The Sources of Productivity Slowdown in Pakistan: A Novel Structural Decomposition Analysis

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Abstract

The aggregate labor productivity in Pakistan has deteriorated during the last three decades. The study examines the causes of the slowdown in aggregate labor productivity. By examining the role of structural change in productivity slowdown, the study develops a novel shift-share methodology and decomposes aggregate productivity into within-sector productivity and structured components. The results revealed that within-sector, along with structural labor productivity in the manufacturing and construction sectors has deteriorated over time. Furthermore, within-sector productivity growth in the agriculture sector has also declined. Whereas structural productivity level and growth have positively contributed to aggregate agricultural productivity growth. The core findings of the study demonstrate that within-sector productivity of agriculture, manufacturing and construction, along with structural labor productivity of the manufacturing and construction sectors, has deteriorated over time and played a considerable role in the reduction of aggregate productivity. This study also offered evidence for the validity of the novel decomposition, and the results indicate that the novel structural decomposition is more reliable for the identification of the sources of aggregate productivity growth.

Keywords: Aggregate Labour Productivity, Structural Change, Structural Labour Productivity, Sectoral Productivity, Structural Decomposition, Productivity Slowdown.

Introduction

High economic growth is crucial for increasing living standards, poverty reduction, and for enhancing the overall welfare of society (Acemoglu, 2008). A growing economy creates more job opportunities and higher income for the people (Jones, 2022). Moreover, high economic growth leads to sectoral expansion through business dynamism, driving efficiency and competitiveness in various sectors (Mihaela, 2016). Substantial growth of productivity is vital for boosting economic growth and development. Productivity shows the efficiency with which an economy converts labor and capital into outputs. In addition to this, high productivity growth allows the economies to produce more products and services without increasing input proportionately. Furthermore, technological advancement is the core factor of productivity growth. The process of innovation involves not only the development of new technologies but also their successful diffusion (Stoneman & Battisti, 2010). Another important factor that influences productivity is human capital. An educated, skilled, and healthy workforce can efficiently use technologies and

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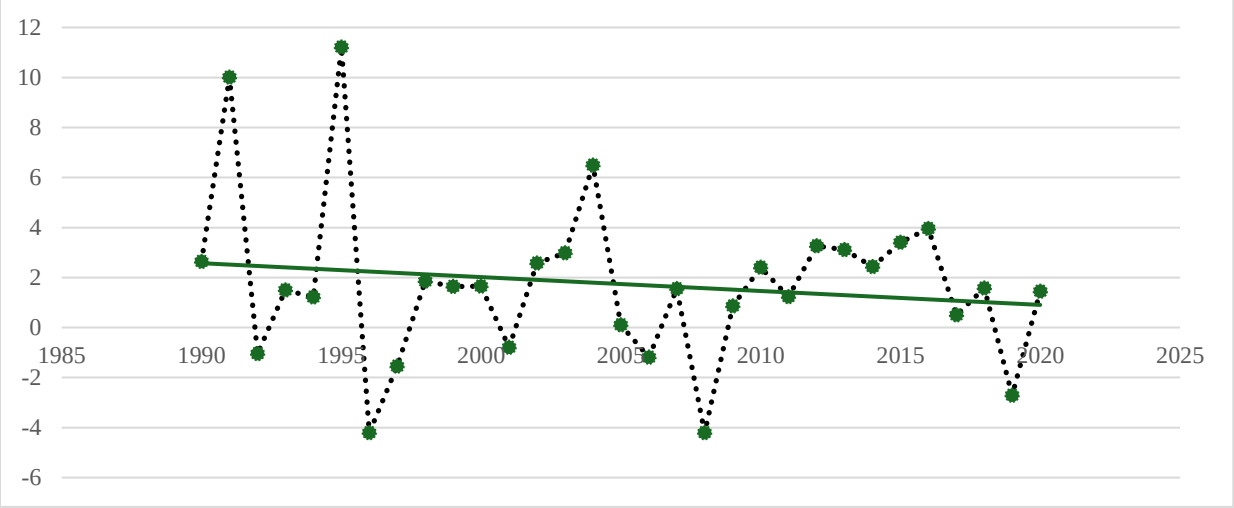
implement more efficient production methods (Daher & Ziade, 2024). Resource reallocation (structural change) between the different sectors can boost productivity growth. Many countries experience high structural change and achieve higher productivity growth. In contrast, shifting labor to the low-productivity sectors might reduce productivity growth. Recently, productivity growth has declined in several countries. Numerous studies analyze the determinants of productivity reduction. For example, Saltari and Travaglini (2009) investigated that the technological shock contributed to the productivity slowdown. Decker et al. (2017) revealed that the decline in business dynamism and the reduction in allocative efficiency led to a productivity slowdown. Wroński (2019) explored that low productivity growth originated from the structural transformation, lower human capital accumulation, capital misallocation, and lower innovation. Goodridge and Haskel (2023) discovered that the capital deepening and TFP played a substantial role in the labor productivity slowdown. Mouel and Schiersch (2024) find that a deterioration in aggregate productivity originates from the intangible capital. Mollins and St-Amant (2019) demonstrated that information and communication technology (ICT) positively contributes to productivity growth, but the contribution of ICT declined over time and subsequently contributed to the productivity deterioration. Dew-Becker and Gordon (2012) examined that the lower productivity growth originated from high employment growth and the institutional, cultural factors, resulting in a strong negative relationship between employment and productivity. Nakamura et al. (2019) highlighted that the different factors, such as labor and capital as well as research and development, have not been efficiently utilized and have led to a worsening productivity growth. Hambur and Andrews (2023) studied that the low investment, decline in the capital reallocation, lower business dynamism, and lower reallocation of the labor force are the core sources of weak productivity. Millar and Sutherland (2016) illustrated that business dynamism, low investment, the lack of aggregate demand, and structural factors create a deterioration in productivity growth. Moreover, the lower business occurred due to the aging population, intellectual property rights, and funding difficulties. Duernecker (2024) revealed that structural change played an extensive role in the poor performance of aggregate productivity growth. The productivity growth in Pakistan has also not been remarkable. Figure. 1 display that aggregate labor productivity has constantly declined. Structural change, labor composition, TFP, and capital per worker are the important elements of productivity growth, and deterioration in these factors might stagnate productivity growth. Moreover, the relative significance of these factors can vary over time and across countries. It should be worth noting that several other factors that have not yet been identified may have also contributed to the productivity reduction.

Figure 1: Aggregate Labor Productivity



Sources: Author's calculation.

The major objective of the study is to identify the sources of the aggregate productivity growth slowdown in Pakistan by examining the role of structural change. The plausible explanation for the sources of productivity slowdown must follow these criteria: first, the factor that is identified as the cause of the slowdown must be significant in explaining the slowdown of productivity. Second, the relevant cause should display this effect during the study period. The specific research questions to be answered are:

i. What are the reasons for the aggregate labor productivity slowdown in Pakistan?
ii. How does structural change influence productivity growth in Pakistan?

Understanding the sources of labor productivity slowdown is a prerequisite to addressing several economic challenges, including a lack of efficiency, the absence of competitiveness, lower living standards of the people, and the slowdown of economic growth. The findings of this study will be helpful for businesses, academics, and policymakers while improving the growth of productivity and fostering economic growth in the country.

The paper is organized as follows: Section 2 examines the theoretical framework along with the conceptual framework. Section 3 describes data and methodology. Section 4 demonstrates results. Section 5 presents the main findings. The final section provides the conclusion.

Theoretical and Conceptual Framework

The theoretical framework is a prerequisite to understanding the drivers of labor productivity as well as the sources of productivity slowdown. This section examines the theoretical foundations, starting with the conventional framework and moving to the novel decomposition approach for identification of the sources of aggregate productivity.

Conventional Decomposition of Aggregate Labor Productivity

Several studies, such as Foster et al. (2001), Tang and Wang (2004), McMillan and Rodrik (2011), and De Vries et al. (2015) analyzed the relationship between structural change and labor productivity using the traditional shift-share. They decomposed aggregate productivity into within-sector productivity, labor reallocation level effect (static effect), and labor reallocation growth effect (dynamic effect). The traditional shift-share approach is as follows.

$$LP^t = \sum_{i=1}^{n} LP_i^t \quad (1)$$

LP_t is the aggregate productivity, $\sum_{i=1}^{n} LP_i^t$ is the sectoral productivity. The labor reallocation between the sectors plays a significant role in enhancing aggregate productivity growth.

$$LP^t = \sum_{i=1}^{n} LP_i^t * \frac{L_i^t}{\sum_{i=1}^{n} L_t} \quad (2)$$

The difference at times 0 and T can be written as:

$$LP^t = \sum_{i=1}^{n} (LP_i^t - LP_i^0)L_i^0 + \sum_{i=1}^{n} (L_i^t - L_i^0)LP_i^0 + \sum_{i=1}^{n} (LP_i^t - LP_i^0)(L_i^t - L_i^0) \quad (3)$$

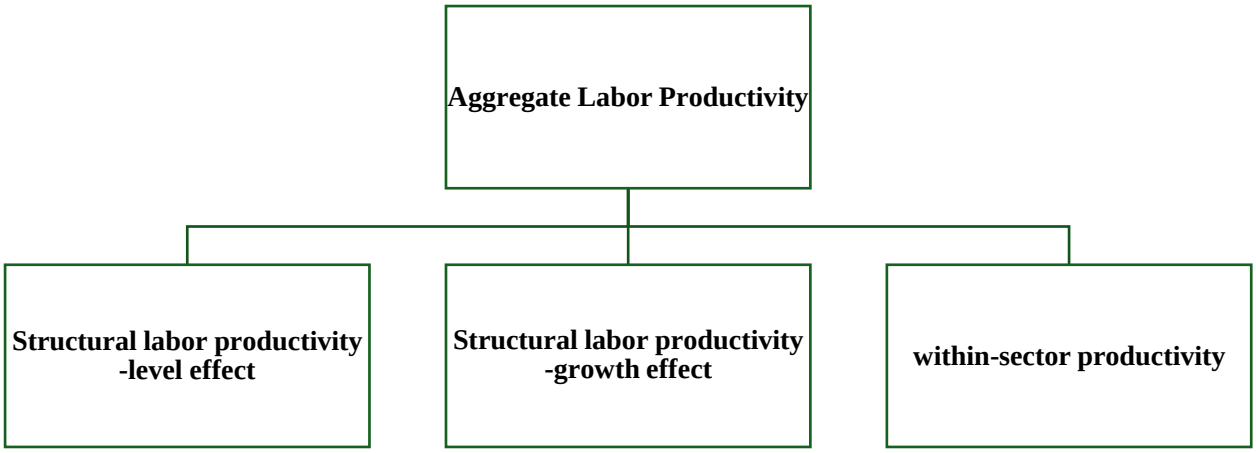
Equation (3) shows the traditional decomposition of aggregate productivity, which consists of three components $\sum_{i=1}^{n} (LP_i^t - LP_i^0)L_i^0$ is within-sector productivity growth, $\sum_{i=1}^{n} (L_i^t - L_i^0)LP_i^0$ is labor reallocation level effect, and $\sum_{i=1}^{n} (LP_i^t - LP_i^0)(L_i^t - L_i^0)$is labor reallocation a growth effect. This method has some drawbacks, such as the strong dependence on changes in labor shares, as well as ignoring how sectoral changes in input and output work together to affect aggregate productivity growth. Moreover, this decomposition also ignored the efficiency (productivity) of the reallocated labor force.

A Novel Structural Decomposition Based on Structural Productivity

This study suggests a novel decomposition approach based on structural productivity (output growth shares minus growth of labor share or output share divided by input share). The idea of structural productivity highlights that output and input share differences can influence labor productivity growth. A structural change will be productivity-enhancing if the output share growth increases more than its input share growth. If input share growth increases more than output share growth, the structural change will be productivity-reducing. The novel structural decomposition is based on both output and inputs rather than only labor shares. As a result, the new structural decomposition consists of three components, the first within-sector productivity growth component, which depends on technological advancement. The structural productivity level effect (static structural productivity) component shows the productivity of the reallocated labor force, which labor reallocated to the high productivity level sector. and the third component, structural productivity growth effect (dynamic structural productivity), which shows the productivity of the reallocated labor force which reallocated to the high productivity growth sector. This approach makes it easier to distinguish between labor reallocations and labor productivity by considering both input and output. Additionally, the novel decomposition highlights the inefficiencies in structural change. On the other hand, the traditional approach may overestimate the influence of labor reallocation by assuming that increasing the labor share (structural change) is always productivity-enhancing. To sum up, the traditional approach (shift-share analysis) ignored the structural labor productivity (productivity of the reallocated labor force). This study focuses on the decomposition of labor productivity into three components: within-sector productivity, structural labor productivity growth effect, and structural labor productivity level effect. Structural labor productivity is important for three reasons. first, the reallocation of the labor force from agriculture to the industrial (manufacturing) sector requires proper training to enhance industrial labor productivity because the skill requirements in both sectors (industrial and agriculture) are

different. Lack of the required skills may reduce the efficiency (productivity) of the reallocated labor force and will affect the aggregate labor productivity. Second, the skills requirement within the industrial sector also differs. Similarly, the reallocated labor force may have different skills and abilities that should be moved to the sector that is more suitable for their skills; otherwise, it may reduce the efficiency (productivity) of the reallocated labor force. Third, the high capital per worker is necessary for the reallocated labor force to contribute to the aggregate labor productivity; lower capital per reallocated labor force may reduce the labor productivity. The positive contribution of structural change (reallocation of the labor force) depends on structural labor productivity. To consider the structural components of labor productivity, this study decomposes aggregate labor productivity into three major components depicted in the Figure. 2.

Figure 2: Decomposition of aggregate labor productivity



Sources: author's analysis

The conceptual framework is illustrated in Figure 2, which demonstrates the decomposition of aggregate labor productivity into three components: within-sector productivity, structural labor productivity growth effect, and structural labor productivity level effect. The structural productivity level effect shows the productivity of the reallocated labor force which reallocated to the high productivity level sector. and the term structural productivity growth effect shows the productivity of the reallocated labor force, which reallocated to the high productivity growth sector. To sum up, the previous research ignored structural labor productivity. Therefore, this study highlights the importance of structural labor productivity.

To develop and decompose the aggregate labor productivity, consider the aggregate output at time *T*.

$$Y^t = \sum_{i=1}^{n} Y_i^t \qquad (4)$$

Y_t is the aggregate output, $\sum_{i=1}^{n} Y_i^t$ is the sectoral output. To analyze the role of labor reallocation between the sectors (structural change) the equation (1) can be rewritten as:

$$Y^t = \sum_{i=1}^{n} Y_i^t * \frac{Y_i^t}{\sum_{i=1}^{n} Y_t} \tag{5}$$

Whereas Y_i^t is the sector "i" output and $\sum_{i=1}^{n} Y_t$ is the aggregate output (all sectors of output). The term $\frac{Y_i^t}{\sum_{i=1}^{n} Y_t}$ shows the share of sector "i" output. put $\frac{Y_i^t}{\sum_{i=1}^{n} Y_t}$ is equal to YS_{it}.

$$Y^t = \sum_{i=1}^{n} Y_i^t * YS_i^t \tag{6}$$

Using the above equation (6), the difference (change between two periods) at times 0 and T can be written as:

$$Y^t - Y^0 = \sum_{i=1}^{n} (Y_i^t - Y_i^0) YS_i^0 + \sum_{i=1}^{n} (YS_i^t - YS_i^0) Y_i^0 \tag{7}$$

To include the growth effect, we get the following equation:

$$Y^t - Y^0 = \sum_{i=1}^{n} (Y_i^t - Y_i^0) YS_i^0 + \sum_{i=1}^{n} (YS_i^t - YS_i^0) Y_i^0 + \sum_{i=1}^{n} (Y_i^t - Y_i^0)(YS_i^t - YS_i^0) \tag{8}$$

The growth of the output can be written as:

$$\frac{Y^t - Y^0}{Y^0} = \sum_{i=1}^{n} \frac{(Y_{it} - Y_{i0}) YS_{i0}}{Y_{i0}} + \sum_{i=1}^{n} \frac{(YS_{it} - YS_{i0}) Y_{i0}}{Y_{i0}} + \sum_{i=1}^{n} \frac{(Y_{it} - Y_{i0})(YS_i^t - YS_t^0)}{Y_{i0}} \tag{9}$$

For simplicity, we consider that the $\frac{Y^t - Y^0}{Y^0}$ is equal to Yg^t , $\sum_{i=1}^{n} \frac{(Y_{it} - Y_{i0}) YS_{i0}}{Y_{i0}}$ is equal to $\sum_{i=1}^{n} (WYg_i^t)$, $\sum_{i=1}^{n} \frac{(YS_{it} - YS_{i0}) Y_{i0}}{Y_{i0}}$,is equal to $\sum_{i=1}^{n} (SYg_i^t)$ and $\sum_{i=1}^{n} \frac{(Y_{it} - Y_{i0})(YS_i^t - YS_t^0)}{Y_{i0}}$ is equal to $\sum_{i=1}^{n} (SWYg_i^t)$ We get:

$$Yg^t = \sum_{i=1}^{n} (WYg_i^t) + \sum_{i=1}^{n} (SYg_i^t) + \sum_{i=1}^{n} (SWYg_i^t) \tag{10}$$

The term $\sum_{i=1}^{n} (WYg_i^t)$ denotes the within-sector (sectoral) output growth. The term $\sum_{i=1}^{n} (SYg_i^t)$ shows the output growth that is produced by the reallocated labor forces that are moved to the high-output sector (level effect or structural output level effect). The term $\sum_{i=1}^{n} (SWYg_i^t)$ demonstrates the output growth that is produced by the reallocated labor forces, which are moved to the high-output growth sector (growth effect or structural output growth effect).

The aggregate employed labor force at time *T* is written as:

$$L^t = \sum_{i=1}^{n} L_i^t \tag{11}$$

L_t is the aggregate employed labor force, $\sum_{i=1}^{n} L_i^t$ is the sectoral employed labor force. To explore the linkage between structural change and the aggregate labor force, the (11) can be rewritten as:

$$L^t = \sum_{i=1}^{n} L_i^t * \frac{L_i^t}{\sum_{i=1}^{n} L_t} \tag{12}$$

Whereas L_i^t is the sector "i" labor and $\sum_{i=1}^{n} L_t$ is the aggregate employed labor force (all sectors of labor). The term $\frac{L_i^t}{\sum_{i=1}^{n} L_t}$ shows the share of sector "i" labor. put $\frac{L_i^t}{\sum_{i=1}^{n} L_t}$ is equal to LS_{it}We get the following equation.

$$L^t = \sum_{i=1}^{n} L_i^t * LS_i^t \tag{13}$$

Using the above equation (13), the difference (change between two periods) at times 0 and T can be written as:

$$L^t - L^0 = \sum_{i=1}^{n} (L_i^t - L_i^0) LS_i^0 + \sum_{i=1}^{n} (LS_i^t - LS_i^0) L_i^0 \tag{14}$$

The term $\sum_{i=1}^{n} (L_i^t - L_i^0) LS_i^0$ shows the within-sector labor and the term $\sum_{i=1}^{n} (LS_i^t - LS_i^0) L_i^0$ indicates the reallocated labor (level effect). To include the growth effect of a structural change, equation (14) can be rewritten as:

$$L^t - L^0 = \sum_{i=1}^{n} (L_i^t - L_i^0) LS_i^0 + \sum_{i=1}^{n} (LS_i^t - LS_i^0) L_i^0 + \sum_{i=1}^{n} (L_i^t - L_i^0)(LS_i^t - LS_i^0) \tag{15}$$

The aggregate employed labor growth is:

$$\frac{L^t - L^0}{L^0} = \sum_{i=1}^{n} \frac{(L_{it} - L_{i0}) LS_{i0}}{L_i^0} + \sum_{i=1}^{n} \frac{(LS_{it} - LS_{i0}) L_{i0}}{L_i^0} + \sum_{i=1}^{n} \frac{(L_{it} - L_{i0})(LS_i^t - LS_t^0)}{L_i^0} \tag{16}$$

For simplicity, we consider $\frac{L^t - L^0}{L^0}$ is equal to Lg^t , $\sum_{i=1}^{n} \frac{(L_{it} - L_{i0}) LS_{i0}}{L_i^0}$ is equal to $\sum_{i=1}^{n} (WLg_i^t)$, $\sum_{i=1}^{n} \frac{(LS_{it} - LS_{i0}) L_{i0}}{L_i^0}$, is equal to $\sum_{i=1}^{n} (SLg_i^t)$ and $\sum_{i=1}^{n} \frac{(L_{it} - L_{i0})(LS_i^t - LS_t^0)}{L_i^0}$ is equal to $\sum_{i=1}^{n} (SWLg_i^t)$ The equation (16) can be rewritten as

$$Lg^t = \sum_{i=1}^{n} (WLg_i^t) + \sum_{i=1}^{n} (SLg_i^t) + \sum_{i=1}^{n} (SWLg_i^t) \tag{17}$$

The term $\sum_{i=1}^{n} (WLg_i^t)$ denotes the within-sector (sectoral) labor growth. The term $\sum_{i=1}^{n} (SLg_i^t)$ is the reallocation of the labor force level effect (static effect). The term $\sum_{i=1}^{n} (SWLg_i^t)$ is the reallocation of the labor force growth effect (dynamic effect). Labor productivity can be calculated through output divided by the employed labor force.

$$LP = \frac{Y}{L} \tag{18}$$

We can also calculate labor productivity growth by subtracting labor growth from the growth of output.

$$\text{Labor productivity growth} = \text{Growth of output} - \text{growth of labor} \tag{19}$$

Using equation (19), subtract equation (17) from equation (10), we get:

$$Yg^t - Lg^t = \sum_{i=1}^{n}(WYg_i^t) + \sum_{i=1}^{n}(SYg_i^t) + \sum_{i=1}^{n}(SWYg_i^t) - \left(\sum_{i=1}^{n}(WLg_i^t) + \sum_{i=1}^{n}(SLg_i^t) + \sum_{i=1}^{n}(SWLg_i^t)\right) \tag{20}$$

After the rearrangement of equation (20), we get:

$$Yg^t - Lg^t = \sum_{i=1}^{n}(WYg_i^t) - \sum_{i=1}^{n}(WLg_i^t) + \sum_{i=1}^{n}(SYg_i^t) - \sum_{i=1}^{n}(SLg_i^t) + \sum_{i=1}^{n}(SWYg_i^t) - \sum_{i=1}^{n}(SWLg_i^t) \tag{21}$$

Where $Yg^t - Lg^t$ is aggregate labor productivity, $\sum_{i=1}^{n}(WYg_i^t) - \sum_{i=1}^{n}(WLg_i^t)$ is the within-sector labor productivity, $\sum_{i=1}^{n}(SYg_i^t) - \sum_{i=1}^{n}(SLg_i^t)$ is the structural labor productivity level effect (static structural productivity) and the $\sum_{i=1}^{n}(SWYg_i^t) - \sum_{i=1}^{n}(SWLg_i^t)$ It is a structural labor productivity growth effect (dynamic structural productivity). The terms $\sum_{i=1}^{n}(SYg_i^t) - \sum_{i=1}^{n}(SLg_i^t)$ and $\sum_{i=1}^{n}(SWYg_i^t) - \sum_{i=1}^{n}(SWLg_i^t)$ is the total structural labor productivity.

Putting, $Yg^t - Lg^t$ is equal to the LPg^t, $\sum_{i=1}^{n}(WYg_i^t) - \sum_{i=1}^{n}(WLg_i^t)$ is equal to the $\sum_{i=1}^{n}(LPg_i^t)$, $\sum_{i=1}^{n}(SYg_i^t) - \sum_{i=1}^{n}(SLg_i^t)$ is equal to the $\sum_{i=1}^{n}(SPg_i^t)$ and $\sum_{i=1}^{n}(SWYg_i^t) - \sum_{i=1}^{n}(SWLg_i^t)$ is equal to the $\sum_{i=1}^{n}(SLPg_i^t)$. Equation (21) can be written as:

$$LPg^t = \sum_{i=1}^{n}(LPg_i^t) + \sum_{i=1}^{n}(SPg_i^t) + \sum_{i=1}^{n}(SLPg_i^t) \tag{22}$$

Equation (22) indicates the decomposition of aggregate labor productivity growth. The term $\sum_{i=1}^{n}(LPg_i^t)$ denotes the within-sector productivity growth. The $\sum_{i=1}^{n}(SPg_i^t)$ is the structural productivity level effect (static structural productivity), which shows the productivity of the reallocated labor force which reallocated to the high productivity level sector and the term $\sum_{i=1}^{n}(SLPg_i^t)$ is the structural productivity growth effect (dynamic structural productivity), which shows the productivity of the reallocated labor force, which is reallocated to the high productivity growth sector.

Validity of the Novel Decomposition

The section describes the validity of the novel's decomposition. The new decomposition, which is based on structural productivity, provides an accurate, consistent, and analytically sound

framework for the sources of aggregate labor productivity growth. The study validates the new decomposition through testing internal consistency as well as comparing with actual productivity growth as well as labor growth at sectoral levels. The evaluation is conducted for the association between labor productivity, the employed labor force, growth in the labor share, and structural productivity. The manufacturing industry has chosen for the validation and assessment of the new framework.

Data Sources and Methodology

The data on Gross Domestic Product and labor force at both aggregate and sectoral levels (manufacturing, construction, and agriculture) are obtained from the Handbook of Statistics on Pakistan's Economy and the Pakistan Economic Survey. Additionally, output and labor share of manufacturing, construction, and agriculture sectors are calculated using sectoral output and labor divided by total output and labor respectively. This study uses the novel shift-share methodology for the decomposition of aggregate productivity.

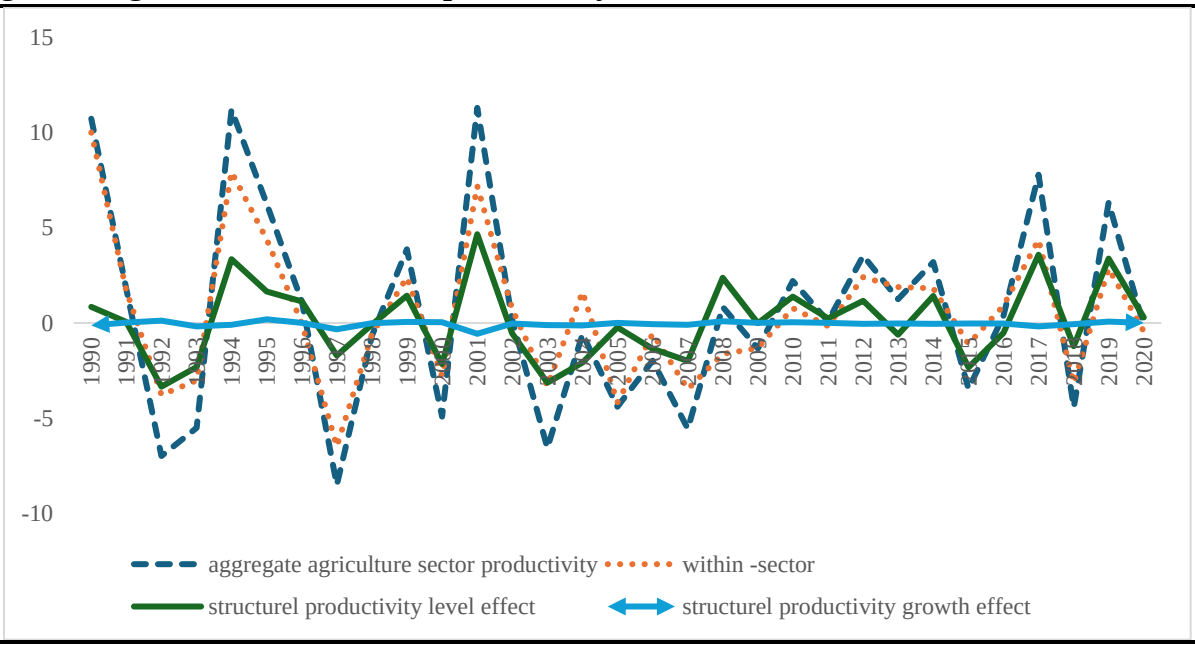
Results and Discussion

This section consists of the results and discussion related to both novel and traditional decomposition. The novel decomposition is explained in the first part of this section, and the conventional decomposition is presented in the second part of this section. The third part of this section consists of the validity of the novel decomposition.

The Results of the Novel Decomposition

Figure 3 shows that the within-sector agriculture sector productivity has deteriorated during the past decades. On the other hand, structural productivity (level effect) and structural productivity (growth effect) have increased over time. The findings indicate that there has been a consistent decrease in the aggregate agricultural sector's productivity.

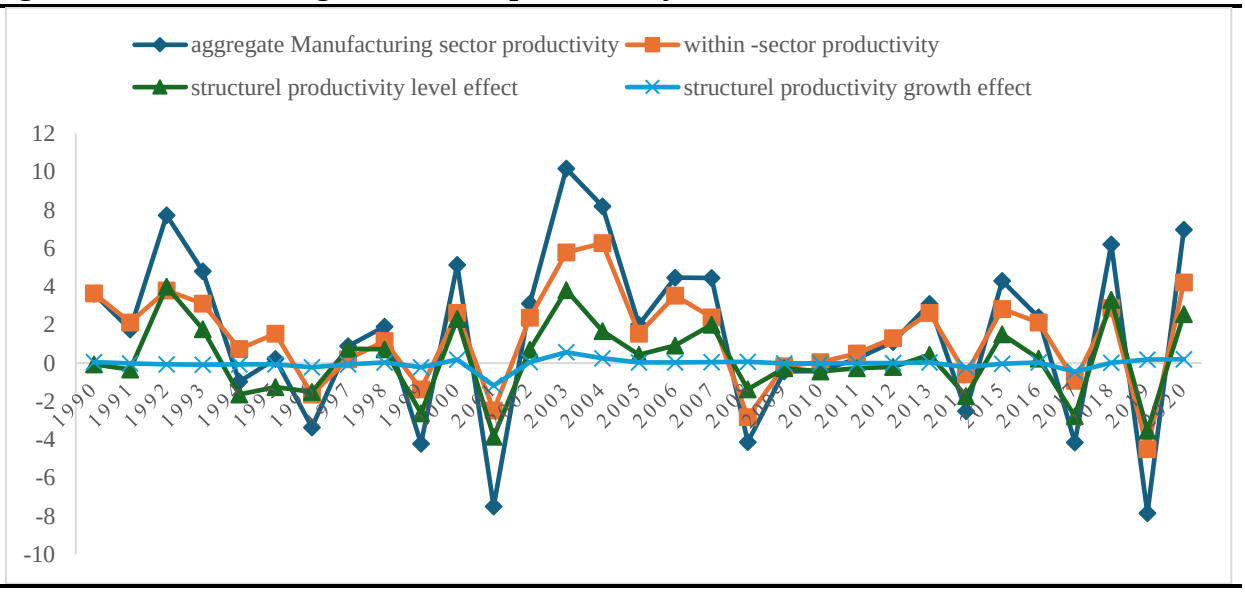
Figure 3: Agriculture sector labor productivity



Sources: Author's calculations.

The key source for the agriculture productivity slowdown is the worsening in within-sector productivity growth, which shows that efficiency improvements and technical advancement could be significantly reduced in the agriculture sector. The structural productivity is favorable, but not enough to substantially change the aggregate productivity growth.

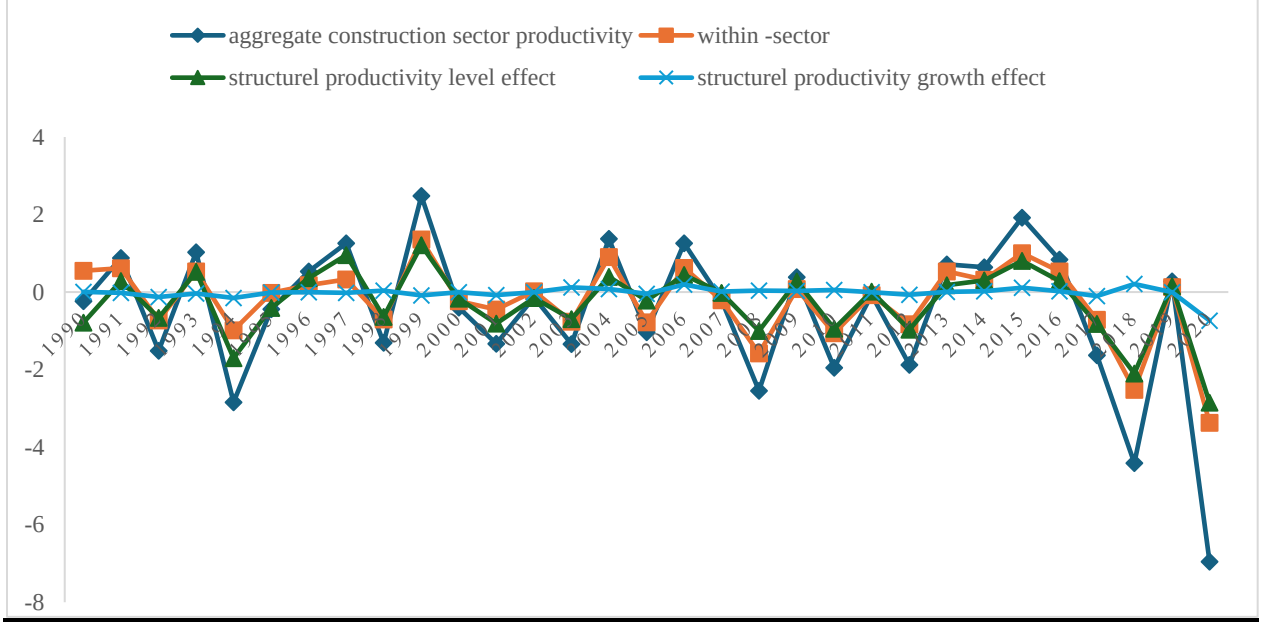
Figure 4: Manufacturing sector labor productivity



Sources: Author's calculations.

Figure 4 displays the results related to the manufacturing sector labor productivity growth. The aggregate manufacturing sector's labor productivity growth consists of within-sector productivity, structural productivity level effect, and structural productivity growth effect. The decline in within-sector productivity has contributed to the manufacturing productivity slowdown. Aggregate manufacturing productivity is also negatively affected by the structural productivity level effect and contributes to the manufacturing productivity slowdown. The structural productivity growth effect favorably influences the manufacturing productivity, but the magnitude is modest and unable to restrict the aggregate manufacturing labor productivity slowdown.

Figure 5: Construction sector labor productivity



Sources: Author's calculations.

Figure 5 indicates that all components of the construction sector productivity declined. Figure 5 demonstrates that each component, such as within-sector productivity, structural productivity level effect, and structural productivity growth, has adversely affected the aggregate construction productivity growth.

Results of Traditional Decomposition

Figure 6 in Appendix 1 reveals that the agriculture within-sector labor productivity has drastically decreased. Within-sector labor productivity could be reduced due to slow technological progress and inadequate infrastructure. Furthermore, the labor reallocation level effect displays that labor moves into sectors with lower productivity levels. The labor reallocation growth contributes positively in comparison to the other two components. The decomposition depicted in Figure 7 in Appendix 2 shows a mixed pattern with prominent differences in each component contribution. The decrease in within-sector productivity is the main cause of the manufacturing productivity slowdown. In contrast, the labor reallocation level positively contributes to the labor productivity growth in the manufacturing sector. This implies that labor has been reallocated to a high-productivity level sector. The overall productivity of manufacturing decreased due to the reduction in within-sector productivity. Although growth effects and level effects did not considerably lessen the manufacturing sector's productivity growth. Figure 8, revealed in Appendix 3, shows that the construction industry exhibits a different pattern with only one component (labor reallocation level effect) contributing positively (increased over time), which shows that labor is reallocated toward sectors with higher productivity levels. The decrease in within-sector productivity and labor reallocation growth is the core source of the deterioration in the construction sector's productivity.

Results Related to the Validity of the Novel Decomposition

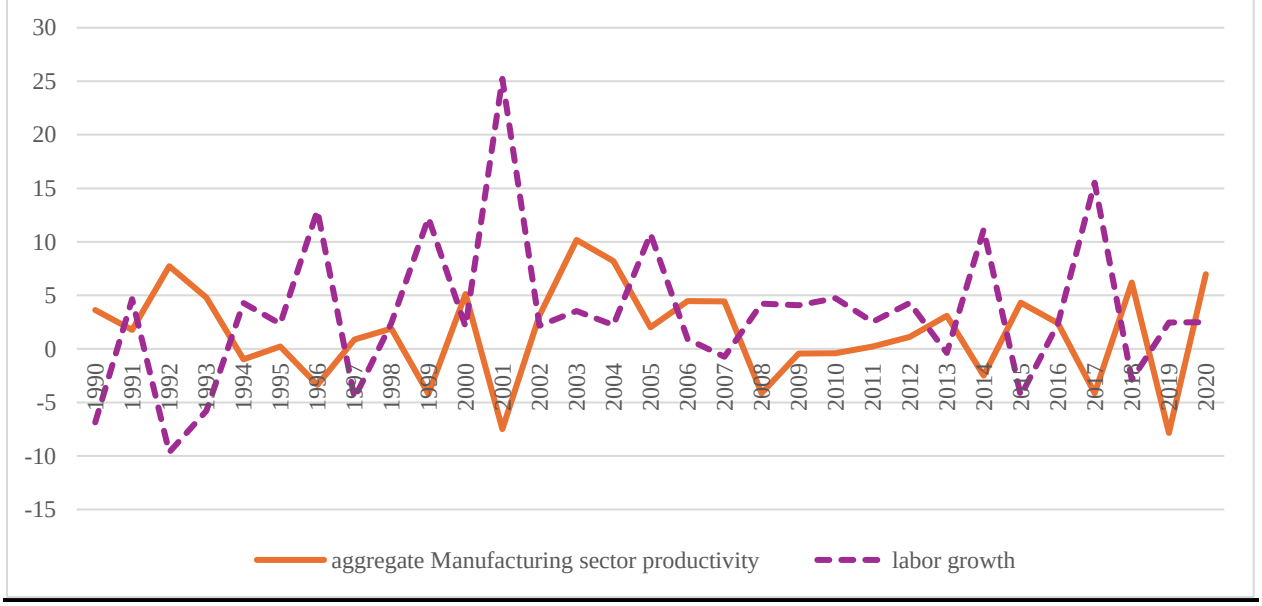
This section illustrates the theoretical reasoning and data-based evidence from Pakistan's manufacturing industry for the validity of the newly proposed decomposition. The determinants

of aggregate productivity can be better understood with the help of the new decomposition, which is based on structural productivity. The conventional decomposition is based on labor share or output share only and separates productivity growth into three categories of within-sector growth, labor reallocation growth, and level effects, which ignores the sectoral inefficiencies as well as the role of capital, skills requirement, and development in the manufacturing sector. The new decomposition is conceptually better because it is based on structural productivity, which is determined by both output and input shares rather than labor shares or output share only. Using data from the manufacturing industry, several graphical analyses were carried out for the validity of the novel decomposition.

Labor Growth and Labor Productivity

Graphical analysis 9 shows an inverse link between labor productivity and the growth of the labor force in the manufacturing sector under the new decomposition framework. There is also a negative relationship between labor productivity and the growth of the labor force by calculating labor productivity without using the decomposition method described in appendix 4.

Figure 9: Labor Growth and Labor Productivity

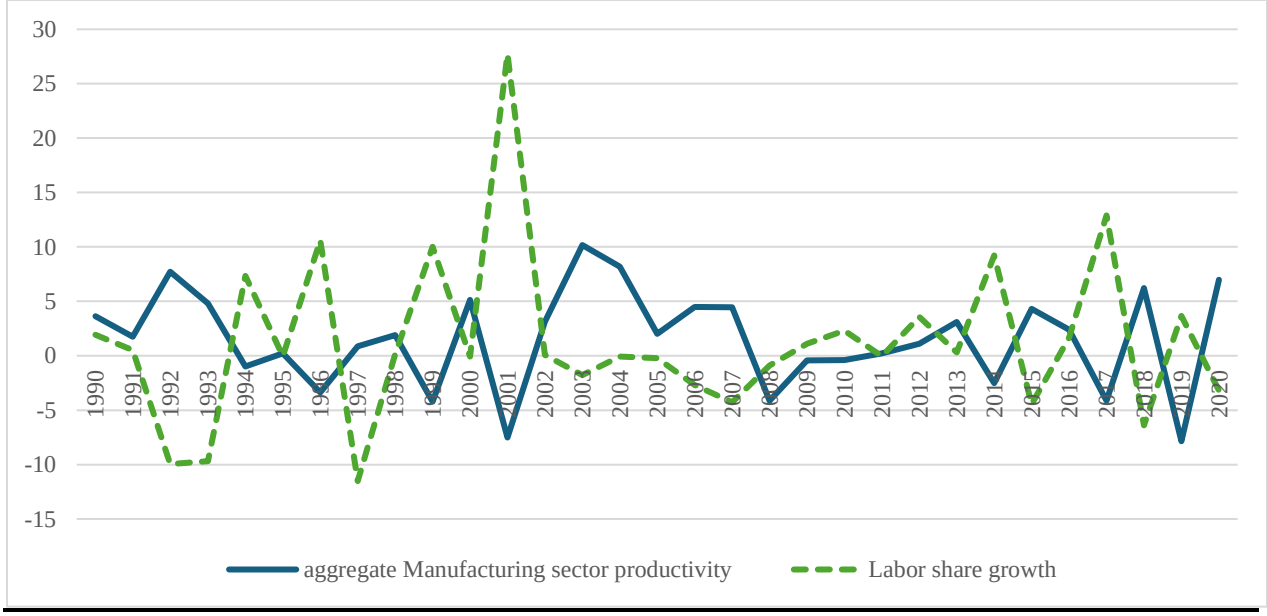


This shows that productivity decreased as more labor moved into the industrial sector; therefore, increasing the labor reallocation to the manufacturing sector leads to lower productivity growth. The traditional decomposition revealed the positive relationship as discussed under the section of results related to the traditional decomposition, where the manufacturing sector labor reallocation level positively contributes to the manufacturing sector productivity growth. which contradicts the association between labor growth and labor productivity reported in appendix 4. The agriculture and manufacturing sectors require different levels of skills. It is not reasonable to expect that a reallocated labor force will enhance productivity in the manufacturing sector immediately; it will take time to train the labor force to gain the required skills and contribute to the labor productivity growth.

Growth of Labor Share and Labor Productivity

Additionally, considering the manufacturing sector there is a negative correlation between labor productivity and labor share, which is depicted in Figure 10. Again, this relationship supports the novel decomposition and contradicts the traditional decomposition. This implies that the larger reallocation of the labor force without proper training or skills will lead to lower productivity growth. This confirms the negative relationship between labor growth and labor productivity as well as validates the novel decomposition.

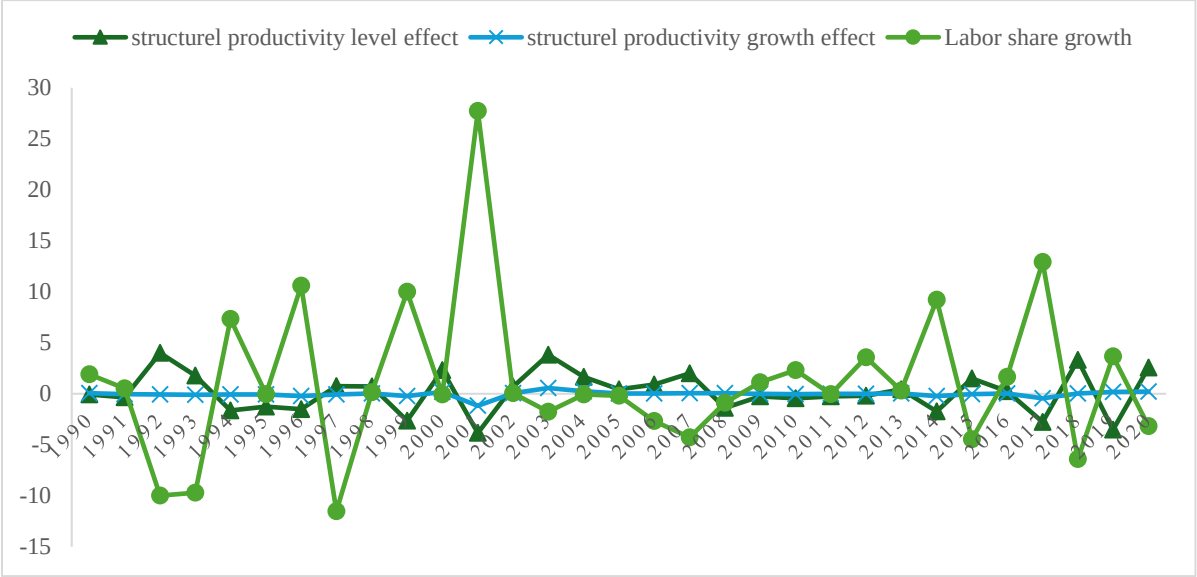
Figure 10: Labor Share and Labor Productivity



Structural Productivity and Labor Share

Both the structural productivity level and growth components of the novel decomposition of the manufacturing sector show a negative relationship with labor share growth. Again, this confirms the negative relationship between labor growth and labor productivity. Additionally, this relationship confirms the results of novel decomposition and rejects the traditional decomposition. It shows that there is a negative relationship between the different components of novel decomposition with labor share growth, along with a negative relationship between labor growth and labor productivity.

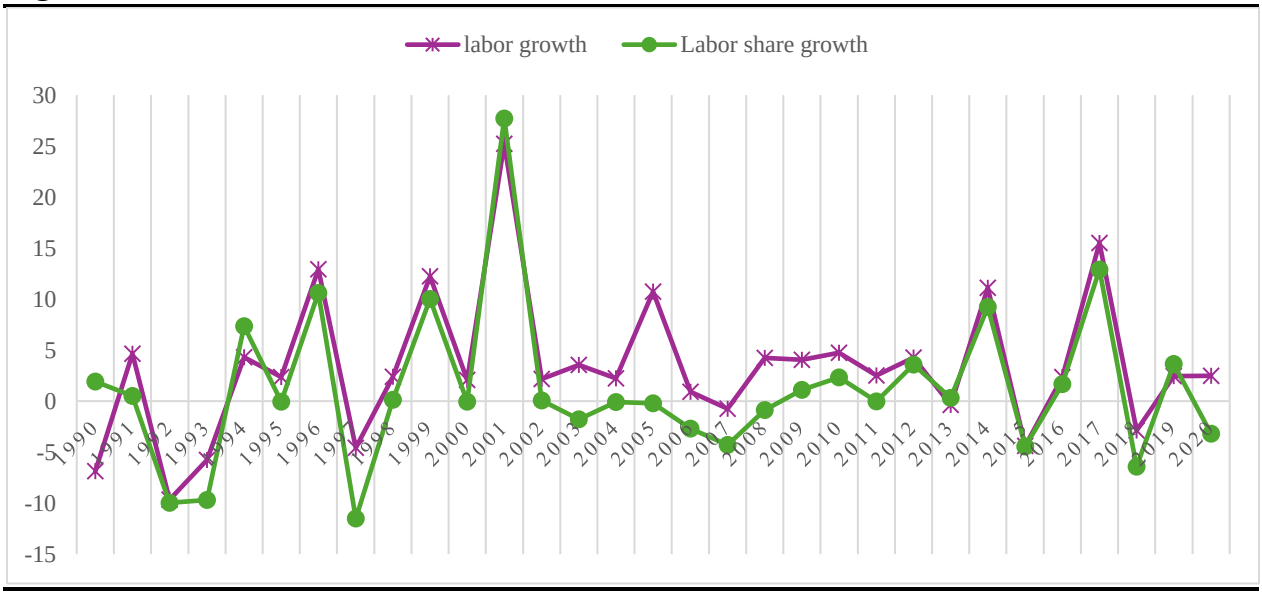
Figure 11: Structural Productivity and Labor Share



The Growth of Labor Force and Labor Share

To further strengthen our novel decomposition, we considered labor growth and labor share growth. The growth of the employed labor force and the growth of labor share are depicted in Figure 12, which shows the positive association between these two variables. Again, this confirms that there is an inverse association between the employed labor force and labor productivity as well as it also confirms that there is a negative link between labor share growth and labor productivity. This analysis indicates that the reallocation of the labor force from agriculture to manufacturing negatively affects the manufacturing sector's labor productivity. Thus, novel decomposition excellently indicates the impact of structural change on labor productivity based on structural productivity growth.

Figure 12: The Growth of Labor Force and Labor Share



To understand productivity stagnation in Pakistan, the new decomposition provides more precise findings and theoretical clarity. It avoids the oversimplifications of the labor-share-based traditional decomposition. The data of several variables support the new decomposition, which is that structural change does not always result in increased productivity growth.

Main Findings of the Study

The key findings of the study illustrates that the sectoral productivity growth, including manufacturing, agriculture, and construction, has declined and largely contributed to the decrease in aggregate labor productivity growth in Pakistan. In addition to this, this study also proves that novel decomposition is vital and reliable for the decomposition of the sources of aggregate productivity growth. The novel decomposition displays that increasing the labor share or labor growth does not guarantee a boost in productivity growth. It also shows that both within-sector and structural components of productivity lead to aggregate labor productivity slowdown in Pakistan. The results further revealed that the agriculture sector's structural productivity growth and levels are positive, whereas the within-sector productivity growth is negatively related and contributed to the aggregate labor productivity slowdown. The structural productivity growth and levels have positive but insufficient effects to offset the overall productivity deterioration in the agriculture sector. There is a continuous fall in within-sector productivity along with a structural productivity level in the manufacturing sector, and it has contributed to the reduction in aggregate productivity. Finally, the construction sector components of productivity growth are declining over time. This study concludes that the aggregate labor productivity growth originated from the fall in sectoral productivity and structural components. The lower sectoral and structural productivity may originate from lower capital per worker, low low-quality labor force, and a lack of technological development. To enhance within-sector productivity growth as well as the structural components, it is a prerequisite to provide the proper training and a skills development program to the labor force. There is also a need for increasing research and development, as well as capital per worker, to boost productivity along with economic growth.

Conclusion

This study investigated the causes of the aggregate labor productivity slowdown in Pakistan using the novel structural decomposition analysis and decomposed aggregate productivity growth into three components. The decomposition of the agriculture sector labor productivity indicates that within sectors, labor productivity has declined and played a vital role in aggregate agriculture and aggregate labor productivity. Whereas the productivity of the reallocated labor force (level effect) has increased. The results of the study further illustrate that manufacturing within-sector and structural labor productivity levels have also deteriorated. The reduction in manufacturing labor productivity originated from a fall in within-sector and structural labor productivity. Additionally, the decomposition of the construction sector indicates that within-sector and structural labor productivity decreased and contributed to the decline in aggregate labor productivity during the past few decades. The key findings demonstrate that within-sector productivity as well as structural productivity components are the core factors of aggregate productivity growth slowdown, including in manufacturing, construction, and agriculture. The study provides the sources of reduction in productivity and provides evidence that the novel decomposition is a sound framework for the identification of the sources of productivity growth. The empirical validation of the new decomposition has been conducted based on the manufacturing sector variables using the relationship between labor productivity and the employed labor force, as well as the growth of the

labor share. In addition to this, the novel decomposition is more reliable while explaining the sources of productivity growth in Pakistan. Based on the findings of this study, the policy recommendation is as follows.

- First, the skilled labor force plays a crucial role in productivity growth; therefore, Policymakers may increase investment in human capital, including skills development programs, to improve and produce the skilled labor force in the country.
- Second, the government must enhance the developmental expenditure, such as expenditure on health, education, research, and development, as it will help to improve the efficiency of the labor force in Pakistan.

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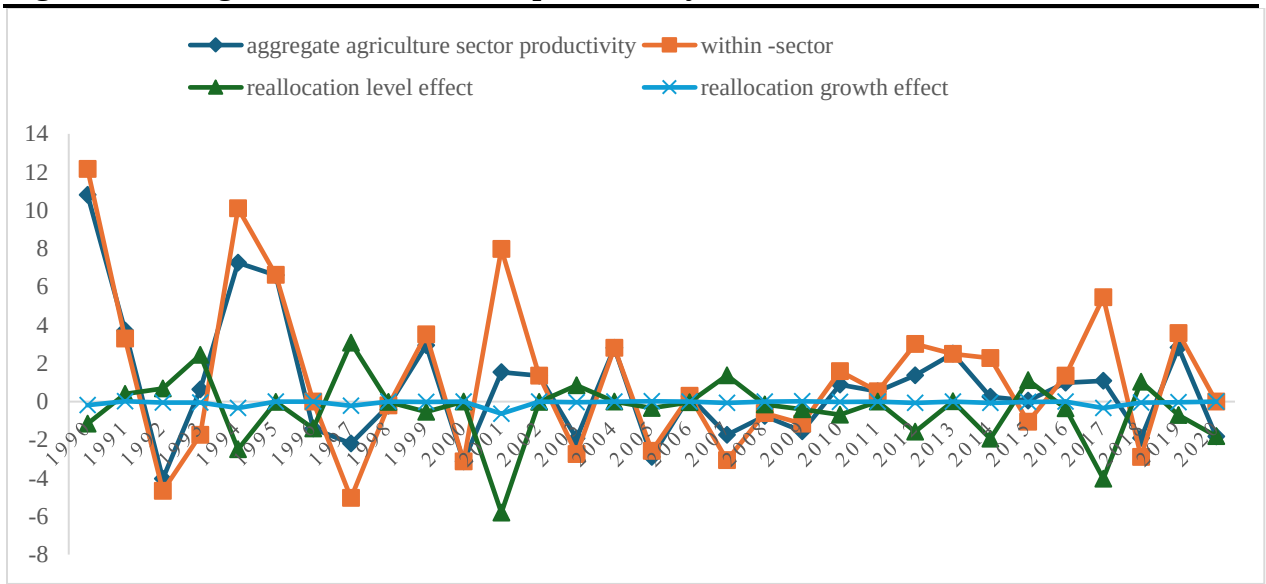
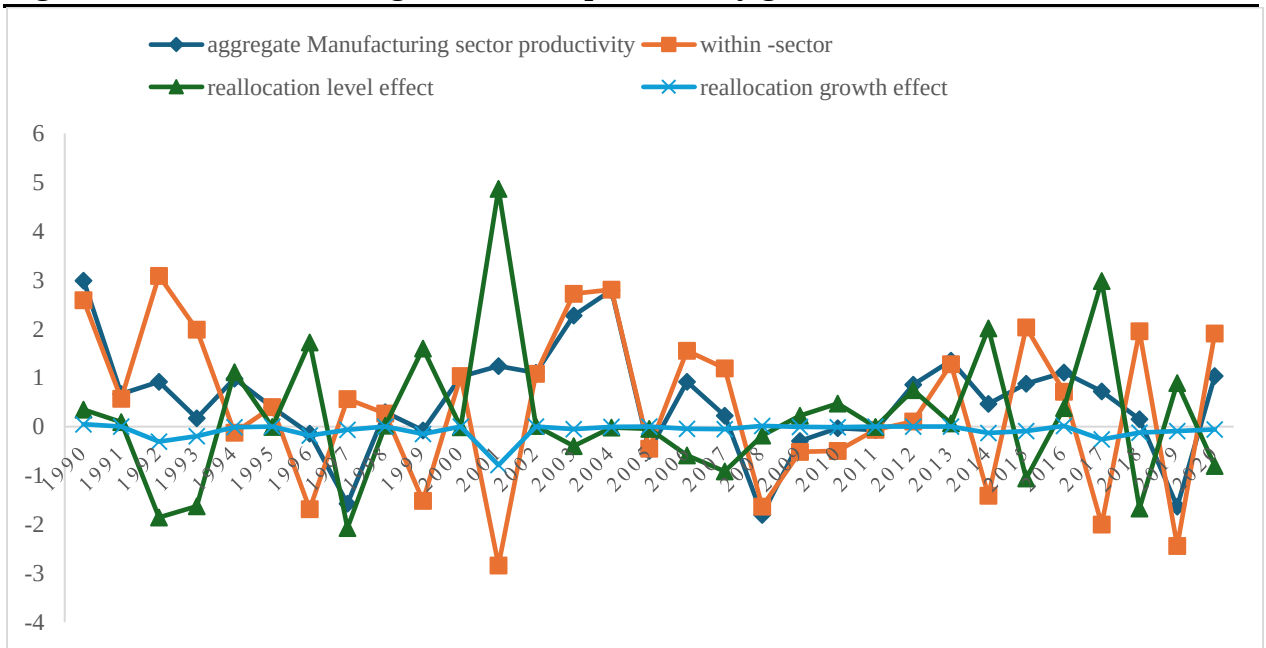
Appendix # 1

Figure 6: The agriculture sector labor productivity



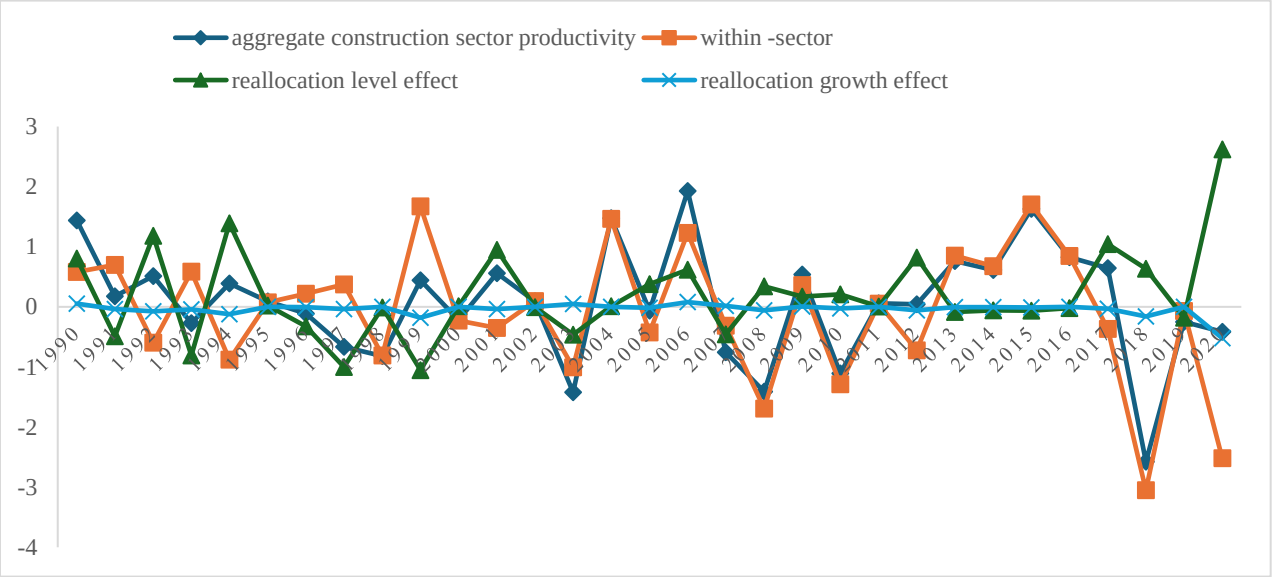
Appendix # 2

Figure 7: The manufacturing sector labor productivity growth



Appendix # 3

Figure 8: The construction sector labor productivity growth



Appendix # 4

Figure 9A: The manufacturing sector labor productivity and labor growth