}{k_i} = 0$. $L = \overline{N} H$. So, $\frac{\dot{L}}{L} = \frac{\dot{H}}{H}$. Then $\frac{\dot{L}}{L}$ is replaced by $\frac{\dot{H}}{H}$ in (7).

There will be no change in $\left(\frac{K}{L}\right)$. But, $\frac{\dot{T}}{T} \rangle 0 \frac{\dot{H}}{H} \rangle 0$ i.e., both technological progress and human capital formation are there.

The proportionate change can be expressed as $\frac{\dot{T}}{T} = \hat{T}$ and $\frac{\dot{H}}{H} = \hat{H}$.

Suppose, the *j*th sector is industry and the *i*th sector is service.

Now, if $\hat{T} \rangle \hat{H}$, it follows from (7) that $\hat{P}_i \rangle \hat{P}_j \ \alpha_j \rangle \alpha_i$. That means, the price of the *i*th sector increases and that of the *j*th sector declines, i.e., $\frac{\dot{p}_i}{p_i} \rangle 0$ and $\frac{\dot{p}_j}{p_j} \langle 0$.

As a result of structural change, capital and labour moved from the *i*th sector to the *j*th sector. Here, $x_i = p_i X_i \Big/ \sum_{i=1}^{3} p_i X_i$ declines and $x_j = p_j X_j \Big/ \sum_{i=1}^{3} p_j X_j$ increases.

Equally, n_i falls and n_j rises and $K_i \big/ K$ falls and $K_j \big/ K$ increases. There will be technology-intensive non-balanced growth.

As a result of this structural change, the relative price of the products will change.

Here,

$$\frac{p_i}{p_j} = f\left(\frac{X_i}{X_j}\right), f'\left(\frac{X_i}{X_j}\right) \langle 0.$$

As *j*th sector (industry) expands relative to *i*th sector (service), the relative price of *j*th product declines. The opposite result will follow if $\hat{H} \rangle \hat{T}$.

Equation (7) can be written as:

$$\left(\hat{P}_i - \hat{P}_j\right) = \left(\alpha_j - \alpha_i\right)\left\{\hat{T} - \hat{H}\right\}. \tag{8}$$

In equation (7) if we consider *i*th sector as industry and *j*th sector as services, and assume that $\hat{H} \rangle \hat{T}$, then $\left(\hat{P}_i - \hat{P}_j\right) \rangle 0$. The relative price of *j*th sector declines relative to the *i*th sector. As the service sector expands relative to the industrial sector the decline of the relative price of services will pave the way for greater expansion of service export.

So, the reallocation of factors and structural change following productivity differences caused by different rates of endogenous technological progress and human capital formation will lead to non-balanced growth in the line of Acemoglu and Guerrieri (2008) and this will determine the nature of trade.

As the service sector expands relative to the industrial sector following higher human capital formation, the relative price of services will decline in the domestic economy i.e., $\left(\frac{P_j}{P_i}\right)$ will decline, where *j* = services and *i* = industry. Then the competitiveness of *j*th product will increase in the international market. Then the country will export more services relative to industrial products.

3. Data and methodology

3.1 *Data*

The source of data in this study is 'World Development Indicators', World Bank (https://datatopics.worldbank.org). The variables are share of services in total export (services_total-export), share of services in GDP (service_GDP), per capita GDP in US dollar (percap_gdp_usd), net FDI inflow in million dollars (fdi_netflow_mnd), gross capital formation as % of GDP (gcf_gdp_ratio), the share of industry in GDP (share_ind_gdp), human capital (mean years schooling), the share of manufacturing in merchandise export (manufacturing_merchant_export), service import in million dollars (serviceimport_mnd), total export in million dollars (total_export_mnd), expenditure on research and development as a percentage of GDP (exp_R&D_gdp) and expenditure on infrastructure as % of GDP (exp_infra_gdp). exp_infra_gdp includes total expenditure on transport and energy. Barro (2001) used years of schooling, scores in maths and reading ability as indicators of human capital. Here, the mean years of schooling have been taken as a measure of human capital. Four rounds of annual data on these variables for the years 2008, 2012, 2015 and 2018 from 34 low and middle-income countries have been used for panel regressions. The relevant variables for the topic of the paper have been chosen for the study. For comparison with developed countries, the same data from 15 high-income countries have been used for the analysis. As per World Bank guidelines 2023, the countries of the world have been categorised as: countries with per capita GDP of $ 1,145 or less are low-income countries, countries with per capita GDP of $ 1,145 to $ 4,515 are low middle-income countries, countries with per capita GDP of $ 4,516 to $ 14,005 are upper-middle-income countries. The countries with per capita GDP above $ 14,005 are high-income countries. 34 low and middle-income countries have been selected randomly from Asia, the Asia-Pacific region, Africa, Europe (mainly eastern), and Latin America. Similarly, 15 developed countries have been chosen on the basis of their per capita GDP and international economic importance. The period from 2008 to 2018 has been chosen to have an analysis of a normal economic situation in recent times. The years after 2018 have been excluded in order to avoid the effects of COVID-19. There was a global recession from 2007 to 2009. The data from 2008 have been included in the study. But before inclusion, it has been checked that the data of 2008 show no abnormality and follow the trend of 2005 and 2006.

3.2 *Methodology*

3.2.1 *Panel regression*

Following Wooldridge (2009), both the Fixed effects model and Random effects model have been estimated in panel regression. Hausman test has been done to determine the appropriateness of the model.

The equation for panel regression is:

$$Y_{it} = \beta_0 + \beta X_{it} + \varepsilon_{it}.$$

Where, Y_{it} is the dependent variable with value of the *i*th individual observed in time *t*, *i* = 1, 2, …… *n*.

X_{it} is the ith independent variable observed in time t.
β is the coefficient for the independent variable.
u_i is the unobserved individual heterogeneity of ith entity of the dependent variable.
ε_{it} is the error term of the ith entity in time t.
In Fixed effects model: $E(X_{it}, u_i) \neq 0$.
That is, X_{it} and u_i are correlated.
Robust standard error test has been done in panel regression to avoid the problem of heteroscedasticity.
In the Random effects model it is:

$$E(X_{it}, u_i) = 0.$$

That means, X_{it} and u_i are uncorrelated.
A robust standard error test has been done in panel regression to avoid the problem of heteroscedasticity.

4. Empirical analysis

Table 5 in Appendix-II shows that the per capita GDP in current US $ has increased in all the developing countries of this study except Algeria, Nigeria and Ukraine in the period from 2008 to 2018. Out of these 34 countries, the increase in per capita GDP in Bangladesh, China, Indonesia, Argentina, Malaysia, Philippines, Costa Rica and Chile is very high. With the increase in per capita GDP, the share of services in GDP has significantly increased in all the countries of this group. That means the low and middle-income countries have experienced service sector-led growth. The countries where the share of services in GDP is 60% or above are India (62%), Brazil (63%), Bulgaria (61%), Philippines (60%), South Africa (64%), Costa Rica (69%), Uruguay (65%) and Mexico (60%). Strikingly, in China and the Russian Federation where industrial growth is significant, the share of services in GDP is 53% (see Table 6 in Appendix-II).

Table 6 and Table 7 in Appendix-II give a picture of the rise of service exports in low and middle-income countries of the world in the period from 2008 to 2018. In all the countries the share of service in total export has increased in the last decade. The share of services in total exports is very high in countries like Sri Lanka, Uruguay, Romania, Jordan, Nepal, Costa Rica, Egypt, India and the Philippines. The share of service in total exports is above 20% in countries like Bulgaria, Colombia, Honduras, El Salvador. In India, the share of service in total export has increased from 32.82% in 2008 to 38.62% in 2018. Along with other services, the growth of IT sector has significant contribution to this increase. In Nepal, a neighbouring country of India, the share of service in total exports reached 65.21% in 2018. One plausible reason may be that the country depends largely on tourism. In contrast, in China, a remarkably growing economy having its dominance both in industry and trade at the global level, the share of service in total trade is very moderate. In other important countries like Brazil, Russia, Indonesia and Malaysia, also the share of service exports remains low (see Table 7 in Appendix-II).

An interesting picture of international trade in these countries is evident in Table 8 of Appendix-II. The growth rates of service exports are found to be much higher than merchandise exports almost in all countries. The export of services has increased at a very high rate in the Philippines, Nigeria, Sri Lanka, Uruguay, Thailand, Belarus, Costa Rica and India. In Bangladesh, exports of both merchandise and services have increased significantly in the last decade. The dominance of China in manufacturing is further established by the fact that in the period from 2008 to 2018, the growth rate of service export has been 42.52% while the growth rate of merchandise export is found to be 73.81% in the same period. The reverse picture is found in India, which has experienced significant growth in the export of both merchandise and services. However the growth rate of merchandise export is found to be much below the growth rate of service export. In other rapidly growing countries like Indonesia, Thailand and the Philippines, the growth rates of service export are remarkably high although their growth of merchandise export shows a dismal picture. Nepal, Nigeria, Jordan, Kazakhstan, Argentina and Russia have shown negative growth in merchandise export in the last decade. The growth of overall trade in Brazil and South Africa is very low in this period. Interestingly, Vietnam shows a remarkable growth in merchandise exports in the period from 2008 to 2018.

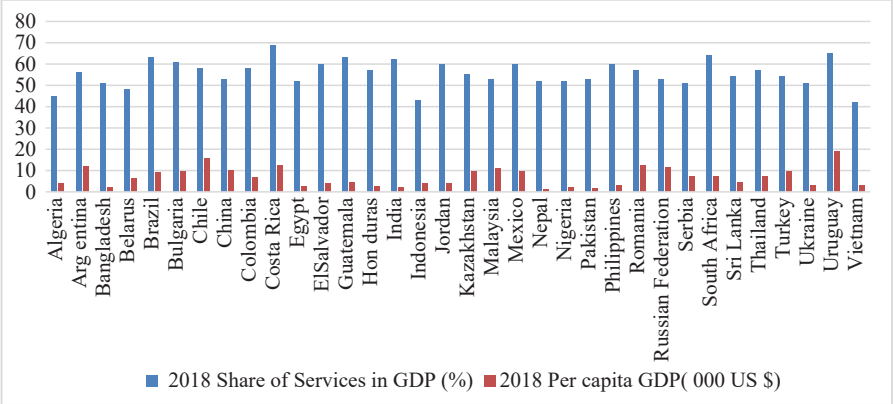

Figure 1. Share of services in GDP and per capita GDP in thousand US $ in low and middle-income countries, 2018

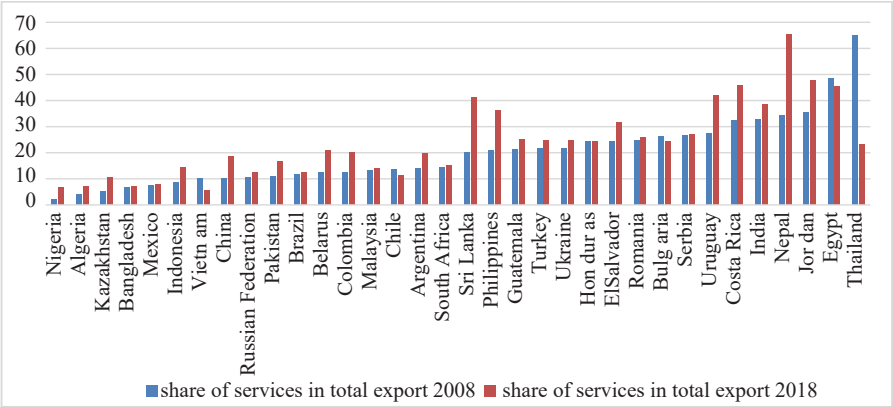

Figure 2. Share of services in total export of low and middle-income countries in 2008 and 2018

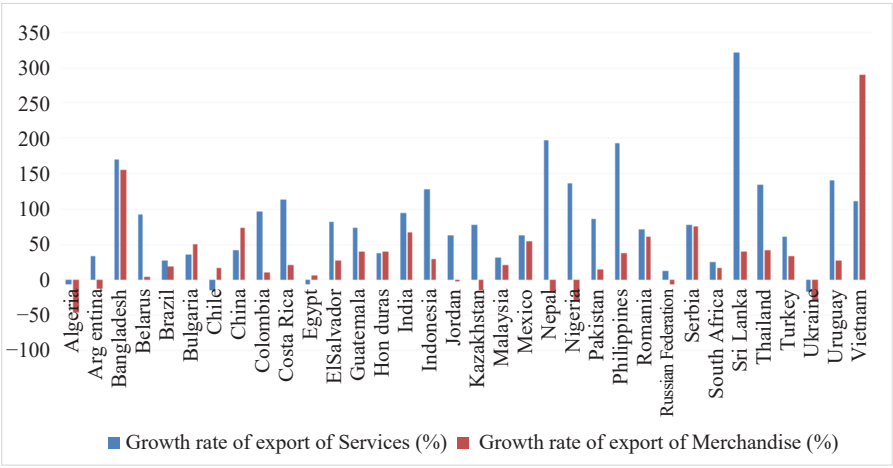

Figure 3. Growth rates of service and merchandise exports in low and middle-income countries in the period from 2008 to 2018

The Figureical presentation of per capita GDP, the share of services in GDP, the share of services and merchandise in total export and growth rates of merchandise and service exports shown in Tables 5, 6, 7 and 8 of Appendix-II have been provided in Figure 1, Figure 2 and Figure 3 with rankings of the countries in respect of the parameters.

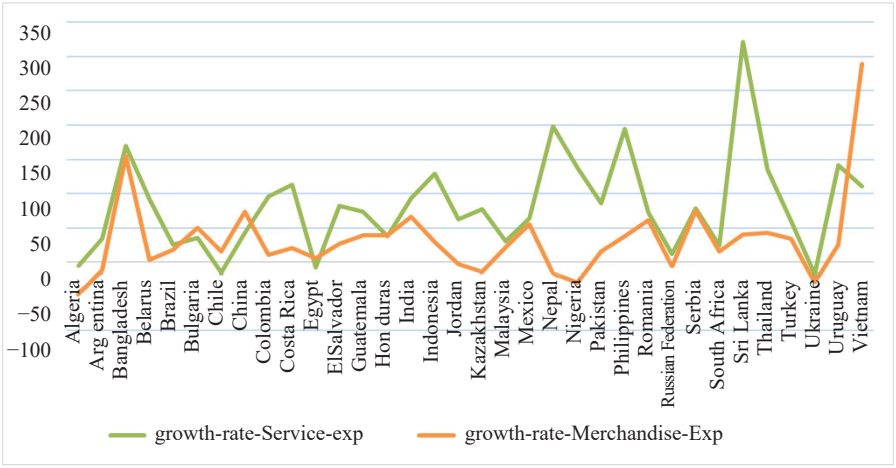

Figure 4. Growth rates of export of Services and Merchandise of low and middle-income countries from 2008 to 2018

Figure 4 shows higher growth rates of service export compared to merchandise export almost in all countries. While comparing per capita GDP, sectoral composition of GDP, and export of merchandise and services in developed countries with those in low and middle-income countries it is found that the per capita GDP in developed countries is much higher compared to the countries in the developing world. In the developed nations, the per capita GDP ranges from 40,000 to 50,000 US dollars or even more. These countries have reached the third stage of economic development with high service sector growth after completing the stage of industrialisation. The share of services in GDP is around 70% in developed countries whereas it is around 50% in most of the low and middle income countries. Although services account for 30-40% of total exports in developed countries, the merchandise still dominates the total exports. However, their growth rates of merchandise export are much less than that of services (see Figures 5, 6, and 7 in Appendix-II).

4.1 *Panel regressions-results and discussion*

Table 1. Panel regression of per capita GDP on explanatory variables in low and middle-income countries

Dependent variable: percap_gdp_usd						
explanatory variables	(1)			(2)		
	Coeff.	*z*	*P* > | *z* |	Coeff.	*z*	*P* > | *z* |
fdi_netinflow_usd	0.037	3.70*	0.000			
exp_R&D_GDP_ratio	-16.267	-0.16	0.872	-21.42	-0.21	0.83
mean_yrs_schooling	922.302	5.18*	0.000	887.78	4.78*	0.000
exp_infra_gdp_ratio	0.007	0.00	1.000	4.05	0.10	0.91
gcf_mnusd				0.001	2.96*	0.003
constant	-1859	-1.18	0.238	-995.93	-0.63	0.53
	R^2: within = 0.20 between = 0.31 overall = 0.30 REM#, Wald chi 2 (4) = 39.91 Prob > chi 2 = 0.000 *n* = 136 Groups = 34			R^2: within = 0.16 between = 0.31 overall = 0.30 REM# Wald chi 2 (4) = 34.14 Prob > chi 2 = 0.000 *n* = 136 Groups = 34		

* significant at 1% level
\# Hausman test accepts a random-effects model

Two models of panel regression of per capita GDP in 34 low and middle-income countries on various explanatory variables have been done in Table 1. The results show that the net flow of FDI and human capital (denoted by mean years of schooling) have a significant positive impact on per capita GDP. However R&D expenditure and expenditure on infrastructure (both as a percentage of GDP) are not found to have any significant effect on per capita income. This may be due to the fact that the expenditure on R&D and infrastructure is so low that they have failed to exert any meaningful effect on GDP. Gross capital formation is found to have a significant positive effect on per capita GDP. So, from these estimates, it is found that FDI, human capital and physical capital have played a positive role in increasing per capita GDP. These results are consistent with the findings of Sasmal and Sasmal (2023) which explain the role of human capital in addition to physical capital in accelerating growth.

Table 2. Panel regression of share of services in GDP on explanatory variables in low and middle-income countries

Dependent variable: share of service_GDP						
explanatory variables	(1)			(2)		
	Coeff.	*t*	*P* > | *t* |	Coeff.	*t*	*P* > | *t* |
fdi_netinflow	9.08	0.36	0.72			
exp_R&D_GDP_ratio	-0.178	-0.92	0.35	-0.183	-0.95	0.343
mean_yrs_schooling	2.782	5.99*	0.000	2.719	5.64*	0.000
exp_infra_gdp_ratio	0.131	1.76**	0.081	0.139	1.84**	0.069
gcf_GDP_ratio				-0.038	-0.53	0.599
constant	30.50	8.05*	0.000	32.14	6.73*	0.000
	R^2: within = 0.29 between = 0.002 overall = 0.008 F (4, 98) = 10.41 Prob > F = 0.000 FEM#, *n* = 136, Groups = 34			R^2: within = 0.30 between = 0.003 overall = 0.009 F (4, 98) = 10.47 Prob > F = 0.000 FEM#		

* significant at 1% level
** significant at 10% level
# Hausman test accepts a fixed-effects model

The results of panel regressions in Table 2 show the structural change in favour of the service sector with the help of human capital and infrastructure. In both models of panel regression, the mean years of schooling and expenditure on infrastructure have a significant positive effect on the share of services in GDP. The R&D expenditure and gross capital formation (both as a percentage of GDP) are found to be insignificant in having any effect on the share of services in GDP. These results have important policy implications. The investment in human capital formation and the development of infrastructure have significantly helped the growth of the service sector. R&D expenditure as before could not explain the increasing share of services in GDP.

The change in the share of industry in GDP is also an indicator of structural change. The results of three equations of panel regression of the share of industry in GDP on explanatory variables have been presented in Table 3. The first equation shows that the share of industry in GDP is negatively impacted by mean years of schooling. The effect is significant. The gross capital formation and FDI have a significant positive impact on industrial growth in the second equation. The expenditure on R&D and infrastructure has no significant effect on the share of industry in GDP. The implication of these results is that human capital (denoted by mean years of schooling) is helpful for service sector growth. As the service sector expands, more capital and labour are used in that sector. It is important to note that R&D expenditure and expenditure on infrastructure are so low that they do not help industrialisation. This has great implications for developing countries. The expenditures on scientific innovations and technological progress are very crucial for industrial growth. But they are so few in developing countries that they have no effect on industrialisation. In

China, more than 2% of GDP is spent on R&D. In Japan and South Korea, it is more than 3% of GDP. But India which is also a fast-growing country, is spending only 0.80% of GDP on R&D. That is why India has no significant presence in the global industrial market.

Table 3. Panel regression of the share of industry in GDP (share_ind_GDP) on explanatory variables in low and middle-income countries

Dependent variable: share_ind_GDP									
explanatory variables	(1)			(2)			(3)		
	Coeff.	*z*	*P* > | *z* |	Coeff.	*z*	*P* > | *z* |	Coeff.	*t*	*P* > | *t* |
gcf_gdp_ratio	-0.021	-0.28	0.78	0.14	1.98**	0.047			
fdi_netflow	-0.000017	-0.62	0.54\						
exp_R&D_gdp	-0.0067	-0.03	0.97				0.0051	0.02	0.98
mean_yrs_schooling	-2.53	-4.85*	0.000				-0.95	-2.52*	0.012
exp_infra_gdp	0.003	0.05	0.96						
ln_fdi_netflow				1.24	3.60*	0.000	1.23	3.72*	0.000
ln_exp_infra_gdp				-0.14	-0.52	0.60	-0.047	-0.17	0.84
constant	50.99	9.88*	0.000	16.20	4.42*	0000	27.03	5.90*	0.000
	R^2: within = 0.211 between = 0.072 overall = 0.046 F (5, 97) = 5.20 Prob > F = 0.000 FEM#, *n* = 136, Group = 34			R^2: within = 0.078 between = 0.36 overall = 0.30 Wald chi 2 (3) = 20.66 Prob > Chi 2 = 0.000 REM##, *n* = 136, Group = 34			R^2: within = 0.20 between = 0.012 overall = 0.023 Wald chi 2 (4) = 21.99 Prob > chi 2 = 0.000 REM##, *n* = 136, Group = 34		

* significant at 1% level
** significant at 5% level
# Hausman test accepts fixed-effects model
Hausman test accepts random-effects model

Table 4. Panel regression of share of services in total export in low and middle-income countries

Dependent Variable: services_total_export						
explanatory variables	(1)			(2)		
	Coeff.	*z*	*P* > | *z* |	Coeff.	*z*	*P* > | *z* |
percap_GDP	-0.0001	-0.30	0.762	0.004	0.13	0.898
fdi_netinflow	-0.0004	-1.03	0.303	-0.0003	-0.96	0.338
share_service_GDP	0.443	2.39*	0.017			
share_ind_GDP				-0.465	-2.84*	0.005
constant	-0.98	-0.10	0.918	35.44	6.07*	0.000
	R^2: within = 0.29 between = 0.002 overall = 0.008 Wald chi 2 (3) = 7.60 Prob > chi 2 = 0.05 REM#, *n* = 136, Groups = 34			R^2: within = 0.04 between = 0.16 overall = 0.14 Wald chi 2 (3) = 9.98 Prob > chi 2 = 0.018 REM#, *n* = 136, Groups = 34		

* significant at 1% level
# Hausman test accepts a random-effects model

The results of two equations of panel regression of the share of services in total export on explanatory variables have been presented in Table 4. It is found that the share of services in GDP has a significant positive impact on service export in equation (1). This is consistent with the arguments of theoretical analysis and findings of other studies like Thomas (2016), Das and Sarma (2021), Chakraborty et al. (2015) and Rao and Mohale (2011) which confirm the role of human capital and service sector in economic growth and service export. This result is reinforced by the significant negative effect of the share of industry in GDP on service export in equation (2). So, the service sector-led growth significantly explains the increasing service export in low and medium-income countries and it is again explained by sufficient human capital formation. The negative effect of the share of industry in GDP on the share of services in total export can be explained by the fact that lack of industrialisation has made the way for the expansion of the service sector and service export. The per capita GDP, an indicator of growth, has no significant effect on the ratio of services to total exports.

In the context of the rising service economy from a global perspective, service export is playing an important role in developed countries also. Here the export of services is increasing at a higher rate than merchandise (see Figures 6 and 7 in Appendix-II). However, in total exports of the developed countries, merchandise still dominates and within merchandise manufacturing constitutes 70-80% of the total merchandise export. This high ratio of manufacturing in total export of the developed countries is significantly explained by R&D expenditure, human capital and GDP growth (for details see Figures 8 and 9 and Tables 9, 10 in Appendix-II). The Figures 8 and 9 in Appendix-II show that R&D expenditure in developed countries is much higher than in developing countries. Thus industrial growth significantly matters in trade and overall growth in developed countries and to achieve industrial growth in developing countries sufficient investment is necessary for capital formation, infrastructure and technological innovations.

5. Conclusions and policy implications

This paper addresses the issue of increasing service exports in low and middle countries and tries to relate it with structural change and patterns of economic growth. This study has analysed the problems using theoretical models and empirical findings. Almost in all the developing countries the share of services in their total export has increased significantly in the period of trade liberalisation. From econometric analysis, it follows that this is the result of service-led growth and structural transformation in favour of services in developing countries. This is also a reflection of comparative disadvantage in industrial growth due to a lack of technological innovations and sufficient capital investment. The results of panel regression find a significant positive impact of the growth of the service sector on service export. The study also confirms that if a country remains industrially backward for different reasons, it will be reflected in its composition of exports and GDP. To explain why the countries in the developing world are mostly moving directly to services from agriculture, this study focuses on the nature of structural change keeping in mind various constraints towards industrial growth. This paper has tried to make a contribution to the theoretical literature on structural change and trade patterns by constructing a theoretical model which examines the nature of structural change and its effect on the composition of exports. The model demonstrates that productivity differences across sectors caused by different rates of growth of endogenous technological innovations and human capital formation determine the nature of growth and trade patterns. Both in theoretical model and empirical analysis, it is found that most of the countries in the developing world are lacking sufficient infrastructure, R&D expenditure and capital investment necessary for industrial growth. The formation of human capital has been found to be comparatively high and very helpful for service sector growth in such countries leading to increasing service export. The important implication from the results is that developing countries, in general, do not have a comparative advantage in industrial production and export. Countries like China which are dominating in manufacturing and global industrial markets, are less dependent on the service sector. India, another fast-growing big country in the world, on the other hand, with its rich pool of human resources and skilled workers is performing better in the service sector for growth and service export. Thus the low and middle-income countries are moving towards unbalanced growth in favour of the service sector. Whether such growth is sustainable or not or whether the increasing service trade can solve the problems of unemployment, inequality and poverty could not be addressed in this study.

This study has the following policy implications: (a) if the developing countries have a comparative disadvantage

in industrial growth, they should invest more in human capital formation and infrastructure so that service sector-led growth is facilitated, (b) for the overall growth of the economy, the low and middle-income countries should put greater emphasis on capital formation and inflow of FDI, (c) to accelerate industrial growth in low-income countries, R&D expenditure and technological innovations should be given higher emphasis, and (d) to increase the share of manufacturing export, greater emphasis needs to be laid on R&D expenditure and technological progress.

Conflict of interest

The authors declare that there is no conflict of interest at any point in financial, academic or any other matters.

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Appendix-I

Model of Economic growth with endogenous technological innovations and human capital formation.

The model

Let us consider a three-sector macro-economic model with agriculture, industry and services where all the sectors produce final products. We can express national income or nominal GDP as the sum of values of the products of different sectors at their respective prices in the line of Oulton (2001). The sectors are: Agriculture (X_1), Industry (X_2) and Services (X_3).

Now, the national income (Y) is

$$\sum_{i=1}^{3} P_i X_i,\ i = 1, 2, 3. \tag{A1}$$

where X_i and P_i are the respective output and price of the ith sector.

The economy is functioning in a competitive market situation where prices are given to firms and households. The factors of production are (i) physical capital (K), labour (L), human capital (H) and technology (T). It is assumed that population is denoted by $\overline{N}$ and it is constant. The human capital enhances the supply of labour in efficiency terms and it is denoted by L i.e.

$$L = \overline{N} \cdot H.$$

The factors are fully mobile across sectors and their prices are the same in all sectors. The production technology in each sector follows the Cobb-Douglas form with CRS as follows:

$$X_1 = A_1 T^{\alpha_1} K^{\beta_1} L^{1-\alpha_1-\beta_1}, \tag{A2}$$

$$X_2 = A_2 T^{\alpha_2} K^{\beta_2} L^{1-\alpha_2-\beta_2}, \tag{A3}$$

$$X_3 = A_3 T^{\alpha_3} K^{\beta_3} L^{1-\alpha_3-\beta_3}. \tag{A4}$$

The same factors are used in all the sectors but their productivities are different in different sectors: α_i is the production elasticity of T in the ith sector, i = 1, 2, 3. β_i is the same for K in ith sector. α_i is technology intensity of the ith product. If $\alpha_i \rangle \alpha_j$, it means that ith product is more technology-intensive than jth product where $i \neq j$. Similarly, $\beta_i \neq \beta_j$ where $i \neq j$. T is generated endogenously from intended investment in R&D by a profit-maximising agent and it is denoted by I_T. Equally, Human capital (H) is created from intended investment in the formation of human skills denoted by I_H. There are productivity differences of factors across sectors. The production functions are different in different sectors. The reallocation of factors caused by productivity differences will lead to non-balanced growth in the economy. It is assumed that the technology intensity of the product in the industrial sector is greater than in other sectors, i.e., $\alpha_2 \rangle \alpha_3 \rangle \alpha_1$ On the other hand, the services are human skill intensive than other sectors, i.e., $(1-\alpha_3-\beta_3) \rangle (1-\alpha_2-\beta_2) \rangle (1-\alpha_1-\beta_1)$.

The representative household derives utility from consumption (C) and as in Barro (1990) the utility function is:

$$u = \frac{C^{1-\theta}}{1-\theta}. \tag{A5}$$

The constant elasticity of substitution in intertemporal consumption is assumed. The budget constraints are:

$$\dot{K} = Y - C - I_H - I_T, \tag{A6}$$

$$\dot{H} = \delta`_1 I_H, \tag{A7}$$

$$\dot{T} = \delta`_2 I_T, \tag{A8}$$

δ_1 and δ_2 are productivity coefficients of I_H and I_T respectively.

The objective of the representative household is maximisation of total discounted utility over an infinite planning horizon. The optimising agent determines the optimal values of consumption (C) and investment on K, H and T in a dynamic perspective. It is done in such a way that returns from physical capital, human capital and technological innovations are equal.

Now, the control variables are C, I_H and I_T. The dynamic optimisation problem can be expressed as:

$$Max \int_0^{\infty} \frac{C^{1-\theta}}{1-\theta} \cdot e^{-\rho t} \cdot dt \,. \tag{A9}$$

S.t.

$$\dot{K} = Y - C - I_H - I_T,$$

$$\dot{H} = \delta_1 I_H,$$

$$\dot{T} = \delta`_2 I_T,$$

and transversality conditions.

ρ is discount rate of future utility from consumption.

The current-value Hamiltonian is:

$$J = \frac{C^{1-\theta}}{1-\theta} + \lambda_1 \left[Y - C - I_H - I_T \right] + \lambda_2 \delta_1 I_H + \lambda_3 \delta_2 I_T, \tag{A10}$$

λ_1, λ_2 and λ_3 are costate variables and they are shadow prices of K, H and T respectively.

Solving this dynamic optimisation problem using optimal control theory, we get the growth rate of consumption as:

$$\psi = \frac{\dot{C}}{C} = \frac{1}{\theta} \{ MP_K - \rho \}. \tag{A11}$$

Since the factors are fully mobile across sectors the return from capital (r) is the same in all sectors. r is the value of the marginal product of capital (VMP_K).

The VMP of the ith sector is

$$VMP_K^i = P_i \cdot \frac{\partial X_i}{\partial K} = P_i \cdot A_i^{'} \left(\frac{T}{L} \right)^{\alpha_i} \left(\frac{K}{L} \right)^{\beta_i} \left(\frac{L}{K} \right). \tag{A12}$$

Here, $A_i' = A_i \cdot \beta_i$, $i = 1, 2, 3$.

The returns to capital (r) are the same in all the sectors. Therefore,

$$r = P_i\, MP_K^i = P_j MP_K^j, i \neq j, \tag{A13}$$

and the same is true for labour i.e.,

$$w = P_i MP_L^i = P_j MP_L^j, \; i \neq j, \tag{A14}$$

r is rental on capital and w is wage rate.

Then the growth rate becomes

$$\psi = \frac{\dot{C}}{C} = \frac{1}{\theta}\left\{MP_K^i - \rho\right\}. \tag{A15}$$

If there is balanced growth K, L, C, Y, I_H, I_T, H, T and other related variables will grow at the same rate. Therefore, equation (A15) will give the overall growth rate of the economy as

$$\psi = \frac{\dot{C}}{C} = \frac{\dot{Y}}{Y} = \frac{1}{\theta}\left\{MP_K - \rho\right\}, \tag{A16}$$

or,

$$g_Y = \frac{1}{\theta}\left\{P_i \cdot A_i^{'}\left(\frac{T}{L}\right)^{\alpha_i} \cdot \left(\frac{K}{L}\right)^{\beta_i} \cdot \left(\frac{L}{K}\right)\right\}, \tag{A17}$$

where $i = 1, 2, 3$.

We can express (A13) and (A14) as:

$$w/r = \frac{1-\alpha_i-\beta_i}{\beta_i} \cdot k_i \text{ where } k = K/L,$$

or,

$$k_i = \frac{\beta_i}{1-\alpha_i-\beta_i}\left(w/r\right), \tag{A18}$$

$k = f\left(w/r\right)$, $f'\left(w/r\right) \rangle\, 0$. If $\left(w/r\right)$ remains constant, $\left(K/L\right)$ will also remain constant. In a balanced growth model, the factor ratio will remain the same. $\frac{X_i}{X_j}$ Will also remain constant. But structural change requires that factor share in different sectors will change and as a result of reallocation of factors, the output composition in GDP will change. Then there will be a non-balanced growth.

Appendix-II

Table 5. Per capita GDP in US dollars as per rank and category of the low and middle income countries in 2008 and 2018

Countries and categories					
2008			2018		
Rank	Countries	Per capita GDP	Rank	Countries	Per capital GDP
Low-income countries			Lower middle-income countries		
1.	India	993	1.	Guatemala	4,486
2.	Pakistan	915	2.	Sri Lanka	4,360
3.	Bangladesh	630	3.	Algeria	4,172
4.	Nepal	467	4.	Jordan	4,146
Lower middle-income countries			5.	El Salvador	4,146
1.	Thailand	4,328	6.	Indonesia	3,903
2.	Algeria	4,260	7.	Vietnam	3,267
3.	Ukraine	4,066	8.	Philippines	3,194
4.	China	3,468	9.	Ukraine	3,096
5.	Jordan	3,416	10.	Egypt	2,531
6.	El Salvador	2,964	11.	Honduras	2,458
7.	Guatemala	2,802	12.	India	1,974
8.	Nigeria	2,228	13.	Bangladesh	1,963
9.	Indonesia	2,144	14.	Pakistan	1,621
10.	Sri Lanka	2,007	15.	Nepal	1,161
11.	Philippines	1,990	Upper-middle-income countries		
12.	Egypt	1,942	1.	Costa Rica	13,383
13.	Honduras	1,713	2.	Romania	12,494
14.	Vietnam	1,158	3.	Argentina	11,795
Upper-middle-income countries			4.	Russian Federation	11,287
1.	Russian Federation	11,635	5.	Malaysia	11,074
2.	Turkey	10,802	6.	China	9,905
3.	Chile	10,783	7.	Mexico	9,857
4.	Romania	10,435	8.	Kazakhstan	9,813
5.	Mexico	10,120	9.	Bulgaria	9,452
6.	Uruguay	9,328	10.	Turkey	9,400
7.	Argentina	8,977	11.	Brazil	9,121
8.	Brazil	8,801	12.	Serbia	7,252

Table 5. (cont.)

Countries and categories					
2008			2018		
Rank	Countries	Per capita GDP	Rank	Countries	Per capital GDP
Upper-middle-income countries			Upper-middle-income countries		
9.	Kazakhstan	8,458	13.	Thailand	7,124
10.	Malaysia	8,343	14.	South Africa	7,048
11.	Bulgaria	7,271	15.	Columbia	6,782
12.	Serbia	7,101	16.	Belarus	6,360
13.	Costa Rica	6,842	High-income countries		
14.	Belarus	6,376	1.	Uruguay	19,026
15.	South Africa	6,252	2.	Chile	15,796
16.	Colombia	5,535			

Source: World Bank: Development indicators

Table 6. Share of services in GDP in low and middle-income countries in 2008 and 2018

Country	Share of services in GDP (%)	
	2008	2018
Algeria	33	45
Argentina	50	56
Bangladesh	53	51
Belarus	38	48
Brazil	57	63
Bulgaria	56	61
Chile	54	58
China	43	53
Colombia	52	58
Costa Rica	59	69
Egypt	47	52
El Salvador	59	60
Guatemala	58	63
Honduras	60	57
India	46	62
Indonesia	37	43
Jordan	57	60

Table 6. (cont.)

Country	Share of services in GDP (%)	
	2008	2018
Kazakhstan	52	55
Malaysia	44	53
Mexico	59	60
Nepal	49	52
Nigeria	49	52
Pakistan	53	53
Philippines	53	60
Romania	47	57
Russian Federation	51	53
Serbia	48	51
South Africa	61	64
Sri Lanka	57	54
Thailand	50	57
Turkey	55	54
Ukraine	53	51
Uruguay	58	65
Vietnam	42	42

Source: World Bank-Development Indicators

Table 7. Share of Services in total export of low and middle-income countries (in percentage) in 2008 and 2018

Country	2008	2018
Algeria	4.13	7.16
Argentina	13.87	19.67
Bangladesh	6.68	7.04
Belarus	12.33	20.72
Brazil	11.87	12.54
Bulgaria	26.20	24.30
Chile	13.80	11.16
China	10.21	18.53
Colombia	12.52	20.17
Costa Rica	32.49	45.83
Egypt	48.47	45.34

Table 7. (cont.)

Country	2008	2018
El Salvador	24.50	31.77
Guatemala	21.20	25.08
Honduras	24.45	24.22
India	32.82	38.62
Indonesia	8.72	14.48
Jordan	35.42	47.75
Kazakhstan	5.31	10.39
Malaysia	13.35	13.96
Mexico	7.64	8.03
Nepal	34.47	65.21
Nigeria	2.02	6.70
Pakistan	11.02	16.70
Philippines	21.01	36.25
Romania	24.78	26.04
Russian Federation	10.41	12.54
Serbia	26.73	27.04
South Africa	14.23	15.10
Sri Lanka	19.99	41.22
Thailand	64.85	23.37
Turkey	21.73	24.84
Ukraine	21.83	24.71
Uruguay	27.39	41.92
Vietnam	10.05	5.72

Source: Calculated using data from the World Bank

Table 8. Growth rates of service export and merchandise export in low and middle-income countries from 2008 to 2018

Country	Growth rate of export of services (%)	Growth rate of export of merchandise (%)
Algeria	-5.51	-47.29
Argentina	34.17	-11.76
Bangladesh	170.27	155.38
Belarus	92.51	3.55
Brazil	26.14	18.45
Bulgaria	35.97	50.33

Table 8. (cont.)

Country	Growth rate of export of services (%)	Growth rate of export of merchandise (%)
Chile	-14.60	16.01
China	42.52	73.81
Colombia	96.04	11.02
Costa Rica	112.66	20.95
Egypt	-7.11	5.34
El Salvador	82.54	27.24
Guatemala	73.15	39.19
Honduras	37.74	39.44
India	93.36	66.70
Indonesia	128.72	29.02
Jordan	62.69	-2.37
Kazakhstan	77.28	-14.35
Malaysia	30.74	21.73
Mexico	63.34	54.74
Nepal	198.18	-16.29
Nigeria	137.37	-29.82
Pakistan	86.53	15.26
Philippines	193.99	37.51
Romania	71.92	60.82
Russian Federation	12.55	-5.87
Serbia	78.06	75.24
South Africa	24.70	16.33
Sri Lanka	320.95	40.68
Thailand	135.24	42.28
Turkey	59.78	34.19
Ukraine	-16.92	-29.30
Uruguay	141.45	26.19
Vietnam	110.10	288.77

Source: Calculated from World Bank data

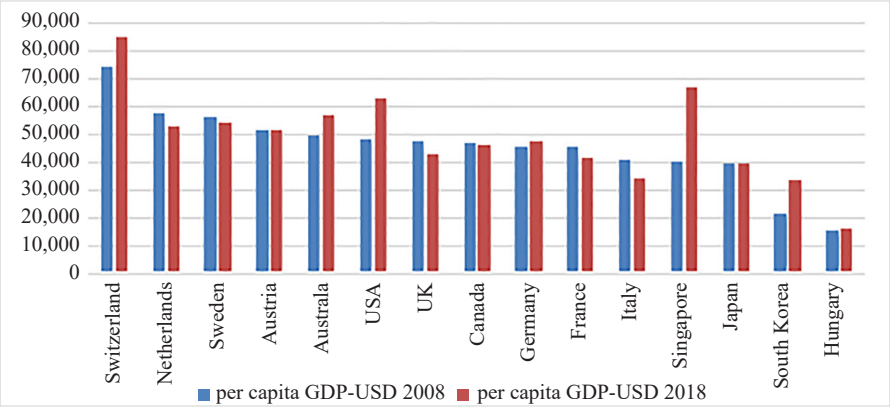

Figure 5. Per capita GDP in US dollars in selected developed countries in 2008 and 2018

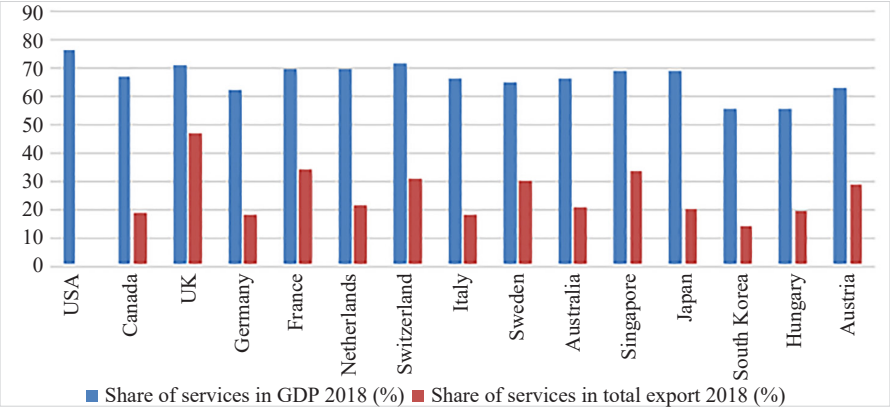

Figure 6. Share of services in GDP and share of services in total export of some selected developed countries in 2018

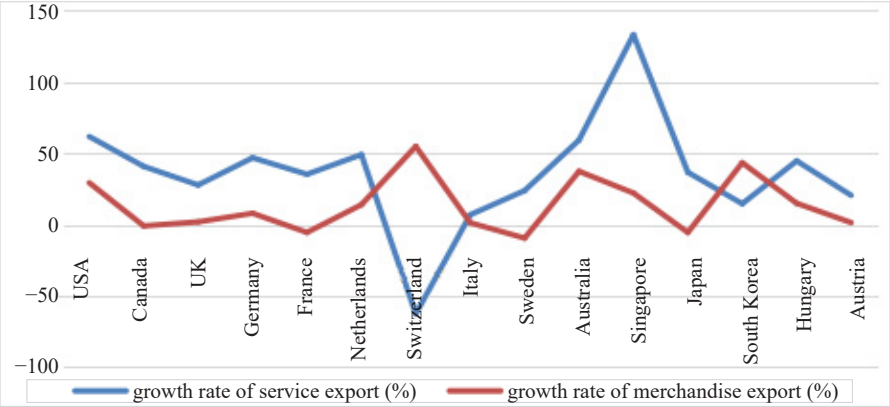

Figure 7. The growth rate of service export and merchandise export in some selected developed countries in the period from 2008 to 2018

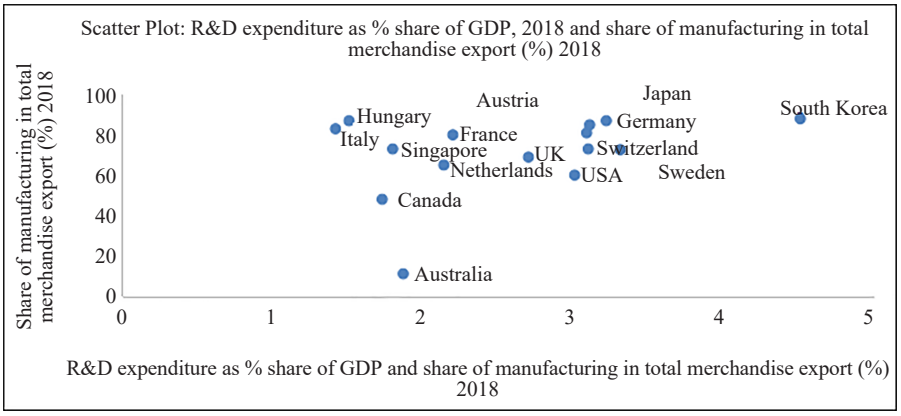

Figure 8. R&D expenditure as % share of GDP and share of manufacturing in total merchandise export (%) in selected developed countries in 2018

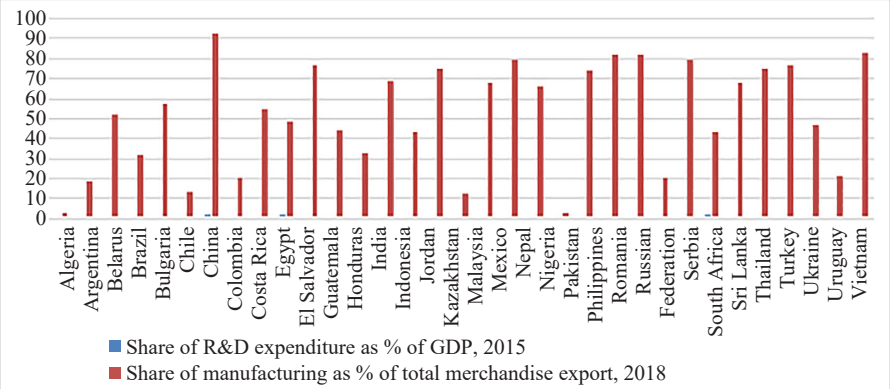

Figure 9. R&D expenditure as % of GDP 2015 and Share of manufacturing in total merchandise export in 2018 in 34 low and middle-income countries

Table 9. Panel regression of total export in developed countries on explanatory variables

explanatory variables	Dependent variable: total export					
	(1)			(2)		
	Coeff.	*z*	*P* > | *z* |	Coeff.	*z*	*P* > | *z* |
exp_R&D_GDP_ratio	74.74	1.93**	0.054			
Mean_yrs_schooling	37.96	1.10	0.27	61.53	1.80**	0.072
pc_GDP_usd	10.17	4.77*	0.000	9.67	4.31*	0.000
share_ind_GDP				-6.67	-0.69	0.48
constant	-403.12	-1.00	0.31	-325.34	-325.34	0.54
	R^2: within = 0.46 between = 0.04 overall = 0.04 REM# Wald chi 2 = 37.06 Prob > chi 2 = 0.000 *n* = 60, Group = 15			R^2: within = 0.43 between = 0.03 overall = 0.04 REM# Wald chi 2 (3) = 30.56 Prob > chi 2 = 0.000 *n* = 60, Group = 15		

* significant at 1% level
** significant at 5% level
# Hausman test accepts a random-effects model

Table 10. Panel regression of the share of manufacturing in total merchandise export on explanatory variables in developed countries

Dependent variable: manufacturing_merchant_export			
explanatory variables	(1)		
	Coeff.	*z*	*P* > | *z* |
total export	-0.0093	-2.35*	0.019
Exp_R&D_GDP_ratio	2.86	2.16*	0.031
share_ind_gdp	-0.14	-0.43	0.66
constant	73.34	7.08	0.000
	R^2: within = 0.17 between = 0.002 overall = 0.001 REM# Wald chi 2 (3) = 8.06 Prob > chi 2 = 0.044 *n* = 36, Group = 15		

* significant at 1% level
# Hausman test accepts a random-effects model