The Effect of Premature Deindustrialization on Labor Productivity and Economic Growth in Asia[1]

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1. Introduction

The association between the industrial structural change and economic development is one of the basic issues which have been even taught in the undergraduate textbook of development economics. Todaro and Smith (2011), for example, introduce its consequences by highlighting the classical works of Chenery and his colleagues.[2] In their empirical researches, Chenery and his colleagues focus on the structural change associated with economic growth which suggests the particular patterns of development. In their analyses, they employ the cross-country and time-series data analysis, and highlight several features of economic development. For example, they emphasize the importance of both physical and human capital accumulation, the change of consumer demands from the basic agricultural foods to manufacturing products, the decline of family size and population growth, and the growth of cities and urban industries.[3]

The basic concept of their industrial transformation may depend on the simple assumption: every country follows the similar, if not the same, development patterns. In other words, many poor developing countries are supposed to go through the similar development patterns with rich developed countries. Moreover, the law of Petty-Clark seems to be a universal phenomenon: the importance of industrial structure shifts from

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[2] For example, see Chenery and Syrquin (1975).
[3] Todaro and Smith (2011), p.121.

agriculture to manufacturing, and then manufacturing to service associated with economic development. This development pattern applies to many developing countries as well as developed countries, however at the different degree. The speed of development might be also different among developing countries. Recently, it is witnessed that the middle income countries are somehow trapped in the midst of industrialization, and hence at the middle level of economic growth. Some developing countries have faced with the issue of deindustrialization much below the level of developed countries' experiences. The notion of "premature deindustrialization" has now emerged as the research interests in developing countries.

In this paper, we organize our paper as follows. After introduction, we first conduct a brief literature review for structural change and economic development in Chapter 2, especially focusing upon the recent works. We then indicate our regression framework in Chapter 3, and the empirical results are discussed in Chapter 4, followed by concluding remarks in Chapter 5.

2. Literature Review

There are numerous works for investigation between structural change and economic growth in development economics. The famous topic of this issue is industrialization associated with the growing income level. Dasgupta and Singh (2006), for example, recall Kaldor who see manufacturing[4] as the engine of growth, and suggest the higher income elasticity of demand for manufacturing products than that for agriculture products.[5] This association between manufacturing and economic growth now receives a new attention. "De-industrialization" recently emerges as the consequent issue for developing countries since they face with this issue at a much lower level of income than the experiences of developed countries. In this literature review, we thus highlight premature deindustrialization. The examinations for premature deindustrialization have two dimensions: the one for the cross-country data analysis and the other for the individual country data analysis. The recent cross-country analysis for premature deindustrialization can be found, for example, in Dasgupta and Singh (2006), Felipe, Mehta and Rhee (2014), and Rodrik (2015). Dasgupta and Singh (2006) employ the cross-country analysis with 48 countries for the

[4] In this paper, we use "industry" and "manufacturing" synonymously in most cases. It is especially important in Chapters 3 and 4 where we employ the sector level data of industry rather than that of manufacturing. The manufacturing data are simply not available when we write this paper.

[5] Dasgupta and Singh (2006), p.3.

period of 1990-2000. They find the evidence for premature deindustrialization in terms of employment but not in terms of output. Moreover, the turning point for the inverted U curve has declined from a per capita of about US$3000 to US$10000 in some countries.[6] In their regressions, the variables for gross fixed capital formation and trade openness have shown the positive signs, and imply that these two variables promote the manufacturing sector.[7] Felipe, Mehta and Rhee (2014) moreover utilize the data of 52 countries from the OECD. They find that the manufacturing employment previously indicated around 18-20 percent which has now declined to around 13-16%.[8] Deindustrialization in employment now sets at a lower per capita income level of US$8000-9000 which is however not clear in the case of output. They find that manufacturing employment is more important than manufacturing output for economic growth.[9] Recently, Rodrik (2015) uses the data of 42 countries from the Groningen Growth and Development Center for the period of late 1940s or early 1950s to the early 2010s. He indicates the recent trend of deindustrialization, and suggests both globalization and labor-saving technical progress in manufacturing contribute to these phenomena.

Moreover, the single country-based analysis is found in McCaig and Pavcnik (2013) for Vietnam, McCaig, McMillan Verduzco-Gallo and Jefferis (2015) for Botswana, and Lawrence and Edwards (2013) for the United States. The outcomes of these studies are somehow similar to those of the cross-country analyses.

Lastly, the objectives of our empirical analyses are similar to Felipe, Mehta and Rhee (2014). We attempt to reexamine their following agenda[10] in case of the Asian countries.

(1) The peak employment share for the industrial sector has declined.

(2) The turning points of the inverted U curve for both employment and GDP have declined over time.

(3) The inverted U curve is more evident in employment than output.

3. Regression Framework

The existing studies show the inverted U curve between the per capita GDP and the share of industrial sector in both GDP and employment. In this section, we empirically

[6] Dasgupta and Singh (2006), p.5.
[7] Ibid., p.12.
[8] Felipe, Mehta and Rhee (2014), p.22.
[9] Ibid., p.5.
[10] Ibid.

investigate those associations in the regressions. We employ the following standard regression framework in this analysis.

$$Y = c + \alpha_x X + \alpha_o O + \varepsilon$$

The dependent variable, Y, is the share of industry sector in either GDP or employment. The independent variables of X are both per capita GDP and its squares, which examine the inverted U curve between the two variables of the income level and the level of industrialization. Moreover, independent variables of O indicate other variables of our interest associated with examination of the inverted U curve in the regressions. The variables of O include population, trade openness, investment, and two different education variables. These variables are selected based on the previous studies. ε is the error term. Our regression finally takes the following equation.

$$\begin{aligned} \text{LYIND (or LEMPIND)} = c &+ \alpha_1 \text{LGDPH} + \alpha_2 \text{SQLGDPH} + \alpha_3 \text{LPOP} \\ &+ \alpha_4 \text{SQLPOP} + \alpha_5 \text{LOPEN} + \alpha_6 \text{LGFCF} + \alpha_7 \text{LSECEDU} \\ &+ \alpha_8 \text{LTEREDU} + \alpha_9 \text{Year Dummy} + \alpha_{10} \text{Regional Dummy} \end{aligned}$$

Necessary data are all taken from World Bank (2015). The details for variables are as follows: LYIND (the share of the industry sector in GDP, log), LEMPIND (the share of the industry sector in employment, log), LGDPH (per capita GDP, 2005 constant US dollar, log), SQLGDPH (the square value of LGDPH), LPOP (population, log), SQLPOP (the square value of LPOP), LOPEN (trade openness, log), LGFCF (the share of gross fixed capital formation in GDP, log), LSECEDU (the enrollment ratio of the secondary education, gross, log), LTEREDU (the enrollment share of the tertiary education, gross, log). Moreover, we include two different dummy variables: the one for the year of 1960s, 1970s, 1980s, 1990s, 2000s, and the other for the regions of South Asia and East Asia. Our sample includes 15 countries in Asia and the Pacific for the period of 1960-2013.[11] The data availability is various among the sample countries as shown on Appendix.

4. Regression Results

[11] These countries are Australia, Bangladesh, China, Hong Kong, India, Indonesia, Japan, South Korea, Malaysia, New Zealand, Pakistan, the Philippines, Singapore, Sri Lanka and Thailand.

In our regressions, we have examined the inverted U curve of industrialization in the two dimensions: one for GDP and the other for employment.

4-1. Deindustrialization in GDP

Tables 1 and 2 show our regression results for GDP of the industrial sector. Model 1 is the base model and the year dummy variables are included in Model 2. We also include the variables of our interest in both Model 3 and Model 4. In particular, the variables of gross fixed capital formation (LGFCF) and trade openness (LOPEN) are included in Model 3 whilst the education variables of the enrollment ratio of secondary education (LSECEDU) and that of tertiary education (LTEREDU) are added in Model 4. Moreover, we include the regional dummy variables in Model 1 which indicates at least one statistically significant dummy variable. Therefore, we decide to conduct the separate regression for each region: i.e. East Asia and South Asia. We find 5 observations.

First, two income variables of LGDPH and SLGDPH exhibit the expected signs and show the inverted U curve at the 1 % significance level in all regressions. Second, the dummy variables for the year generally perform very poorly. Only the dummy variable for the 1960s appear to be statistically significant. Third, the education variables appear to be statistically significant. The enrollment ratio of secondary education, LSECEDU, contributes to industrialization. On the other hand, the enrollment ratio of tertiary education, LTEREDU, promotes deindustrialization. Perhaps, the promotion of higher education enhances the activities of the service sector which may reduce the industrial output in GDP. Fourth, the regional dummy variable for South Asia indicates the negative sign in the regression which imply the lower inverted U curve for South Asia than that for other countries. Moreover, separate regressions demonstrate that the estimated inverted U curves are indeed different among the sub-regions in Asia. Finally, the variables of our interest, LPOP, SLPOP, LOPEN, LGCFC, do not show the robust results. Their signs and parameter values are different upon the regression models.

In a nutshell, the regression results generally indicate the expected outcomes in line with the existing literature though the variables of our interest do not exhibit the statistically meaningful results.

4-2. Deindustrialization in Employment

Tables 3 and 4 exhibit our regression results for employment of the industrial sector. Similarly to the regressions for GDP, Model 1 is regarded as the base model and the

year dummy variables are included in Model 2. We also include the variables of our interest in both Model 3 and Model 4. Moreover, we include the regional dummy variables in Model 1 which in fact demonstrates the regional differences for both East Asia and South Asia. Therefore, we also examine separate regression for each region. We find 5 observations.

First, two income variables of LGDPH and SLGDPH exhibit the expected signs and show the inverted U curve at the 1 % significance level in all regressions. Second, the dummy variables for the year of 1980s and 1990s significantly enter the regressions. Third, the education variables appear to be statistically significant, especially in East Asia. The enrollment ratio of secondary education, LSECEDU, contributes to industrialization. On the other hand, the enrollment ratio of tertiary education, LTEREDU, promotes deindustrialization: these results are similar to the regression results for GDP. Fourth, the regional dummy variables for both East Asia and South Asia indicate the positive signs in the regression which imply the higher inverted U curve for both regions. Moreover, separate regressions for employment also demonstrate that the estimated inverted U curves are different among the sub-regions in Asia.

In a nutshell, the regression results generally indicate the expected outcomes in line with the recent literature.

(Tables 1, 2, 3, and 4)

4-3. Productivity Differences and Discussions

Based on the results of Model 1, we estimate the turning point for each inverted U curve which is indicated in Table 5. Moreover, the estimated fitted lines are shown on Figures 1 to 5. Table 5 somehow provides the perplexed views in the two ways. First, there is a large gap for the estimated turning points between GDP and employment. Concerning the GDP data, per capita GDP at the peak income level for all sample countries is US$3380 whilst that for employment is US$14484. Moreover, the difference of the turning income levels between East Asia and South Asia is much bigger in the employment data. East Asia indicates US$21881 for the turning point whilst South Asia just shows US$1281 for it. The large differences for the turning income levels for the inverted U curve however are not unique to this analysis since Dasgupta and Singh (2006) provide their estimation for the range of US$3000-YS$10000 for their sample countries.[12] Moreover, Felipe, Mehta and Rhee

[12] Dasgupta and Singh (2006), p.5.

(2014) indicate US$8000-US$9000 at the lower per capita income level in employment for deindustrialization.[13] These existing analyses may support our estimation although our estimation is preliminary and it needs to be treated with caution whose examination is based on the pooled OLS regressions. It should be emphasized however that Table 5 demonstrates the higher turning point for East Asia compared with that for South Asia in both GDP and employment. Our estimation thus supports premature deindustrialization which is evidenced in the Asian region.

Table 5: Estimated Turning Point

Data	Model 1	Estimated Turning Point (US$, 2005 price)
GDP	All Countries	3380
	East Asia	2347
	South Asia	1417
Employment	All Countries	14484
	East Asia	21881
	South Asia	1281

Source: Author's estimation.

Moreover, Figures 1 to 5 demonstrate both actual and fitted values of the share of the industry sector for both GDP and employment. In particular, Figure 1 shows the actual and fitted values for the share of the industry sector in GDP whilst Figure 2 does those in employment. These figures clearly indicate that deindustrialization starts at the lower income level in South Asia compared to East Asia.

Figures 3, 4 and 5 show that the estimated turning points of the inverted U curve in the regressions for employment have declined over time. Since our regression results indicate that the most of the dummy variables for the year are not statistically significant for GDP, we only show the fitted values for employment.[14] These figures are evident that the turning points of the inverted U curve for employment have declined over time.

[13] Felipe, Mehta and Rhee (2014), p.5.

[14] It should be noted however that Tables 1 to 4 show the statistically significant dummy variable only for the year of 1960s in the regressions for GDP, but not for other years. Moreover, the dummy variable for the year of 2000s in the regressions for employment appear to be not statistically significant at the 10 percent level.

Figure 1: Actual and Fitted LYIND (All sample, East Asia and South Asia)

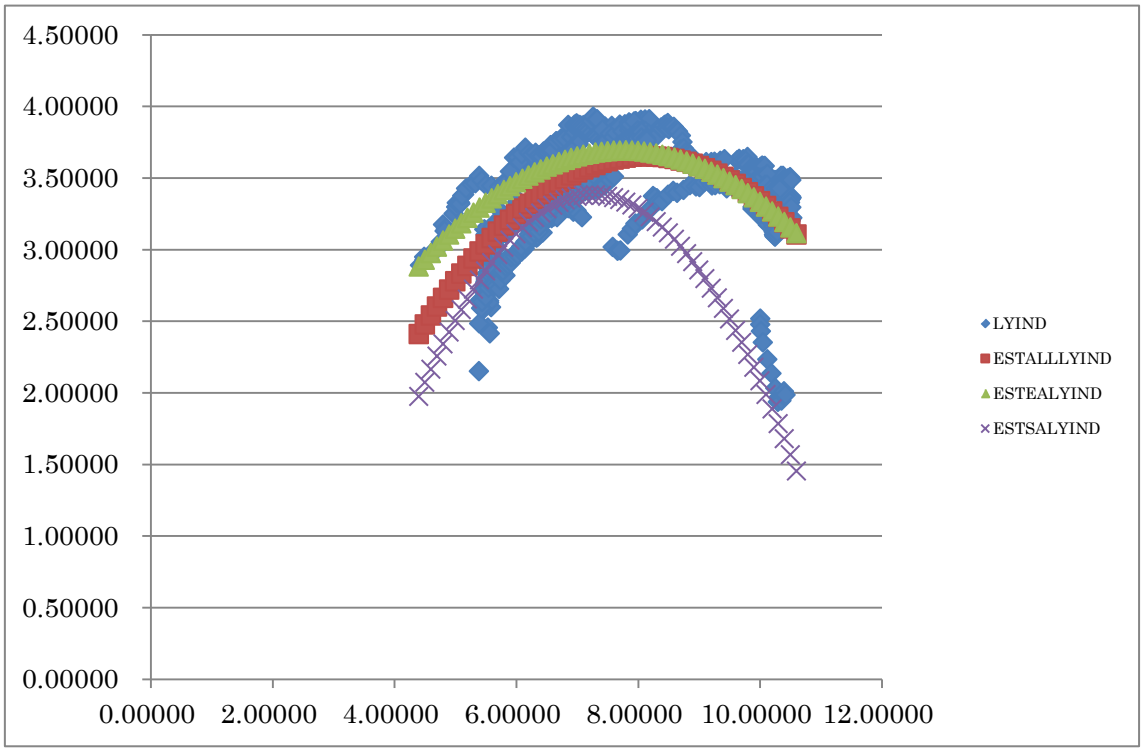


Figure 2: Actual and Fitted LEMPIND (All sample, East Asia and South Asia)

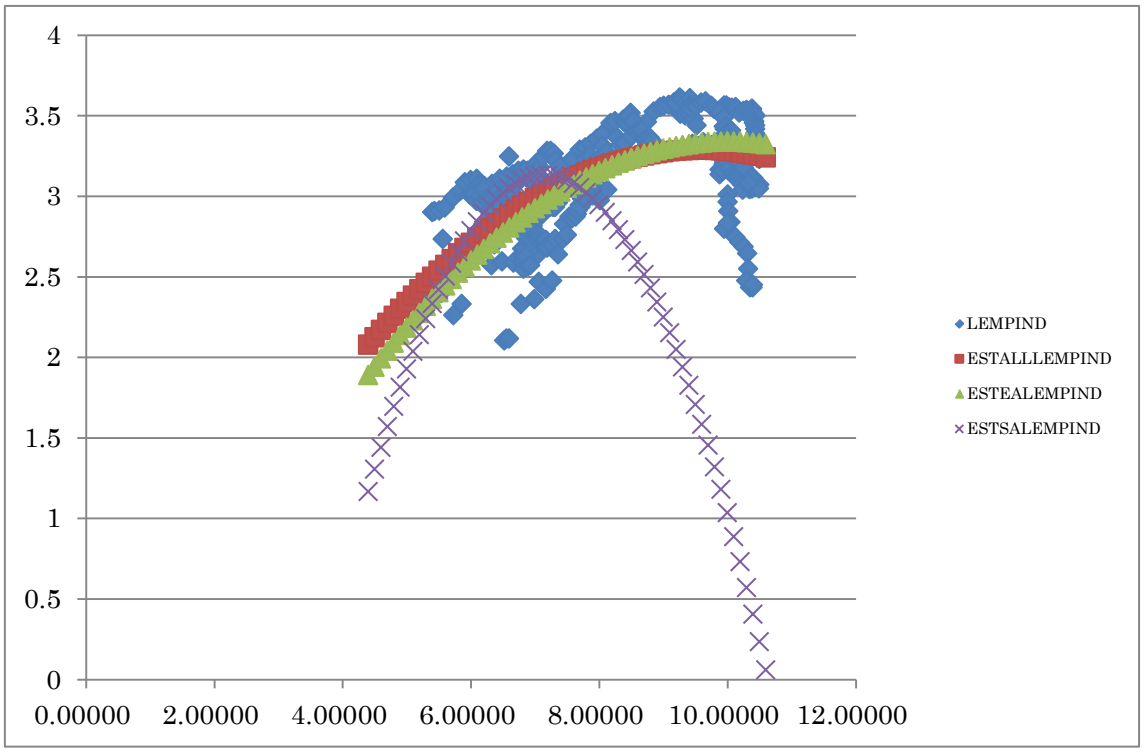


Figure 3: Actual LEMPIND and Fitted LEMPIND for all sample countries for 1980s, 1990s, and 2000s

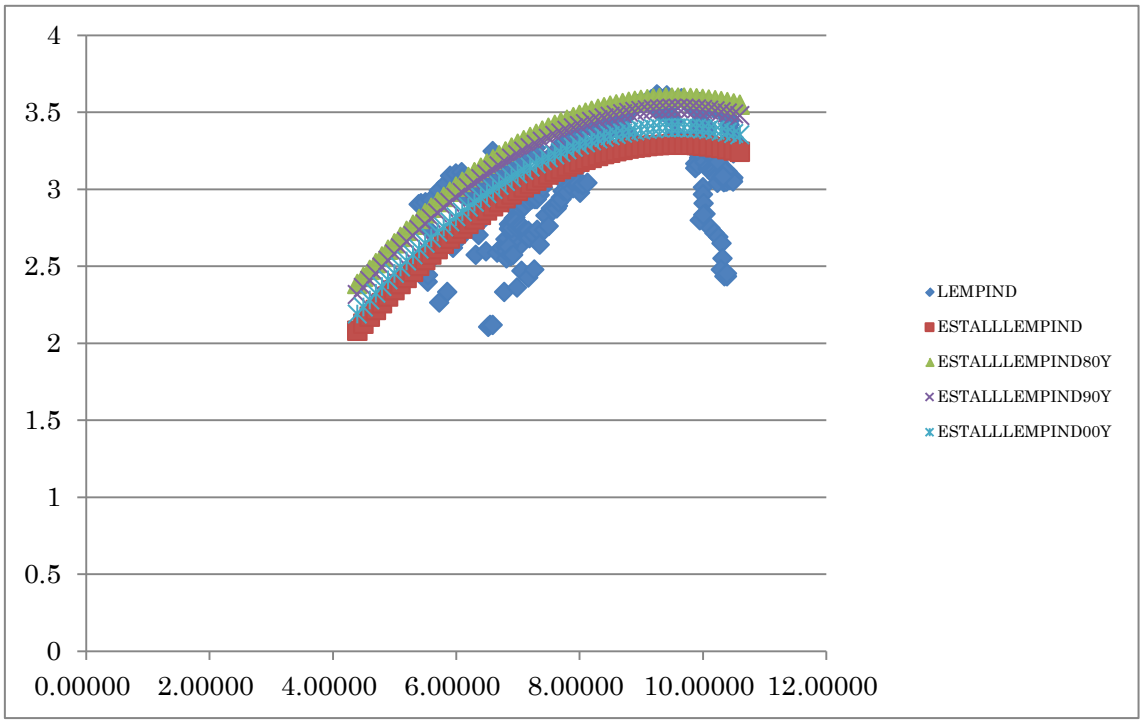


Figure 4: Actual LEMPIND and Fitted LEMPIND for East Asia for 1980s, 1990s, and 2000s

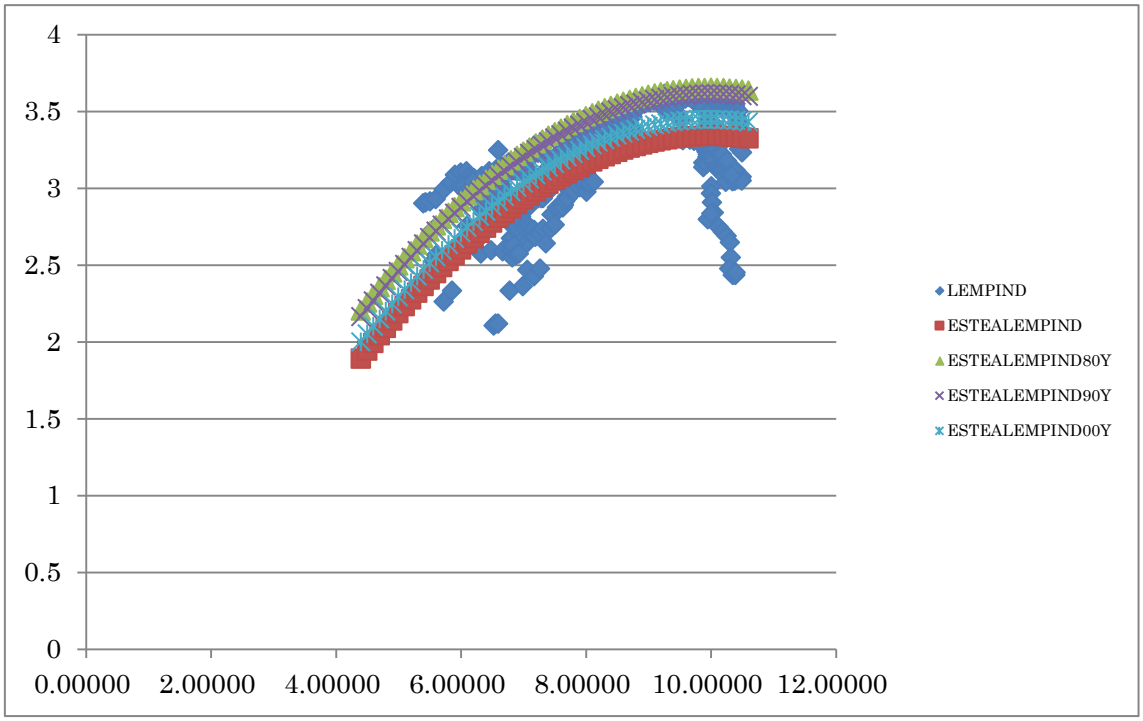
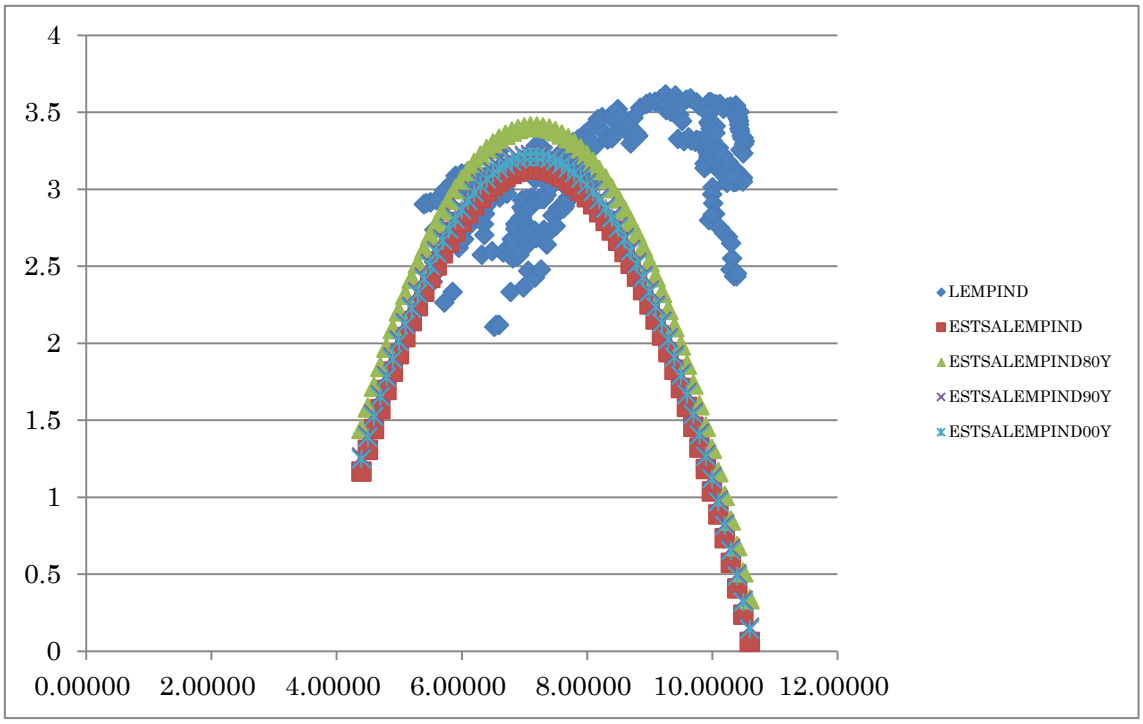


Figure 5: Actual LEMPIND and Estimated LEMPIND for South Asia for 1980s, 1990s, and 2000s



4-4. Determinants of Labor Productivity

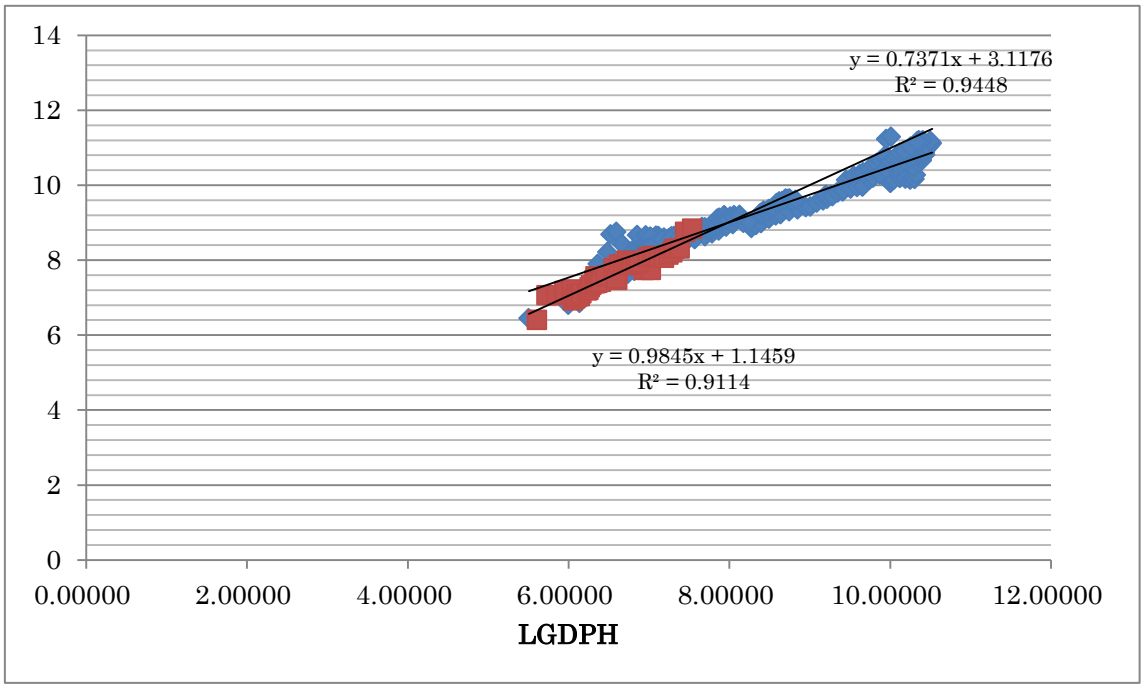
In the previous sections, we have investigated the inverted U curve associations between the income level and the level of industrialization in both GDP and employment. Our findings are mostly in line with the existing literature, for example, Felipe, Mehta and Rhee (2014), and support the idea of premature deindustrialization in both South Asia and East Asia. We now turn to the issue of labor productivity in industry. In this paper, we employ the data of per employment output as the labor productivity in the industry sector.

Figure 6 shows the labor productivity in industry both for East Asia and South Asia. South Asia shows the slightly steeper fitted line for the labor productivity than that for East Asia. The estimated fitted line indicates 0.985 of the parameter value for LGDPH for South Asia whilst the same figure is 0.731 for East Asia.[15]

[15] The regression result with all sample data is as follows:
LINDEMPVA = 1.092*LGDPH (R^2 = 0.836).

Figure 6: Labor Productivity in Asia

(The blue dots for East Asia and the red dots for South Asia)



We now investigate the determinants of labor productivity in both the long run and the short run. We first examine the log linear relationship among variables in the long run with the pooling data as the previous sections. We specify the following equation.

$$\text{LINDEMPVA} = c + \beta_1 \text{LGDPH} + \beta_2 \text{LPOP} + \beta_3 \text{LOPEN} + \beta_4 \text{LGFCF} + \beta_5 \text{LSECEDU} + \beta_6 \text{LTEREDU} + \beta_7 \text{Year Dummy} + \alpha_8 \text{Regional Dummy}$$

We here additionally define LINDEMPVA as per employment output in industry (US$, log). The regression results are shown on Tables 5 and 6. Model 1 is set as the base model with the variables of our interest, and the model 2 includes two dummy variables for the year and region. Models 3 and 4 additionally include two education variables of the enrollment ratio of the secondary education and that of the tertiary education. We moreover conduct the regressions for East Asia and South Asia separately since Model 1 shows the possible regional difference with the negative parameter value for South Asia. We have 4 findings in the regressions.

First, LGDPH (per capita GDP, log) appears to be statistically significant at the 1% level in all regressions. The positive association between LINDEMPVA (per employment output in the industry) and LGDPH (per capita GDP) can be found in line

with the conventional idea since the parameter value is also near to 1. Second, LGFCF (gross fixed capital formation, log) shows the negative signs which are contradictory to the conventional understanding that investment enhances productivity. The possible explanation is that the regression results are more influenced by the data from East Asia which most countries are already in the stage of deindustrialization and the investment is directed to other sectors than industry. Third, the tertiary education indicates the positive parameter values whilst the secondary education does not show the consistent results in the regressions. The positive parameter values for the tertiary education may imply that the industrial output more depends on more skilled labors than before. Fourth, the regional dummy variable demonstrates the lower labor productivity in South Asia. Combined with Figure 6 which shows the higher parameter value of LGDPH for South Asia, it might be possible that the labor productivity of the industry sector in South Asia catch up with that in East Asia in future.

We now turn to the short run associations among variables in examining the determinants of labor productivity in industry. We employ the panel data analysis with the differenced variables in the above mentioned framework. Tables 7 and 8 show our results. [16] Since several data are missing, we are not able to use the panel data for a long period. We thus have to reduce our sample size due to the unavailability of data. Consequently, we are not able to conduct our regression for South Asia due to the same problem. Although we have serious data problem for the panel data analysis, our results may provide the interesting finding. It appears that trade openness contributes to labor productivity in industry. Moreover, DLGFCF (gross fixed capital formation) indicates the statistical significance only in East Asia.

In a nutshell, our regression analysis for labor productivity in Asia provides interesting insights. The positive association between the income level and labor productivity in industry, the higher education and investment may promote the income convergence in the region in the long run. Moreover, trade openness contributes to labor productivity in industry in the short run that implies the positive impacts of globalization in the Asian region.

(Tables 5, 6, 7 and 8)

[16] We only show the results of the fixed effect regressions in this paper. The results of the random effect regressions will be submitted upon request.

5. Concluding Remarks

In this paper, we focus on the issue of premature deindustrialization in Asia. In particular, we revisited three agenda given by Felipe, Mehta and Rhee (2014). Our preliminary empirical examination provides the evidence to support them. First, the peak employment share for the industrial sector has declined. It is evident from the different turning points for the employment share for East Asia and South Asia. Second, the turning points of the inverted U curve for both employment and GDP have declined over time. In this inquiry, our estimation provides the evidence for employment but not for GDP. Third, the inverted U curve is more evident in employment than that in output.

Finally, our empirical analysis is preliminary, and it needs to be reexamined again when the relevant data become more available. Moreover, the necessary policy implications need to be provided for further analysis.

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