

ATINER's Conference Paper Proceedings Series

CBC2017-0052

Athens, 15 March 2018

**Economic Development and Structural Transformation
Revisited**

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Athens, 15 March 2018

ISSN: 2529-167X

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**Economic Development and Structural Transformation
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Abstract

This study analyses the mechanism of structural transformation, defined as the reallocation of economic activity across tradable sectors (agriculture and manufacturing) and service sector. The focus is on the stylised fact of development that the value-added share of the service sector tends to increase at a slower rate than the employment share of the sector. We present a simple model to analyse the difference between value-added and employment shares and find the change of relative capital intensity (the share of capital in the national income) of the tradable sector versus the service sector is a key factor in causing the difference.

Keywords: structural transformation; value-added share of services and employment share of services; capital intensity; capital deepening; total factor productivity, service-based economy.

Introduction

The structural transformation of a country wherein the focus of economic activity shifts from the agriculture and manufacturing sectors to the service sector is a phenomenon that can be observed worldwide. The macroeconomics and growth literature have decomposed this reallocation into three components: a demand-side effect due to low income elasticity of demand for agricultural products (income effects) and two supply-side effects, one due to differential sectoral total factor productivity (TFP) growth rates and the other due to differential sectoral capital deepening (relative price effects)¹. The income effects focus on the lower income elasticity of demand for the consumption of agricultural products and the decreasing percentage of agricultural products in overall consumption as income rises. In the supply-side effects, the lower labour productivity of the service sector relative to the tradable sectors (agriculture and manufacturing) leads to higher price levels (the Balassa-Samuelson effect) and thus to the sector's higher nominal value-added share in economic development. Supply-side effects also play a role in shifting production factors from highly productive sectors (agriculture and manufacturing) to unproductive sector (services).

This study focuses on the stylised fact of development that the value-added share of the service sector tends to increase at a slower rate than the employment share of the sector. We focus on the relation between the tradable and service sectors because it is known that the proportion of the service sector increases as economic development progresses. The other reason is that the productivity of services is relatively low and an increase in the proportion of services will lead to a slowdown in an economy's growth rate. In this respect, a move toward services has an important influence on economic development.

We present a simple model to analyse the difference between value-added and employment shares and find that the different impacts of the change of relative capital intensity (the share of capital in national income) on the two different kinds of shares of the tradable sector versus the service sector is a key factor to cause the difference². The magnitude of the change of relative capital deepening factor across the two sectors becomes relatively larger in the employment share from the influence of capital intensity changes.

Prior research by Dennis and İşcan (2009) examined changes in the shares of agriculture and manufacturing in the US using a similar model; however, their study is calibrated with the labour and capital intensities set as constant, analysing only the share of employment. Their study contains no analysis of differences between the shares of production and employment in progression toward the service sector.

¹ Capital deepening is the situation in which the capital per unit of labour is increasing in the economy.

² There are the well-known empirical regularities regarding economic growth, namely, the Kaldor facts, proposing that the shares of labour and capital in national income are roughly constant. Some studies, however, have recently documented the share is not constant. See, for example, ILO and OECD (2015).

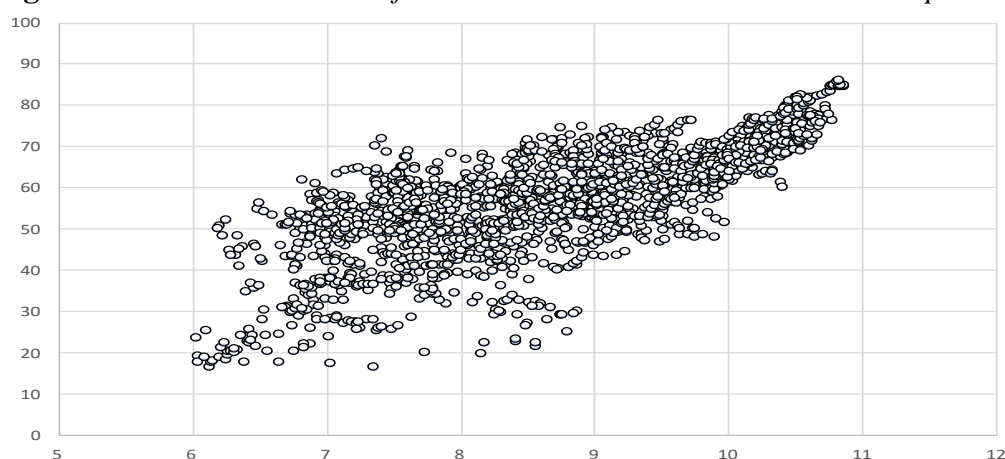
Prior studies that show a research interest similar to this paper's in respect of the differences between value-added share and employment share include Verma (2012) and Buera and Kaboski (2009). The former analysed why in India, unlike other countries, employment share led to low-level and small changes compared to the share of value added. The latter argues, based on the seminal work of Kongsamut et al. (2001) and Ngai and Pissarides (2007) that incorporated structural change into the traditional balanced growth model, that this type of model should incorporate some sectoral production factor distortions in order for it to match the actual data (long-term data from the US).

The Empirical Facts

Figure 1 shows the relation between the services share of nominal value added (GDP) (vertical axis and percentage) and GDP per capita (horizontal axis and logarithmic value) from 1950 to 2013 for 42 countries, including 13 OECD countries and 29 developing countries³. The dispersed shares of services in developing countries having lower levels of income can be seen in Figure 1. For the developed countries, located on the far right in this figure, the overall share of the services sector appears to move upward.

Figure 2 shows the change in the service sector's share of employment for all of the countries sampled in Figure 1. Compared to Figure 1, which shows the GDP share of the services sector, it appears that the services share of employment grows at a mostly consistent and a more rapid rate in accordance with income.

Figure 1. *The Services Share of Nominal Value-Added and GDP Per Capita*

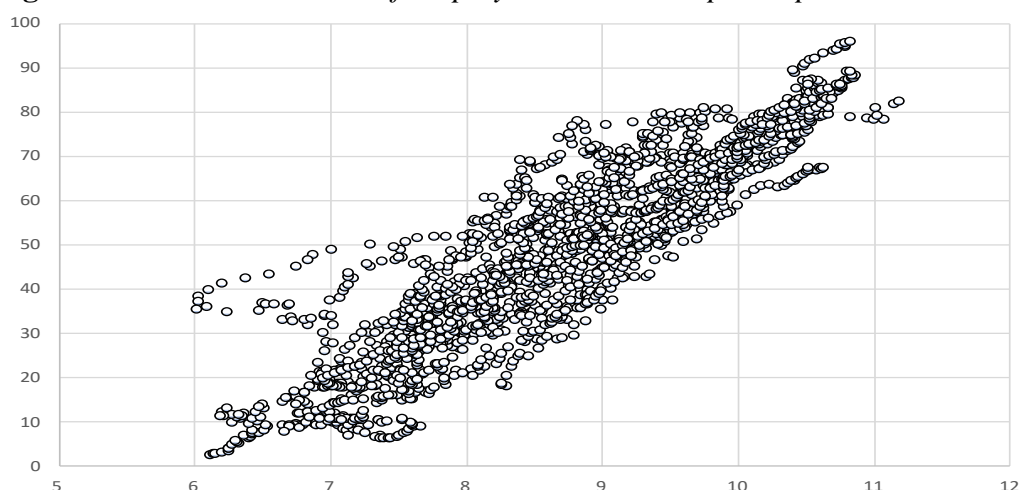


Notes: The horizontal axis indicates the logarithmic GDP per capita (value of expenditure-side real GDP at chained PPPs (in million 2011US\$) deflated by population (in millions)). The vertical axis indicates the services share of nominal value added (%).

Source: Penn World Table version 9.0 (<https://www.rug.nl/ggdc/productivity/pwt/>) and the GGDC 10-Sector Database (<https://www.rug.nl/ggdc/productivity/10-sector/>).

³ In this section, services sector includes all industries other than agriculture, mining and manufacturing.

Figure 2. *The Services Share of Employment and GDP per Capita*



Notes: The horizontal axis indicates the logarithmic GDP per capita (value of expenditure-side real GDP at chained PPPs (in mil. 2011US\$) deflated by population (in millions)). The vertical axis indicates the services share of employment (%).

Source: Penn World Table version 9.0 (<https://www.rug.nl/ggdc/productivity/pwt/>) and the GGDC 10-Sector Database (<https://www.rug.nl/ggdc/productivity/10-sector/>).

Next, we estimate the relation between income and change in the share of services for these countries by using panel data of these countries. Table 1 indicates the estimation results. Rows (1) to (4) indicate estimations for the value-added share and (5) to (8) show the employment share. Rows (1), (3), (5) and (7) are estimations by pooled OLS and (2), (4), (6) and (8) are those by panel estimations with fixed effects for sample countries. All estimations include an explanatory variable, GDP per capita and an OECD dummy to find that the share of the service sector appears to move upward significantly in developed countries with higher income levels in the above figures. Rows (3), (4), (7) and (8) are estimations with different area dummies for developing countries in Asia, Latin America and Sub-Saharan Africa.

From Table 1, one observes that the parameters of GDP per capita for the employment share are larger than those for the value-added share. The results are the same in both the pooled OLS and panel estimations. From this result, we confirm that the degree of increase in the proportion of services employment is larger than that of services value-added along economic development.

Table 1 also shows that there are significant differences in the point estimates of the interaction terms between GDP per capita and regional dummies between these two estimation methods. These indicate that we should select panel estimations with fixed effects to analyse the causal relation between income change and structural transformation and that there are large differences between developing and developed countries in the impacts that an income increase has on structural transformation.

Table 1. Causal Relation between GDP per Capita and Structural Transformation

Dependent variables	constant		GDP per capita		GDP per capita*OECD dummy		GDP per capita*Asia dummy		GDP per capita*Latin America dummy		GDP per capita*Sub-Saharan Africa dummy		Adjusted R-squared	Total panel observation	
(1) Value-added share	-17.893 *** (-13.05)	***	7.866 *** (47.77)	***	-0.140 *** (-3.86)	***							0.68	2069	pooled OLS
(2) Value-added share	-2.499 * (-1.70)	*	4.508 *** (21.42)	***	4.357 *** (12.43)	***							0.89	2069	Fixed effect
(3) Value-added share	-16.95 *** (-11.84)	***	7.783 *** (47.35)	***	-0.073 * (-1.82)	*	-0.265 *** (-7.17)	***	0.043 (1.04)		0.085 (1.50)		0.70	2069	pooled OLS
(4) Value-added share	-9.143 *** (-5.75)	***	12.129 *** (24.94)	***	2.021 *** (5.39)	***	-7.256 *** (-15.57)	***	-7.873 *** (-11.69)	***	-9.601 *** (-16.10)	***	0.92	2069	Fixed effect
(5) Employment share	-95.069 *** (-82.89)	***	15.895 *** (111.19)	***	-0.252 *** (-6.84)	***							0.91	2208	pooled OLS
(6) Employment share	-83.879 *** (-79.99)	***	11.508 *** (78.91)	***	8.118 *** (31.92)	***							0.98	2208	Fixed effect
(7) Employment share	-90.362 *** (-76.08)	***	15.438 *** (106.43)	***	-0.178 *** (-4.13)	***	-0.351 *** (-8.45)	***	0.398 (7.99)	***	-0.354 *** (-6.63)	***	0.91	2208	pooled OLS
(8) Employment share	-99.072 *** (-67.21)	***	16.330 *** (44.35)	***	3.958 *** (11.33)	***	-5.941 *** (-16.39)	***	7.496 *** (13.78)	***	-9.283 *** (-14.99)	***	0.98	2208	Fixed effect

Notes: t-values are in parentheses. *** Indicates 1% significance and * 10% significance.

The Model

Production and Preferences

Our model focuses solely on the implications for optimal consumption and production behaviour within each period. The advantage of this ‘static’ approach is that the first order conditions for the stand-in household and the stand-in firm are given by only observed current variables and we do not have to take a stand on the exact nature of intertemporal opportunities available to them (i.e. the appropriate interest rates for borrowing and lending). In what follows, subscript t , which indicates time, is omitted in each variable.

The model has two sectors of activity—tradable (T) and services (S). The tradable sector includes agriculture and manufacturing. The production function in each sector is assumed to be Cobb-Douglas with constant returns to scale. Our static approach allows all variables to change in each period without exceptions and capital intensity (K) is also assumed to change in each period. The output of services can be used for consumption (C) and investment (I). The output of the tradable sector can also be disaggregated into consumption (C) and investment (I). This is a model without international trade and the share of investment in each sector is exogenously determined in this model. Production structures and their market clearings in each of the product markets are as follows:

$$Y_S = A_S K_S^{\theta_S} L_S^{1-\theta_S} = C_S + I_S$$

$$Y_T = A_T K_T^{\theta_T} L_T^{1-\theta_T} = C_T \quad (1)$$

where y_i , T , A_i are the value added, total factor productivity (TFP), capital stock and employment in sector i , respectively. All resources for production (K and L) are fully used, meaning:

$$\begin{aligned} K_S + K_T &= K \\ L_S + L_T &= L \end{aligned} \quad (2)$$

We assume the period utility function $u(C_S, C_T)$ is of the form:

$$\begin{aligned} u(C_S, C_T) &= \left[\omega^{\frac{1}{\varepsilon}} C_S^{\frac{\varepsilon-1}{\varepsilon}} + (1-\omega)^{\frac{1}{\varepsilon}} C_T^{\frac{\varepsilon-1}{\varepsilon}} \right]^{\frac{\varepsilon}{\varepsilon-1}} \end{aligned} \quad (3)$$

where ε is the elasticity of substitution between the consumption of services and tradable products.

Equation (3) is a homothetic constant elasticity of substitution (CES) preference and does not take the income effects into consideration. This model focuses on the relative price effects to detect factors that cause structural transformation as mentioned above. If the income effects are considered, C_i should be changed into C_i^i (C_i^i is usually fixed for the entire sample period and set to be zero for manufacturing and non-zero for the agriculture and service sector).

Optimality Conditions

Next, production side efficiency is derived. There is perfect factor mobility across two sectors if sector-specific distortions to production factors (capital and employment) are cleared. The first order conditions for the stand-in firm in sector i are given by:

$$\begin{aligned} R &= P_S \theta_S A_S \left(\frac{K_S}{L_S} \right)^{\theta_S-1} = P_T \theta_T A_T \left(\frac{K_T}{L_T} \right)^{\theta_T-1} \\ W &= P_S (1 - \theta_S) A_S \left(\frac{K_S}{L_S} \right)^{\theta_S} = P_T (1 - \theta_T) A_T \left(\frac{K_T}{L_T} \right)^{\theta_T} \end{aligned} \quad (4)$$

P_i is the price of sector i ; and R and W denote rental rates of capital and employment. Both are expressed in nominal currency. Dividing these two equations by each other gives:

$$\begin{aligned} & \frac{1 - \theta_S}{\theta_S} \left(\frac{K_S}{L_S} \right) \\ &= \frac{1 - \theta_T}{\theta_T} \left(\frac{K_T}{L_T} \right) \end{aligned} \quad (5)$$

From the second equation in Equation (4), the implications for relative prices can be derived:

$$\begin{aligned} & \frac{P_S}{P_T} \\ &= \frac{1 - \theta_T}{1 - \theta_S} \frac{A_T}{A_S} \frac{k_T^{\theta_T}}{k_S^{\theta_S}} \end{aligned} \quad (6)$$

In the above equation, k_T : and k_S :

If θ_S and θ_T and their prices, P_S and P_T are observed, the first order condition for the stand-in household corresponds to:

$$\begin{aligned} & \left(\frac{P_S}{P_T} \right)^{\varepsilon} \frac{C_S}{C_T} \\ &= \frac{\omega}{1 - \omega} \end{aligned} \quad (7)$$

In what follows, we derive the relative consumption value of services to that of tradable products and the sectoral allocation of employment across the two sectors.

From Equations (6) and (7), the relative consumption values across the two sectors are obtained as follows:

$$\begin{aligned} \frac{P_S}{P_T} \frac{C_S}{C_T} &= \left(\frac{P_S}{P_T} \right)^{1-\varepsilon} \frac{\omega}{1 - \omega} \\ &= \left(\frac{1 - \theta_T}{1 - \theta_S} \right)^{1-\varepsilon} \left(\frac{A_T}{A_S} \right)^{1-\varepsilon} \left(\frac{k_T^{\theta_T}}{k_S^{\theta_S}} \right)^{1-\varepsilon} \frac{\omega}{1 - \omega} \end{aligned} \quad (8)$$

Based on Equation (1), we define the relation between Y_S and Y_T as $Y_S(1 - \gamma_S)$; and also define the relation between C_S and C_T as $Y_T(1 - \gamma_T)$;, where γ_S : and γ_T :. By using these definitions and Equation (7), the next equation, Equation (9) is derived:

$$\begin{aligned} \frac{Y_S}{Y_T} \frac{1 - \gamma_S}{1 - \gamma_T} &= \frac{C_S}{C_T} \\ &= \left(\frac{P_S}{P_T} \right)^{-\varepsilon} \frac{\omega}{1 - \omega} \end{aligned} \quad (9)$$

To derive the implications for relative employment allocation, we substitute Equation (1) into Equation (9) and rearrange it to obtain:

$$\begin{aligned} \frac{A_S k_S^{\theta_S} L_S}{A_T k_T^{\theta_T} L_T} &= \left(\frac{P_S}{P_T} \right)^{-\varepsilon} \frac{\omega}{1-\omega} \frac{1-\gamma_T}{1-\gamma_S} \\ &= \left(\frac{1-\theta_T}{1-\theta_S} \right)^{-\varepsilon} \left(\frac{A_T}{A_S} \right)^{-\varepsilon} \left(\frac{k_T^{\theta_T}}{k_S^{\theta_S}} \right)^{-\varepsilon} \frac{\omega}{1-\omega} \frac{1-\gamma_T}{1-\gamma_S} \end{aligned} \quad (10)$$

Equation (10) can be rearranged to obtain the next equation, Equation (11), for the relative employment allocation:

$$\begin{aligned} \frac{L_S}{L_T} &= \left(\frac{1-\theta_T}{1-\theta_S} \right)^{-\varepsilon} \left(\frac{A_T}{A_S} \right)^{1-\varepsilon} \left(\frac{k_T^{\theta_T}}{k_S^{\theta_S}} \right)^{1-\varepsilon} \frac{\omega}{1-\omega} \frac{1-\gamma_T}{1-\gamma_S} \end{aligned} \quad (11)$$

Then, we obtain some factors to decide the relative consumption and employment ratios of services.

From Equation (8), the relative consumption across the two sectors is factorised into the following two factors: (1) relative capital deepening $\left(\frac{1-\theta_T}{1-\theta_S} \right)^{1-\varepsilon} \left(\frac{k_T^{\theta_T}}{k_S^{\theta_S}} \right)^{1-\varepsilon}$ and (2) relative TFP $\left(\frac{A_T}{A_S} \right)^{1-\varepsilon}$. From Equation (11), the relative employment across the two sectors is decided by following three factors: (1) the relative capital deepening $\left(\frac{1-\theta_T}{1-\theta_S} \right)^{-\varepsilon} \left(\frac{k_T^{\theta_T}}{k_S^{\theta_S}} \right)^{-\varepsilon}$; (2) the relative TFP $\left(\frac{A_T}{A_S} \right)^{1-\varepsilon}$; and (3) the demand composition $\frac{\omega}{1-\omega} \frac{1-\gamma_T}{1-\gamma_S}$.⁴

Implications of the Model

From the empirical analyses in Section 2, the rate of services share increase viewed as employment share is larger than that when it is viewed as value-added share. This difference is, in fact, originated from the difference between Equations (8) and (11). The most important difference between these two equations is related to the contribution of relative capital deepening to sectoral structural change. In many countries, relative capital intensity () tends to increase as the tradable sector (especially the manufacturing sector) promotes capital deepening along economic development. This leads to a

⁴The nonnegative weight for services consumption (ω) assumes to be fixed and thus has no effect on the sectoral changes. The weight is usually calibrated as an averaged services consumption share in the entire period of analysis.

decrease in relative labour intensity () and results in an increase in the relative capital-labour ratio () from Equation (5). In Equation (8) for relative consumption share, $\left(\frac{1-\theta_T}{1-\theta_S}\right)$ and $\left(\frac{k_T^{\theta_T}}{k_S^{\theta_S}}\right)$ move in the opposite direction if we assume ϵ is below unity (gross complementarity) and thus, the magnitude of the change of capital deepening factor $\left(\frac{1-\theta_T}{1-\theta_S}\right)^{1-\epsilon} \left(\frac{k_T^{\theta_T}}{k_S^{\theta_S}}\right)$ tends to be relatively small. While on the other hand, $\left(\frac{1-\theta_T}{1-\theta_S}\right)$ and $\left(\frac{k_T^{\theta_T}}{k_S^{\theta_S}}\right)$ move in the same direction in Equation (11) and the magnitude of the change of the capital deepening factor $\left(\frac{1-\theta_T}{1-\theta_S}\right)^{-\epsilon} \left(\frac{k_T^{\theta_T}}{k_S^{\theta_S}}\right)$ tends to become relatively larger.

Conclusion

This study analyses one of the important stylised facts of structural transformation: that the degree of increase in the proportion of services employment is larger than that of services value-added. The value-added share of the service sector tends to be stable in developing economies and tends to increase in advanced economies. On the other hand, the services share of employment grows at a mostly consistent and a more rapid rate in accordance with economic development. The difference is attributed to the change of capital intensity. The change of relative capital intensity of the tradable sector versus the services sector affects the value-added share and employment share in a different manner. A simple static model reveals that the magnitude of the change of relative capital deepening of the tradable sector versus the services sector becomes relatively larger under the influence of capital intensity changes in the employment share than in the value-added share.

It will be important to extend this analysis. In this article, we present only a static growth model and do not quantitatively analyse the importance of the factors mentioned above. In this quantitative analysis, it is of interest to include sectoral data of developing countries, even though there may be some difficulty in obtaining the related data. This will be an important step in assessing the extent to which each factor can account for the process of structural transformation with rising income levels.

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