

The Effect of Structural Change on Labor Productivity Growth and Employment in the Philippines

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Abstract

Philippines is considered one of the fastest developing economies because of the growing service sector. This growth brought a significant change in the economic structure of the country which previously relied on the agricultural sector. This paper conducted a study about the significant impact of structural change on labor productivity growth and employment. The paper localized the decomposition analysis used in literatures to extract the share of “within” sector and “structural change” to total changes in labor productivity in the Philippines from 2004-2018, and Applied Pooled Least Square, to obtain the impact of structural change to labor productivity growth and employment. Based on Durbin-Watson test results, both Panel Regression Equation and Seemingly Unrelated Equation were utilized because there is no contemporaneous autocorrelation found in Pooled Least Square. Using Breusch-Pagan LM Test, Panel Regression is deemed more appropriate than Seemingly Unrelated Regression. Furthermore, the decomposition analysis showed that higher share of service sector in employment makes the contribution of “structural change” lesser to labor productivity growth due to labor market that becomes less flexible as service sector dominates the labor market because of higher skillsets needed by the sector. The regression analysis showed that structural change is a significant determinant of employment and labor productivity; structural change has a positive relationship to labor productivity due to the transfer of labor to high-productivity sector; and structural change has a negative relationship to employment because the employment brought by the structural change cannot be absorbed by the labor force because of skills mismatch.

Keywords: *Structural Change, Labor Productivity Growth, Employment, Seemingly Unrelated Regression Equation Model, Panel Regression*

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1. Introduction

The Philippines, as a newly industrialized country today (Boddin, 2016), has experienced the different phases of the economic cycle. In the 1950s, the country was considered as the model of development in Southeast Asia next to Japan. It was likewise identified as one of Asia's industrial powerhouses that manufactured consumer goods, fabricated raw materials, and built manufacturing facilities for automobiles, televisions, and other home appliances. However, by the 1970s to 1980s, the country transformed into one of the worst economies in East Asia and was even considered the "Sick Man of Asia" because of its poor economic condition, where it only registered an average of 3.4% growth rate, while its neighboring countries like Indonesia, Malaysia, Singapore, and Thailand registered a mean growth of 5.4% (de Dios, 1984). Today, the Philippines is known as one of the fastest growing and developing economies, with an average annual growth rate of 6.4% between 2010-2018, due to the powerful consumer demand followed by the dynamic labor market and blooming remittances with business activities flourishing in the service industries, including the business process outsourcing, finance and insurance, and real estate industries (World Bank, 2019). These service industries are considered as the main movers of growth in the country. Their rise, from 32.1% of total employment in 1970s to 52.5% of total employment in 2010s, brought the significant change in the economic structure of the country that previously relied on the agricultural sector (Intal, 2017).

Economic development and structural transformation follow a delicate and complex process. There are many factors that may affect and contribute to the development and transformation of a country. These may involve large-scale change as new and leading sectors may emerge as drivers of technological advancement and employment creation, thus the composition of output and employment may also drastically change – for instance, resources are reallocated among agriculture, industry, and services.

In classical economics, structural transformation takes place when agricultural productivity growth releases labor and creates demand for manufacturing goods, which will eventually result to the diversification of employment and a decrease share of agriculture in the economy – a common scenario in most developing countries (Mowla, 2017). According to studies, there are five distinct patterns of structural transformation: (1) decreasing share of agriculture in Gross Domestic Product, (2) decreasing share of agriculture in employment, (3) urbanization, (4) growth in other sectors, and (5) the structure of the population transitions with

the declining of population growth rates (Kuznets, 1955; Chenery & Syrquin, 1989; Timmer, 2009; Agarwal et al., 2018). Since the Philippines is considered as a newly industrial country today and every industrialized country goes through the process of structural transformation, it is very essential to know the significant impact of structural change to total labor productivity and employment in the Philippines and its administrative division. Furthermore, this will provide new evidence through a more comprehensive investigation about these changes.

This study also tested the following null hypotheses:

H01: Structural change has no significant correlation with labor productivity and employment

H02: Structural change has no significant effect on labor productivity growth

H03: Structural change has no significant effect on employment

2. Literature review

2.1 Structural Change and Labor Productivity Growth: The Effect, Relationship, and Policy Implications

According to Briones and Felipe (2013), the overall shape of the economy is established based on the degree of agricultural development as well as the degree of homogenization of agriculture with other sectors and everybody else in the economy that play a vital role in narrowing the gap between the rich and the less fortunate essential in alleviating poverty (Bathla et al., 2019; Johnston & Mellor, 1961). Meanwhile, Guncavdi et al. (2013) used the input-output model and found that Turkey has not yet fully achieved the structural transformation from agricultural economy to industrial economy. However, despite the sectors' production losses, it has a little bit affected the changing determinant of the demand or supply in the agricultural sector. Therefore, it is realized that the agricultural sector is not highly dependent in terms of input supply or demand. Moreover, Stegman (2011) used the term "convergence" and found that productivity convergence is evident in some sectors, generally in the in-service sector, while it is not evident in other sectors and thus the productivity convergence appears to be driven by structural change. This is supported by the study of Inklaar and Timmer (2009) where they argue that in OECD countries, their sequence of convergence in every sector has changed since 1970;

whereas productivity in market services merged, but there is no merging in manufacturing. A more comprehensive analysis justified that the sequence of merging is highly industry specific. There is no superior merging trend in sectoral productivity growth across developed countries.

In Africa, Mcmillan et al. (2014) found that structural change contributed positively to Africa's overall productivity growth which indicates a limitless potential for development through structural change. Moreover, in another study of Mcmillan and Rodrik (2011), they were able to identify the three elements that help influence whether structural change contributes to the total productivity growth or not: first, economies with a revealed comparative advantage in raw materials are at a disadvantage; second, economies that can maintain a competing or underrated currencies tend to encounter greater growth-amplifying structural change; lastly, countries with more flexible labor markets tend to experience a much greater growth-amplifying structural change that is why for the economies with a comparatively large contribution of raw materials in exports, structural change has generally been growth reducing because they cannot utilize the surplus labor from agriculture.

In most of the Asian countries, Forster-Mcgregor and Versapen (2016) found, using the decomposition of income changes in three elements, the following: adjustments in labor productivity within sectors; employment movement in different sectors (structural change); and, adjustment in the strength of employment participation that changes in labor productivity which is mostly brought by the changes "within" instead of structural change. However, in lower income Asians countries, structural change has a significant share to total labor productivity growth. Like in the case of Indonesia, Badriah et al. (2017) found, using shift-share decomposition analysis and panel data regression, that structural changes have minimal effect on labor productivity growth. Thus, structural change should be aided by various components like appropriating government programs and policies that will increase the value of human capital and that will give a better framework through developing an appropriate budget allocation by the government. Meanwhile, Escobar and Muhlen (2019) who utilized the two-step decomposition approach, data show that structural change is growth-reducing instead of growth-enhancing during the period of 2005 to 2016 mainly due to the redistribution of (unskilled) labor within the administrative district which reduces the overall growth in Mexico.

In the Philippines, Usui (2011), using decomposition analysis, found that unlike other countries in the Association of Southeast Nation (ASEAN) region, growth caused by sectoral

reallocation of labor or structural change makes little share to countrywide or overall productivity growth. The minor growth in the overall productivity came from the reallocation of labor from agriculture to services, where productivity has been sluggish but still higher than agriculture.

2.2 Structural Change and Employment: The Effect, Relationship, and Policy Implications

Evidence was found in China where Felipe et al. (2014) reported that the flow of labor out of low-productivity agriculture is a necessary condition for the country's aspirations to develop and finally to become one of the highest-income economy. The analysis indicated that the employment share of agriculture in China would continue to decrease to about 24% by 2020. This is confirmed by Martins (2019) when he found out that labor redistribution has played a vital role in improving the economic condition since the early 2000s, even if they continue to become relatively less dominant than within-sector productivity developments implying that the rampant redistribution of labor from agriculture to the other sectors has been the main leader of structural change, therefore agricultural employment shares are highly correlated with Gross Domestic Product per capita (Wingeder, 2014).

In Vietnam, Ravago et al. (2017) found that the growth in employment is because of the machinery and equipment investment by the government and a major part of the changes is because of the technical deviation caused by these investments. Using regression analysis, this was confirmed by Abbot et al. (2017) that employment in Vietnam grows slower than its GDP over the past decade. Because of this, Vietnamese policymakers argue that the relentless structural transformation is generating fewer jobs than expected. Using the seven aggregated sector and overall economy of Vietnam, they found that some of the changes between the growth in GDP and employment can be accredited to machinery and equipment investment by the government, and the bulk of these changes is because of technical change, which is also the same case in OECD countries according to Afsar and Mecik (2014). Although structural transformations have a significant effect in the labor market and the economy in OECD, the growth in labor productivity has a negative influence over employment in OECD affecting the long-term unemployment in an increasing rate. Meanwhile, Ando and Nassar (2017) found that

education can boost the successful rate of structural change to generate jobs. They emphasized that higher educational attainment is important because skills are necessary for labor mobility.

According to Timmer (2009), no economy has been able to maintain a fast-paced evolution out of poverty without expanding its agricultural productivity except for Singapore and Hong Kong. It was also argued that these countries should emphasize capital investment in irrigation and other agricultural infrastructures and pursue technology based on research and development through thereby increasing the budget allocation for these areas since they play a vital role in encouraging private investment and capital accumulation and thus promoting growth and employment opportunities. This was supported by Bustos et al. (2013) that factor bias of technical change through extensive research and development results to a labor-saving approach and leads to industrial and employment growth. Similarly, Badiane and Makombe (2014) emphasized that a rapid agricultural productivity growth is necessary for a successful transformation, but it should avoid government intervention in favor of industrialization because, as they stated, in Africa around 1960s-1970s, the government neglected agriculture which resulted to bad economic development and a growth-reducing structural transformation. This is distinguished by the increasing share of labor in the low productivity informal service sector. Thus, informal service sector must be regulated through adequate industrialization strategies and with the collaboration among government, industries, and the multi-stakeholder for better allocation of scarce labor resources (Senbet & Simbanegavi, 2017). However, Felipe (2019) argues that rapid structural change usually leads to greater unemployment, which requires prescriptions to focus on fostering full employment and to achieve inclusive growth. The government must commit all of its efforts and resources to pursue full employment to increase income and taxes, and reduce poverty.

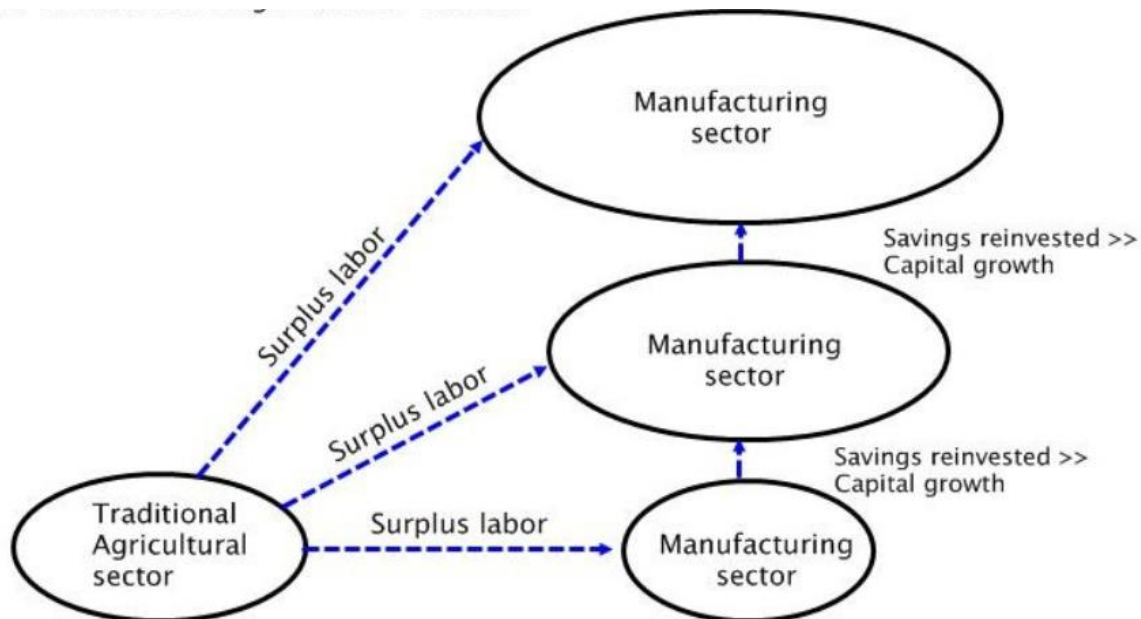
In the Philippines, Usui (2011) found through decomposition analysis that services-led structural change has not generated enough job opportunities. Over the years, the country is still suffering high unemployment (and underemployment) which is the highest in the ASEAN region. He also emphasized the importance of BPO industry which employs beneath 1% of the total labor force in the Philippines. Given the large amount of unused raw labor and the prospect of a young population to further increase labor force in the country, with proper utilization, it is not difficult to expect that the BPO industry may be the savior of the Philippine economy.

2.3 Theoretical framework

There are theories and studies that explain the structural change on labor productivity and employment. One of the best theories is the Structural Change Theory that explains how underdeveloped countries shift their national economic structure from a more traditional agriculturalized economy to a more modern industrialized and diverse manufacturing and service economy (Syrquin, 1988). This theory was further explained by the Lewis two-sector model by W. Arthur Lewis and later modified by John Fei and Gustav Ranis. According to their study, an economy starts with two sectors: a traditional agricultural sector and a modern industrial sector, which implies that higher productivity in the industrial sector promotes the transfer of economic resources from agriculture to the industrial sector in order to industrialize the economy and increase overall economic production. The theory also emphasizes that in a conventional two-sector economy model, an excess in agriculture plays a vital role in the overall economic structural transformation. This concept is summarized in figure 1.

Figure 1

Lewis' Structural Change Model of Growth



Source: Models of Economic Growth and Development

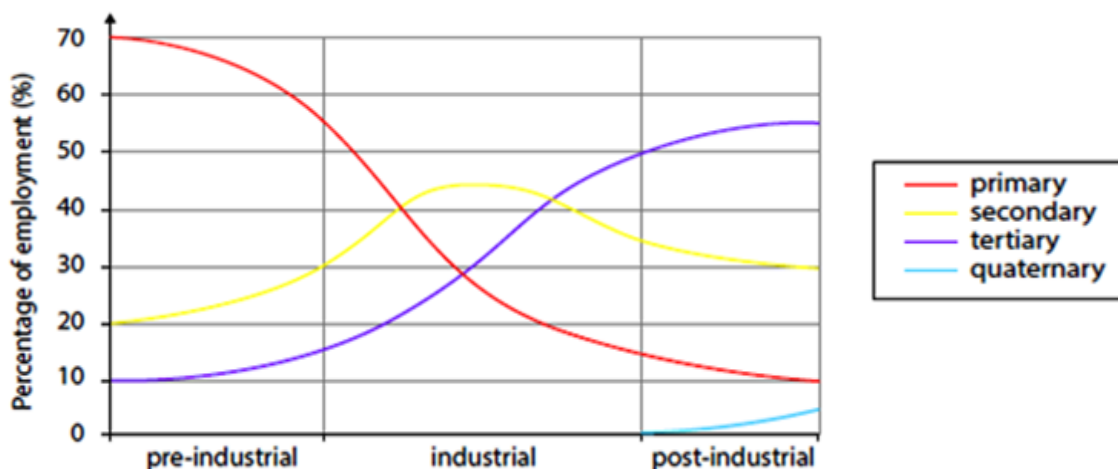
Figure 1 shows the flow of resources in the two sectors where the agricultural sector is at the maximum capacity and where the marginal product of labor is 0. This means that with the additional unit of labor, the production of the sector is still the same having a surplus of labor.

This surplus in labor is absorbed by the manufacturing sector while the existence of cheap labor in the manufacturing sector results to higher profit and higher savings. These savings are reinvested back in the industrial sector thus encouraging growth within, followed by the shifting of economic inputs from the agricultural sector to the industrial sector. As the industrial sector further expands, a reallocation of resources happens until such time that the industrial sector reaches maximum capacity where the marginal product of labor is 0 and cannot absorb additional unit of labor.

Another theory that relates to shifting of the economy and employment overtime, or structural change, is the three-sector model constituted by Allan Fisher, Colin Clark, and Jean Fourastié. The model represents the change in employment structuring as the economy of regions evolve overtime. It distinguishes four sectors of the economy which are primary (agriculture and fishing), secondary (manufacturing and industry), tertiary (producer services) and quaternary (knowledge services). The model is summarized in figure 2.

Figure 2

Clark-Fisher Model



Source: GCSE Revision Notes Unit 3 Economic change

Figure 2 shows that the share of employment in the primary sector decreases over time with the shares of the secondary sector and tertiary sector increasing until such time that the share of both sectors to employment declines and the quaternary sector emerges. It also shows that pre-industrial phase occurs when the declining primary sector has the largest share of

employment, followed by the increasing share of secondary and tertiary sectors with estimated workforce quotas of around 65% in the primary sector, 20% in the secondary sector, and 15% in the tertiary sector. The industrial phase occurs when the secondary sector starts to dominate the primary sector with the increasing share of the tertiary sector and with estimated workforce quotas of around 40% in the primary sector, 40% in the secondary sector, and 20% in the tertiary sector. Finally, the post-industrial phase occurs when the tertiary sector starts to decline with both primary and secondary sectors declining and the quaternary sector emerging in the economy with estimated workforce quotas of around 10% in the primary sector, 20% in the secondary sector, and 70% in the tertiary sector. This model is very useful in classifying the stages of structural transformation of an economy.

3. Methodology

This paper utilized quantitative research design with descriptive and empirical analysis to accomplish the objectives of the study. Descriptive statistics was utilized to comprehend and explain the behavior of the determinants, whereas inferential statistics was used to measure the relationship between the observed variables. The sectoral and aggregate productivity and employment statistics of the Philippines and seventeen (17) administrative divisions from 2004 to 2018 were all gathered and collected from the 2004 - 2018 Philippine Statistical Yearbook (PSY) edition which is published annually by the National Statistical Coordinating Board (NSCB).

3.1 Treatment of Data

Labor productivity growth in an economy can be attained in one of two methods. First, productivity can flourish within economic sectors through capital investment, technological advancement, and/or better allocation of capital resources. Second, labor can transfer across different sectors, moving out from low-productivity sectors to high-productivity sectors or vice versa, thus improving the total labor productivity in the economy in general.

3.1.1 Decomposition Analysis

The decomposition analysis of McMillan and Rodrik (2011), McMillan et al. (2016), and Bathla et al. (2019) were adopted to generate the share of “within sector” and “structural change”

to the total changes in labor productivity in the Philippines and its regions. This is expressed using this mathematical equation:

$$\Delta PHP_t = \sum_{i=n} \theta_{i,t-k} \Delta PHL_{i,t} + \sum_{i=n} PHL_{i,t} \Delta \theta_{i,t}$$

Where:

PHP = Philippine labor productivity growth

PHL = Philippine labor productivity growth per sector i

Θ = Share of employment per sector i

The Δ symbol represents the change in productivity or employment shares between t-k and t. The first term in the decomposition is the weighted sum of labor productivity growth within individual sectors, where the weights are the employment share for each individual sector at the beginning of the time period. This is addressed as the “within” component of productivity growth. The second term represents the productivity effect of labor reallocations across different sectors. It is basically the inner product of productivity levels (at the end of the time period) with the change in the employment share across sectors. This second term is addressed as the “structural change”. When changes in employment shares are positively correlated with productivity levels, this term will be positive and structural change will increase economy-wide productivity growth (McMillan and Rodrik, 2011; McMillan et al., 2016; Bathla et al., 2019).

Due to the unavailability of the updated Data on Labor Productivity in the Philippines, this paper used the formula of International Labor Organization (ILO) to manually extract the labor productivity of each sector and administrative region in the Philippines. The indicator on labor productivity is calculated as follows:

$$L = \frac{RGDP}{EMP}$$

Whereas, labor productivity (L) is equal to the difference of Gross Domestic Product (RGDP) at 2018 constant prices and the total number of employed (EMP) persons.

This paper also manually computed the labor productivity level by using the formula:

$$LP = \frac{L_t - L_{t-1}}{L_{t-1}}$$

Whereas, labor productivity level (LP) is equal to the current less the previous labor productivity divided by the previous labor productivity.

3.2 Statistical Treatment of Data

3.2.1 Pearson Correlation

To find out the relationship of structural change to labor productivity and employment in the Philippine regions, Pearson Correlation test was used. This treatment was helpful to measure if there is a significant relationship between the variables. The Pearson Correlation can be a positive or negative correlation signified by the formula:

$$r = \frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}}$$

The value of Pearson is computed based on the following: r implies a good correlation or association between the variable X and Y , whereas if the value is near zero, it indicates little or no correlation (Gujarati, 2009).

3.2.2 Regression Models

3.2.2.1 Panel data regression analysis

To find out the effect of structural change to labor productivity and employment in the Philippine regions, panel data regression analysis was used. This is expressed using the following mathematical equation:

$$(1) SC = \beta_0 + \beta_1 LP + \beta_2 EMP + \mu$$

$$(2) LP = \beta_0 + \beta_1 SC + \mu$$

$$(3) EMP = \beta_0 + \beta_1 SC + \mu$$

Where:

LP = Labor productivity level

EMP = Employment

SC = Structural change

μ = Error term

Since the data is a mixture of cross-section and time series, the panel regression analysis is appropriate in controlling the regional effects which may be correlated with the independent variables in the specification. To assess the significance of each regressor coefficient, the t-ratio is used. This means that if the derived value exceeds the critical t-value at a desired level of significance, the null hypothesis is rejected.

3.2.2.2 Durbin-Watson Test

The Durbin-Watson Test helps determine if an autocorrelation exists in the data. The null hypothesis of the test offers the interpretation; no first-order autocorrelation exists. The e_{it} is the residual from an ordinary least squared regression with fixed effects for each observational unit i , associated with the observation in panel i at time t , then the test statistics is:

$$d = \frac{\sum_{t=1}^n (e_{1t} - e_{1,t-1})^2}{\sum_{k=1}^n e_{1t}^2}$$

The Durbin-Watson statistics can be compared with tabulated rejection values. These values are derived dependent on T which is the length of the balanced panel time periods the individuals were observed. K is the number of regressors and N is the number of individuals in the panel. This test can also be utilized in assessing the null hypothesis of a unit root against stationary alternatives in fixed-effects models utilizing another set of bounds. After the pooled least square regression, the Durbin-Watson statistics tests the contemporaneous correlation in the panel regression. This is to determine whether to rely only on Seemingly Unrelated Regression Equation or run a separate panel regression for each dependent variable. The contemporaneous correlation occurs when the residual of the observed units each period is correlated. To the extent that these problems exist and not corrected, the analysis of the panel data using the pooled least square regression may produce incorrect analytic results.

3.2.3 *Seemingly Unrelated Regression Equation*

In order to analyze a group of multiple equations with cross-equation framework restrictions and correlated error terms, a Seemingly Unrelated Regression Equation is used in this study which is developed by Zellner (1962). According to Zellner (1962), the combined estimated equation models such as the Seemingly Unrelated Equation is much better than the independent equation solution methods where contemporaneous correlation is present because independent equation solution methods such as multiple regression models will suffer from simultaneous bias. The SURE method, also known as Zellner's method, calculates the parameters of the system, taking into account the heteroskedasticity and contemporaneous correlation in the errors across equations. This is expressed using this mathematical equation:

$$SC = \beta_0 + \sum \beta_1 LP + \sum \beta_2 EMP + \mu$$

Where:

LP = Labor productivity level

EMP = Employment

SC = Structural change

μ = Error Term

Whereas, structural change is a function of labor productivity and employment in the Philippine regions.

3.2.3.1 *Breusch-Pagan LM Test*

The Breusch-Pagan LM test was utilized in this study to choose between the Seemingly Unrelated Regression Model and the Pooled Least Square Regression Model. The null hypothesis in the Breusch-Pagan LM test is that variances across observations is zero, therefore, there is no significant difference across units. If the p-value is less than 0.05 level, the Generalized Least Square (GLS) of estimation of Seemingly Unrelated Regression is entirely different with the Pooled Least Square Model, thus the residual are correlated across regions and

the Generalized Least Square estimator is more efficient to use compare with the Pooled Least Square. If the result it is greater than the 0.05 level, accepting the Pooled Least Square Modelling is more preferred than Generalized Least Square of Seemingly Unrelated Regression Model.

4. Findings and Discussion

Table 1

Average Labor Productivity and Labor Composition in the Philippines

Region	Average Labor Productivity	Labor Composition Average (A/I/S)
NCR	901,072.49	1%/ 19%/ 80%
Region IV-A	381,585.20	9%/17%/74%
Region III	341,201.03	15%/24%/61%
CAR	321,637.82	43%/15%/42%
Region XI	292,460.48	31%/17%/52%
Region X	285,079.29	36%/16%/48%
Region VII	261,828.97	21%/22%/57%
Region IV-B	214,669.25	35%/7%/58%
Region I	214,076.71	27%/18%/55%
Region VIII	207,619.42	34%/15%/51%
Region VI	195,949.73	31%/15%/54%
Region IX	192,732.57	41%/12%/ 47%
Region XII	188,528.06	42%/14%/44%
Region II	185,942.51	47%/11%/42%
CARAGA	183,905.94	34%/16%/50%
Region V	153,919.21	31%/18%/51%
ARMM	150,900.09	61%/6%/33%
Philippines	334,977.20	24%/19%/57%

Table 1 shows the average labor productivity and average labor composition of each region in the Philippines from 2004 to 2018. It shows that NCR, a service sector economy, has

the highest labor productivity among the regions, followed by Region IV-A and Region III which are also service sector economies. On the other hand, the top three lowest labor productivity are ARMM which is an agricultural sector economy followed by Region V and CARAGA that are both service sector economies. CAR being an agricultural sector economy has high labor productivity since it is abundant in natural resources and also rich in high-valued mineral reserves. Gold, copper, silver, and zinc are among the precious minerals which are great contributions to their labor productivity. Although mineral reserves are found all over Cordillera, mining is concentrated in Benguet, and almost all of Cordillera's economic activity is still focused on farming and small-scale production (Department of Agriculture, 2020). CARAGA and Region V are service sector economies but have relatively low-labor productivity mainly because CARAGA region is mainly based on wood economy and according to Paqueo and Silfverberg (2015), there is unlimited possibilities for the wood industry in the CARAGA region, but the conceived possibilities of the wood processing industry in CARAGA is not yet fully explored because of policy, regulatory, and production issues. On the other hand, Region V is one of the most vulnerable areas for natural disaster in the country because of its geographical location, and natural hazards, mainly storms, floods, and volcanic eruptions greatly affect its productivity (FAO, 2020).

Figure 3

Decomposition of “Within” and “Structural Change” in the Changes in Average Regional Labor Productivity Growth in the Philippines from 2004 to 2018

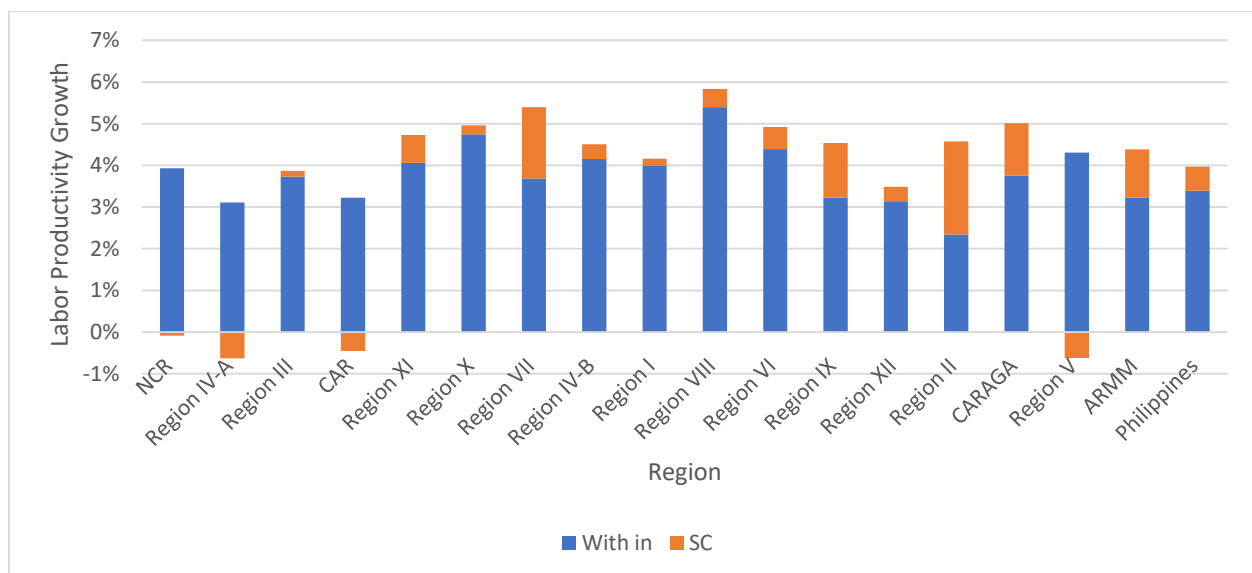


Figure 3 shows decomposition of “within” and “structural change” in the changes in regional labor productivity growth in the Philippines averaged from 2004 to 2018. It shows that NCR, CAR, Region IV-A, and Region V experience a negative contribution of structural change in the total labor productivity growth having Region IV-A as the highest with -0.63%, followed by Region V with -0.62%, CAR with -0.45%, and NCR with -0.08%. This is because both NCR and Region IV-A are service economies with 80% and 74% of their labor force, respectively, which indicate that both regions have high productivity and high income. According to Forster-Mcgregor and Versapen (2016), changes in labor productivity are mostly brought by the changes “within” instead of structural change in high income economies which is the case in both NCR and Region IV-A. Additionally, it also indicates a growth reducing property of structural change as mentioned by Mcmillan and Rodrik (2011). One of the reasons is that the economy cannot absorb the surplus labor due to skills mismatch, like in the case of Mexico where structural change emerged to be growth-reducing during the period 2005 to 2016 mainly due to the reallocation of their low-skilled labor to other sectors (Escobar & Muhlen, 2019).

CAR and Region V are rich in natural resources and have abundant mineral reserves. According to Mcmillan and Rodrick (2011), economies with revealed comparative advantage in raw materials are at a disadvantage because in economies with a relatively large share of natural resources in exports, structural change has typically been growth reducing because they cannot also absorb the surplus labor from agriculture. In addition, Region II has the highest share of structural change in their labor productivity growth with the value of 2.24%, followed by Region VII with 1.71%, and Region IX with 1.32%, which shows a great potential for growth-enhancing structural change as what Forster-Mcgregor and Versapen (2016) mentioned in their study. Structural change in low income economies has a significant portion to the total labor productivity growth just like in the case of Region II and Region IX which are agricultural regions.

Meanwhile, Region VII is one of the eight anchor tourist destinations in the Philippines and one of the supra-regions in the Visayas that relies on tourism as per the Department of Trade and Industry. According to Turner and Sears (2013), tourism sector is labor sponge sector. It absorbs surplus labor and is relatively more effective in creating jobs than any other sectors since surplus of labor in Region VII can be absorbed by the tourism sector. This is why the region

experiences a greater growth-enhancing structural change than any of the other regions (McMillan & Rodrick, 2011).

Table 2

Descriptive Statistics and Correlations Among Structural Change (SC), Labor Productivity Growth (LP), and Employment (EMP)

Variable	Descriptive statistics					Correlation	
	Mean	Std. Dev.	C. V.	Min	Max	LP	EMP
SC, %	0.51	2.27	4.45	-11.35	6.7	0.11	-0.13
						P- Value	0.08
LP, %	4.35	6.53	1.5	-35.46	75.55	1	-0.07
EMP, ('000)	2148.87	11198.87	5.21	621	5913	-0.07	1

Table 2 shows the mean, standard deviations, coefficient of variation, minimum and maximum values, along with the correlation coefficients among the observed variables structural change, labor productivity and employment in the Philippine regions. It shows that structural change has a range of -11.35% to 6.7%, labor productivity has a range of -35.46% to 75.55%, and employment has a range of 621,000 to 5,913,000. Results further show that all coefficient of variation of structural change (4.45), labor productivity growth rate (1.5), and employment (5.21) are greater than 1 indicating high variability of the data and high inequality among the regions in terms of structural change, employment and labor productivity. In addition, the correlation of structural change to labor productivity is 0.11 and significant at 10% level of significance with a p-value of 0.08, which indicates a very weak positive correlation among the two variables. Structural change to employment is -0.13 and significant at 5% level of significance with a p-value of 0.04 indicating a very weak negative correlation among the two variables. Therefore, the first null hypothesis that structural change has no significant correlation on labor productivity and employment is rejected.

To test the significant effects of structural change to labor productivity and employment, pooled least square, Durbin-Watson test, panel data regression analysis, and seemingly unrelated regressions analysis were performed.

Breusch-Pagan LM Test was utilized to identify which is better between the two.

Table 3*Pooled Least Square Results*

Independent Var.		Intersect	Labor Productivity	Employment
Structural Change	Estimate	-0.12	0.11	0.09
	SE	0.27	0.04	0.04
	p-value	0.65	0.01	0.03
R- squared	0.03		F- statistics	3.97
Adj R- Squared	0.02		F- statistics (prob.)	0.02

Table 3 shows the regression results of labor productivity and employment to structural change using pooled least squared model. Based on the result, it shows that labor productivity (LP=0.11) and employment (EMP=.09) are significant determinants of structural change (SC) at 5% level of significance with a p-value of .01 and .03, respectively. The value of R-Squared is .03, which means that 3% of the changes in structural change can be explained by the changes in labor productivity and employment. It also shows that labor productivity and employment are positively related to structural change. This signifies that structural change will increase (decrease) if labor productivity and employment increase (decrease). This arrives at the econometric equation:

$$SC = -0.12 + 0.11 (LP) + 0.09(EMP) + \mu$$

Based on the econometric equation, it can be explained that 1% increase in labor productivity will result to 0.11% increase in structural change, and a 1,000 increase in employment will result to 0.09% increase in structural change in the Philippines with a constant value of -0.12%.

Table 4*Durbin-Watson Test Results*

Durbin-Watson Statistics			Sig.
DW	d _u	1.81	1.93
	4 - d _u	2.19	

Table 4 shows that the Durbin-Watson statistics of the ordinary least square regression is in the lower and upper limit of the Durbin-Watson statistics. Therefore, there is no autocorrelation present in the regression. This means that there is no contemporaneous autocorrelation that occurs in the model which are the residuals of the units observed at each period in time (not correlated). Therefore, it is better to have each equation estimated separately by OLS, since based on the Durbin-Watson statistics results, it is implicitly assumed that the error terms are not contemporaneously correlated. To validate these observations, this study run Pooled Least Square and Seemingly Unrelated Regression Equation model. Breusch-Pagan LM Test was also employed to determine whether Pooled Least Square or Seemingly Unrelated Regression Equation model is more appropriate.

Table 5

Panel Regression Equation (PLS) and Seeming Unrelated Regression Equation (SUR) Results

Dependent Var.		Labor Productivity		Employment	
Estimation Method		PLS	SURE	PLS	SURE
Intersect	Estimate	4.19	4.19	2184.26	2184
	SE	0.42	0.42	76.49	76.19
	p-value	0	0	0	0
Structural Change	Estimate	0.31	0.31	-68.74	-68.74
	SE	0.18	0.18	32.97	32.84
	p-value	0.08	0.08	0.04	0.04
R- squared		0.01	0.01	0.02	0.02
Adj R- Squared		0.01		0.01	

Table 5 shows the regression results of structural change to employment and labor productivity using both panel regression model and seemingly unrelated regression model. As gleaned from the table, both seemingly unrelated regression equation and panel regression equation have identical results. Since they have identical results, this study interprets the results as one.

Structural Change and Labor Productivity

Based on the regression results shown in Table 2, structural change (SC=0.31) is a significant determinant of labor productivity (LP) at 10% level of significance with a p-value of 0.08 having a constant value of 4.19. Therefore, the second null hypothesis, structural change has no significant effect on labor productivity growth is **rejected**. In addition, the value for R-Squared is .01 which means that 1% of the changes in labor productivity can be explained by the changes in structural change. It also shows that structural change is positively related to labor productivity which means that labor productivity will increase (decrease) if structural change increases (decreases). This arrives at the econometric equation:

$$LP = 4.19 + 0.31 (SC) + \mu$$

Based on the econometric equation, 1% increase in structural change will result to 0.31% increase in labor productivity in the Philippines with a constant value of 4.19%, which clearly proves that structural change has a significant effect on labor productivity in the country. This is explained by most of the cited literature that the movement of resources from low-productivity activities to high-productivity activities is a key driver of development, thus increasing the overall labor productivity growth of the country (Bah, 2009; Briones & Felipe, 2013; Bustos et al., 2013; Bayar et al., 2013; Inklaar & Timmer, 2009; Johnston & Mellor, 1961; Mcmillan & Rodrik, 2011; Mcmillan et al., 2014; Martin, 2019; Stegman, 2011; Vos, 2019).

Structural Change and Employment

Based on the regression result shown in Table 2, structural change (SC=-68.74) is a significant determinant of employment (EMP) at 5% level of significance with a p-value of 0.04 having a constant value of 2,184.26. Therefore, the third null hypothesis, structural change has no significant effect on employment is **rejected**. In addition, the value for R-squared is .02 which means that 2% of the changes in employment can be explained by the changes in structural change. It also shows that structural change is negatively related to labor productivity which means that employment will decrease if there is increase in structural change. This arrives at the econometric equation:

$$EMP = 2184.26 - 68.74 (SC) + \mu$$

Based on the econometric equation, 1% increase in structural change will result to a 68,700 decrease in employment in the Philippines with a constant value of 2,184,260, which

clearly proves that structural change has a significant effect in the economy in terms of labor markets. Increasing labor productivity through a fast-paced structural transformation has negative effect on the employment (Afsar & Mecik, 2014; Escobar & Muhlen, 2019; Filipe, 2019) resulting to a “structural unemployment” – a kind of unemployment where there is a mismatch between the skills that the labor force can offer, and the skills needed by the labor market. This happens because most of the labor force will be coming from the low-skilled agricultural sector to be absorbed by the labor market of the high-skilled industrial and service sectors during a fast-paced structural transformation. This explains the importance of higher educational attainment and trainings and seminars during a fast-paced structural transformation because skills are necessary for labor mobility (Ando & Nassar, 2017). This also confers countries with more flexible labor markets experience greater growth-enhancing structural change (McMillan & Rodrik, 2011).

To determine whether Pooled Least Square or Seemingly Unrelated Regression Equation model is more appropriate, this study used Breusch-Pagan LM Test as shown in table 6.

Table 6

Breusch-Pagan Test of Independence

Chi	0.682
Probability	0.4089
<i>If probability value is greater than 0.05, PLS is more appropriate than SUR model</i>	
<i>If probability value is less than 0.05, SUR model is more appropriate than PLS.</i>	

The test results with a probability value of 0.4089 is higher than the 0.05 level of significance. Therefore, Pooled Least Square is more appropriate than Seemingly Unrelated Regression model.

5. Conclusion

This study found that structural change has a positive relationship to labor productivity in the Philippines and its regions. This means that when structural change increases, labor productivity also increases or vice versa *ceteris paribus*, where the main reason is the transfer of labor out of the low-productivity agriculture sector to high-productivity industry and service

sector. This is evident during structural change thus encouraging the increase of overall labor productivity in the Philippines. Furthermore, structural change has a negative relationship to employment in the Philippines and its regions. This means that when structural change increases, employment decreases, or vice versa *ceteris paribus*, which proved that increasing labor productivity due to a fast-paced structural change has a negative effect on the employment. This study also proved that Structural Change Theory, Lewis two-sector model and Clark Fisher Model are true and evident in the Philippines.

As then President Rodrigo Roa Duterte signed Executive Order (EO) No. 140 officially adopting the National Employment Recovery Strategy (NERS) and formulating the NERS task forces which are chaired by the Department of Trade and Industry (DTI), Department of Labor and Employment (DOLE), and Technical Education and Skills Development Authority (TESDA), this serves as the Philippine government's roadmap for the revival of the labor market hit by the COVID-19 pandemic. It is recommended that the task force should not only consider the changes in the labor market brought by the pandemic but also the service-led structural change. Specifically, this study would like to recommend the following programs and policies to the NERS taskforce:

- Programs that focus on increasing the human capital of its labor force through subsidizing education, trainings, and seminars because workers with higher skillsets are much needed in a fast-paced structural transformation to experience greater growth-enhancing structural change. If not taken into account, structural change can be growth-reducing mainly due to the reallocation of low-skilled labor within subnational units which increases inefficiency in the economy and thus reduces overall growth (Escobar & Muhlen, 2019).
- Programs that will focus on labor-saving techniques for the agricultural sector like research and development and mechanization or modernization of the agricultural sectors, since the labor force is moving out from the agriculture sector to the industry and service sectors during a fast-paced structural transformation. These are likewise good substitutes for human labor.
- Programs that will absorb the structural unemployment brought by the fast-paced structural transformation like a “public option employment” where the government will be the employer as a last resort.

- Policy that develops education models that can keep up with the fast-paced structural transformation, especially now that the world economy is at 4th Industrial revolution (Schwab, 2016). Adapting Education 4.0 framework which provides a vision on how school systems can be updated to deliver children's future needs (World Economic Forum, 2020) must be the country's direction. This is focused on smart technology, artificial intelligence, and robotics. Likewise, this means teaching students about these technologies as part of the curriculum, changing the approach to learning altogether, and utilizing these technologies to better improve the learning experience. This is crucial since it is essential to prepare the future labor force to adapt to the changing labor market with the threat of automation and jobs being obsolete.

During a fast-paced structural transformation, this study would like to recommend that private individuals invest in their human capital through higher education, trainings, and seminars since learning new skills is much needed to adapt to a fast-paced structural transformation. Flexibility and adaptability are necessary to survive in the changing labor market environment. Especially today, the world economy is now at the 4th industrial revolution – a process of ongoing automation of traditional manufacturing and industrial practices using modern smart technology. This is unlike the previous industrial revolutions. The 4th industrial revolution is evolving at an exponential rather than a linear pace. According to Schwab (2016), during the 4th Industrial revolution, employment will grow in the knowledge service sector, but it will greatly diminish for the industry and product service sectors because of their nature – routine and repetitive jobs – which are easily automated. In this research, it is recommended that other researchers, students, scholars, and educators must study the long-run and short-run relationships and effects of structural change to macro-economic variables to have a better picture of the overall effects of structural change to the economy with the focus on 4th industrial revolution.

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References

- Abbot, P., Tarp, F. & Wu, C. (2017) Structural Transformation, Biased Technological Change and Employment in Vietnam. *Eur J Dev Res* 29, 54–72. <https://doi.org/10.1057/ejdr.2015.64>
- Afsar, M. & Mecik, O. (2014). The Effects of Structural Transformations in Economy on Labor Markets: The Case of OECD Countries. *International Journal of Business and Social Science*. Vol. 5, No. 9(1).
- Ando, S., & Nassar, K. (2017). *Indexing Structural Distortion: Sectoral Productivity, Structural Change and Growth*. IMF Working Paper No. 17/205.
- Badiane, O., & Makombe, T. (2014). *The theory and practice of agriculture, growth, and development in Africa*, WIDER Working Paper, No. 2014/061, The United Nations University World Institute for Development Economics Research (UNU-WIDER), Helsinki
- Badriah, L., Alisjahbana, A., Wibowo, K. & Hadiyanto, F. (2017). *Structural Change and Labor Productivity Growth in Indonesia*. In Proceedings of the 2nd International Conference on Economic Education and Entrepreneurship (ICEEE 2017), pages 397-402.
- Bah, E. (2009). *Structural Transformation in Developed and Developing Countries*. Proceedings of the German Development Economics Conference, Frankfurt a.M, Germany
- Bathla, S., D'Souza, A., & Joshi, P. K. (2019). *Structural Transformation in Southeast Asian Countries and Key Drivers*. IFPRI Discussion Paper 1856.
- Bayar, A., Günçavdi, O., & Küçükçiğçi S. (2013). Economic Development and Structural Change: The Role Of The Agriculture Sector In Turkey, *Middle East Development Journal (MEDJ)*, vol. 5(02), pages 1-29.
- Briones, R., & Felipe, J. (2013). *Agriculture and Structural Transformation in Developing Asia: Review and Outlook*. ADB Economics Working Paper Series No. 363. Manila: Asian Development Bank.
- Boddin, D. (2016). *The role of newly industrialized economies in global value chains*. [Washington, D.C.]: International Monetary Fund.
- Bustos, P., Caprettini, B., & Ponticelli, J., (2015). Agricultural Productivity and Structural Transformation: Evidence from Brazil. *American Economic Review*, 106 (6): 1320-65. DOI: 10.1257/aer.20131061

- Chenery H., & Syrquin M. (1989). Three Decades of Industrialization. *The World Bank Economic Review*, Vol. 3, No. 2: 145-181.
- Dacuycuy C., Felipe j., & Lanzafam M., (2014). *The Declining Share of Agricultural Employment in the People's Republic of China: How Fast?*. Asian Development Bank Economics Working Paper Series No. 419. <http://dx.doi.org/10.2139/ssrn.2558896>
- De Dios, E. S. (1984). *An analysis of the Philippine economic crisis: A workshop report*. Quezon City, Philippines: University of the Philippines Press.
- Escobar, O.R., & Mühlen, H. (2019). *Decomposing a decomposition: within-country differences and the role of structural change in productivity growth*. No 05-2019, Hohenheim Discussion Papers in Business, Economics and Social Sciences, University of Hohenheim, Faculty of Business, Economics and Social Sciences.
- Felipe, J. (2010). *Frontmatter. In Inclusive Growth, Full Employment, and Structural Change: Implications and Policies for Developing Asia* (pp. I-IV). Anthem Press. <https://doi.org/10.7135/UPO9781843313557>
- Fourastié, J. (1949) *Le Grand Espoir du XXe Siècle*. Paris: Presses Universitaires de France. Reprinted as 'Moderne Techniek en Economische Ontwikkeling' (1965). Amsterdam: Het Spectrum
- Inklaar, R., & Timmer, M. (2009). Productivity Convergence Across Industries and Countries: The Importance of Theory-Based Measurement. *Macroeconomic Dynamics*, 13(S2), 218-240. doi:10.1017/S1365100509090117
- Intal, P., & Chen, L., (2017). *ASEAN and Member States: Transformation and Integration*. Economic Research Institute for ASEAN and East Asia. <http://hdl.handle.net/11540/7430>.
- Johnston, B., & Mellor, J. (1961). The Role of Agriculture in Economic Development. *The American Economic Review*, 51(4), 566-593.
- Kokkinas, P. (2014). *GCSE Revision: Economic change*. <https://geographyiseasy.wordpress.com/2014/02/19/gcse-revision-economic-change/>
- Kuznets, S. (1966). *Modern Economic Growth: Rate, Structure and Spread*. New Haven: Yale University Press
- Martins, P.M.G., (2019). Structural change: Pace, patterns, and determinants. *Review of Development Economics* 23, 1-32

- McMillan, M., Rodrick, D., & Sepulveda, C., eds. (2016). *Structural Change, Fundamentals, and Growth: A Framework and Case Studies*. Washington, DC: International Food Policy Research Institute.
- McMillan, M., Rodrik, D. & Verduzco-Gallo, I. (2014) Globalization, structural change, and productivity growth, with an update on Africa. *World Development* 63, 11-32.
- McMillan, M., & D. Rodrik. (2011). *Globalization, Structural Change, and Productivity Growth. In Making Globalization Socially Sustainable*, In M. Bacchetta and M. Jansen, 49-84. Geneva: International Labour Organization and World Trade Organization.
- Paqueo, V. B., & Silfverberg, D. (2015). *A Jobs Value Chain and Policy Analysis of Caraga's Wood Industry*. Mindanao Jobs Report, World Bank.
- Ravago M., Brucal A., Roumasset J., & Punongbayan J., (2018). *The role of power prices in structural transformation: evidence from the Philippines*. Grantham Research Institute on Climate Change and the Environment Working Paper 312. London: London School of Economics and Political Science
- Schwab, K. (2017). *The fourth industrial revolution*. Portfolio Penguin.
- Senbet, L., & Simbanegavi W., (2017). Agriculture and Structural Transformation in Africa: An Overview. *Journal of African Economies*, Volume 26, Issue 1, Pages 3–10, <https://doi.org/10.1093/jae/ejx012>
- Schultz. T. W., (1953). *The Economic Organization of Agriculture*. New York: McGraw-Hill.
- Stegman, A., (2011). Sectoral Productivity, Structural Change and Convergence. *SSRN Electronic Journal*. 10.2139/ssrn.1930724.
- Syrquin, M. (1988). *Patterns of structural change*. Handbook of Development Economics. Vol. 1, pp. 203–273. [https://doi.org/10.1016/S1573-4471\(88\)01010-1](https://doi.org/10.1016/S1573-4471(88)01010-1)
- Timmer, C. & Akkus, S. (2008). *The Structural Transformation as a Pathway Out of Poverty: Analytics, Empirics and Politics*. Center for Global Development, Working Papers. 10.2139/ssrn.1213154.
- Timmer, M., de Vries, K., & de Vries, G. (2015). Structural Transformation in Africa: Static Gains, Dynamic Losses. *The Journal of Development Studies*, 51(6), 674-688
- Turner, R. & Sears, Z. (2013). *Travel & Tourism as a Driver of Employment Growth*. The Travel & Tourism Competitiveness Report 2013 World Economic Forum, 2014
- Usui, N. (2011). *Transforming the Philippine Economy: 'Walking on Two Legs'*. Mandaluyong City: Asian Development Bank

- Vos, R. (2018). *Agricultural and Rural Transformations in Asian Development: Past Trends and Future Challenges*. WIDER Working Paper 2018/87. Helsinki, Finland: United Nations University World Institute for Development Economics Research.
- Welker J. (2012). *Models of Economic Growth and Development*. <http://welkerswikinomics.com/blog/2012/01/30/models-for-economic-growth-ib-economics>
- Wingeder, A. (2014). *Structural transformation in the 20th century: A new database on agricultural employment around the world*. Discussion Papers 14-28, University of Copenhagen. Department of Economics.
- Zellner, A. (1962). An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias. *Journal of the American Statistical Association*, 57(298), 348-368. doi:10.2307/228164