AMERICAN UNIVERSITY OF BEIRUT

UNDERSTANDING PRODUCTIVITY GAPS: A SECTORAL PERSPECTIVE ON STRUCTURAL CHANGE IN EAST ASIA, LATIN AMERICA AND AFRICA

by
AHMAD MOHAMMED TAYYAR

A thesis
submitted in partial fulfillment of the requirements
for the degree of Master of Arts
to the Department of Economics
of Faculty of Arts and Sciences
at the American University of Beirut

Beirut, Lebanon
May 2025

AMERICAN UNIVERSITY OF BEIRUT

UNDERSTANDING PRODUCTIVITY GAPS: A SECTORAL PERSPECTIVE ON STRUCTURAL CHANGE IN EAST ASIA, LATIN AMERICA AND AFRICA

by
AHMAD MOHAMMED TAYYAR

Approved by:

Dr. Nadine Yamout, Assistant Professor — Advisor
Department of Economics

Dr. Ali Abboud, Assistant Professor — Member of Committee
Department of Economics

Dr. Muhammed Alparslan Tuncay, Assistant Professor — Member of Committee
Department of Economics

Date of thesis defense: April 24, 2025

Acknowledgements

I would like to express my deepest gratitude to my supervisor, Professor Nadine Yamout, for her unwavering support, invaluable guidance, and remarkable patience throughout the entire process of my thesis. Her thoughtful feedback and insightful advice have been instrumental in shaping this work, and without her continuous encouragement, this thesis would not have come to fruition. I am also profoundly grateful to her for being not just my academic supervisor, but also a guiding mentor throughout my academic journey.
I would also like to extend my heartfelt thanks to Professor Ali Abboud for serving on my thesis committee. His time, effort in reading and reviewing my work, and his constructive comments have added immense value to this research. His perspectives have significantly contributed to my academic development, and I am grateful for the opportunity to learn from him.
I am equally thankful to Professor Alparslan Tuncay for his time and dedication in reviewing my thesis and contributing to this important milestone in my academic career.
I am profoundly indebted to my parents, whose love, support, and belief in me have been my greatest source of strength throughout my life. They have taught me that there are no limits to what I can achieve and have instilled in me the belief that I can accomplish any goal I set for myself. I also want to express my deep appreciation to my younger brother, Ali, for always being there for me through both the highs and lows. His encouragement and support have been a constant throughout my journey.
I am deeply grateful to my friends, who have been with me throughout these two years. Their companionship, both as colleagues and as friends, has made this journey not only bearable but also enjoyable. Their support and camaraderie have been invaluable, and I will forever cherish their presence in my life.
Finally, I would like to express my sincere gratitude to the Mastercard Foundation for believing in me and for their continuous support. Their generosity has allowed me to pursue my academic dreams, and their dedication to supporting students has made a profound impact on my journey. I am immensely grateful for the opportunities they have provided me and for the academic and personal growth they have helped foster.

Abstract
of the Thesis of

Ahmad Mohammed Tayyar for Master of Arts
Major: Economics

Title: Understanding Productivity Gaps: A Sectoral Perspective on Structural Change in East Asia, Latin America and Africa

This thesis examines the process of structural transformation based on the role of productivity gaps in East Asia, Latin America, and Africa. Depending on sectoral data on employment and value-added, the study documents the evolution of economic structures in a sample of fourteen countries, highlighting the divergent trajectories of sectoral shifts over time.

Aiming to understand the role of sectoral productivity in explaining structural change, I use a multisector model.Such model study structural transformation by depending on sectoral productivities, non-homothetic preferences, and labor market dynamics. Calibration exercises benchmarked against the United States reveal that structural transformation trends vary significantly between countries depending on sector-specific productivity growth rates and historical context.

The analysis demonstrates that while some economies, such as Hong Kong and Singapore, successfully transitioned labor into higher-productivity sectors, others, notably South Africa, experienced premature deindustrialization with limited productivity gains. These findings underscore that structural transformation alone is not sufficient; what matters critically is whether labor is reallocated into sectors capable of sustaining productivity growth.

Although the model captures broad sectoral trends, limitations arise from limiting the role of capital accumulation, policy, and historical institutional constraints, which might shape transformation outcomes in practice. That being said, the findings offer significant insights into how structural transformation interacts with productivity dynamics, contributing to the understanding of economic development process.

Table of Contents

Illustrations

Tables

Chapter 1

Introduction

Economic development and forces behind growth remains one of the most foundamentals questions in modern economics talk. As Lucas (1988) famously noted, "Once one starts to think about them, it is hard to think about anything else." Understanding the forces behind sustained economic growth requires identifying the forces of growth and the mechanisms of this process. Among these mechanisms, structural transformation— the process of reallocating economic activities and resources between sectors—has emerged as a critical engine for long-term productivity growth and rising income levels.

Kuznets (1973) emphasized that structural transformation is not merely a byproduct of economic expansion but an important stage for economic development. As economies grow, the shift of labor and capital from traditional sectors, such as agriculture, to more modern ones, like manufacturing and services, fundamentally reshapes the economy's structure. Such sectoral shifts is essential for closing productivity gaps both within countries and across regions.

This thesis examines the role of structural transformation in shaping productivity gaps across East Asia, Latin America, and Africa. By leveraging sectoral data on employment and value-added, the analysis documents the process of transformation in selected countries, investigates the behavior of aggregate labor productivity, and calibrates a multisector growth model to better understand the underlying dynamics.

This study explores not only how sectoral shifts occur but also how the pace, sequence, and effectiveness of such mechanisms differ across regions. In doing so, it aims to shed light on the critical factors that enable or undermine countries' convergence toward

higher levels of productivity and income.

The structure of the thesis is as follows: the remainder of this chapter reviews the relevant literature on structural transformation and productivity dynamics. Chapter 2 presents a detailed sectoral analysis of fourteen countries across three continents. Chapter 3 outlines the theoretical model and economic environment used to interpret such a process. Chapter 4 discusses the calibration of the model to the United States, followed by a quantitative analysis in chapter 5 and 6, while chapter 7 discusses the model results on the calibrated countries. Finally, the concluding sections summarize the key findings, limitations of this thesis, and discuss their policy implications.

1.1 Literature Review:

1.1.1 *Structural Transformation and Economic Growth:*

Herrendorf et al. (2014) extensively examine the process of structural transformation and emphasize the essential role of reallocating economic activity from traditional sectors (agriculture) to more modern ones (manufacturing and services) as crucial for economic development. They highlight the significance of this process and underscore how structural transformation is consistently correlated with economic growth globally. Structural transformation is defined as the shift of economic activities, specifically employment and output, from agriculture into manufacturing, and subsequently into services as economies develop (Herrendorf et al., 2014).

When reading development economics literature, it is clear that economists discuss classical models, historical data, and facts intending to understand the process of structural change. The contributions of Clark (1957), Kuznets (1966, 1973), and Chenery and Syrquin (1975) are essential for anyone studying structural transformation. They provided empirical evidence documenting structural transformation as a decline in agricultural activities, followed by a rise in the industrial sector's role, and subsequently an increase in services as economies develop over time. All of this literature documents a consistent decrease in the agricultural employment share, followed by a temporary rise

in the manufacturing share and an uninterrupted rise in the services sector's share as economies grow.

To support the idea of the correlation between economic development and structural transformation, Herrendorf et al. (2014) discuss the empirical results of Maddison (1980) and Syrquin (1988), which both highlighted the occurrences of structural transformation in both developed and developing economies. Such an observation suggests that this process is not only characterized as an economic phenomenon but rather plays a fundamental role in economic development.To conclude their review, Herrendorf et al. (2014) define structural transformation as an essential part of economic development.

Their empirical evidence, coupled with theoretical frameworks, demonstrates that as economic development progresses, shifts occur in terms of value-added and employment shares from agriculture to manufacturing and subsequently to the services sector. In their analysis, this process is not solely dependent on productivity and theoretical trajectories but is also linked to employment mobility, inequality, and economic policy.

1.1.2 *Drivers of Structural Transformation:*

To understand the forces behind such a process, Herrendorf et al. (2014) look into the roles of both the supply side and the demand side in creating this mechanism. Starting with the supply side, they highlight the role of productivity gaps between sectors in creating sectoral shifts; increasing agricultural productivity may release employment from agriculture toward other sectors, facilitating transformation. Such evidence aligns with the literature of both Lewis (1954) and Harris and Todaro (1970).

On the demand side, they highlight the role of non-homothetic preferences in driving structural transformation. In terms of defining this term, non-homothetic preferences create an income effect, meaning that as economies develop and income increases, the demand for service goods rises while dropping for both manufacturing and agriculture goods, thus forcing structural change. This fact aligns with the theoretical framework of Kongsamut et al. (2001) and empirical evidence by Echevarria (1997) and Buera and Kaboski (2009).

In addition to the roles of supply and demand, Baumol (1967) introduced the "cost disease" theory as a driver of structural transformation. This hypothesis particularly depends on the relatively slow productivity catch-up of the services sector compared to the manufacturing sector as a force driving labor reallocation, especially in developed economies.

1.1.2.1 Determinants of Structural Transformation by McMillan et al. (2014):

1. Countries highly dependent on natural resources often experience a limited productivity transformation trend, as their sectors often enjoy a high productivity level but lack employment opportunities. Such dependence limits the possibility of sectoral productivity catch-up, which affects transformation negatively.
2. Countries that tend to float their currencies tend to enjoy higher trends of structural change, as such a policy enhances their tradable goods sector, like manufacturing. While relying on overvaluing local currencies might hurt tradable manufacturing and service goods, causing a disturbance in the transformation process.

1.1.3 *Empirical Observations and Methodological Contributions:*

Aiming to report the process of structural transformation from an empirical side, Herrendorf et al. (2014) give a detailed analysis using multi-country data and a historical period. They documented how structural transformation follows similar patterns across countries but differs in terms of speed and magnitude. They added that such difference is fueled by a country's specific factors like policy role, institutional quality, international economic policies and initial economic composition.

Aiming to observe the process of structural change in Africa, Asia, and Latin America, McMillan et al. (2014) examined the relationships between productivity gaps, structural transformation, and globalization as development drivers. They hypothesise that productivity gaps and the failure of relative productivity catch-up between traditional sectors (particularly agriculture) and modernized sectors (such as manufacturing and services) are key drivers of structural change. They show that transformation occurs as labor real-

locates from lower-productivity activities to higher-productivity ones, a process aligned with economic development.

Their explanation of the forces behind productivity growth is linked to within-sector enhancements, characterised by capital accumulation or technological improvements, and productivity-enhancing structural shifts as resources move between sectors. Both explanations align well with the theoretical dual-economy model discussed by Lewis (1954), which explains the movement of laborers from agriculture to the industrial sector as a key indicator of economic growth.

From an empirical perspective, McMillan et al. (2014) highlighted the role of regional differences in shaping the trajectory of structural change. When modelling data from Asian countries, it was clear that the process of sectoral changes in the labor market, as employment shifted from manufacturing toward the services sector, was a key driver of economic growth. However, when applying a similar analysis to countries from either Africa or Latin America, a different pattern emerges. The process of labor movement was from highly productive sectors to lower-productivity ones. Such movements harmed the development process in these countries, affecting not only their relative productivity but also hindering their overall economic catch-up, as they failed to follow the development path of other emerging economies.

For instance, they reported that although Latin America implemented trade liberalization policies, the impact of such policies remained limited in enhancing sectoral productivity. They showed that following liberalization, laborers began moving from highly productive sectors (such as manufacturing) to less productive sectors (such as informal services activities), negatively impacting aggregate national productivity. Instead of leading to macroeconomic improvements as expected, trade liberalization did not produce the anticipated productivity catch-up (Cavalcanti Ferreira & Rossi, 2003; Eslava Mejía et al., 2009; Pavcnik, 2002). As for the African countries, during the period from 1990 to 1999, structural transformation is documented as contributing to negative productivity growth. However, in the early 2000s, due to improved economic policies and increased capital investment, the trajectory of transformation began to contribute

positively to the development process.

1.1.4 *Sectoral Patterns and the Limits of Standard Models:*

Gollin et al. (2004) examine whether the standard neoclassical growth model can accommodate sectoral shifts across countries. While such a framework was able to account for the cross-country income gap (Chari et al., 1996; Parente & Prescott, 2000; Prescott, 1998), they showed that it failed to capture the productivity gap between agricultural and non-agricultural sectors. Unlike the basic framework that emphasizes the role of technological inputs in explaining productivity gaps, they also included home-based economic activities as a factor.

In terms of explaining their results, they found that laborers in poorer countries tend to spend more time on home production when compared to those in developed countries. Such a finding explains the historical and current productivity gap between economies, shedding light on the role of labor allocation in widening the divergence between rich and poor countries, not only technological inputs.

Aiming to understand structural transformation, Ngai and Pissarides (2007)developed a simple multisector model where sectoral productivity differences drive employment reallocation over time. Like others, they do not focus solely on non-homothetic preferences but also emphasize the role of total factor productivity (TFP) in driving growth across different sectors. They seek to limit the role of income effects (homothetic preferences) in causing structural transformation alone. Instead, they shed light on the role of productivity improvements in causing labor to reallocate between sectors. They hypothesize that sectors with higher TFP growth require less employment to meet market demand, leading sectors with lower TFP growth to absorb the excess labor. This reallocation mechanism drives the process of structural transformation in their model.

Similar to the literature, Ngai and Pissarides (2007) defined structural transformation as a process of a decrease in agriculture employment share, an inverted U-shaped pattern for industry employment and a steady increase in the employment share of the services sector. They argued that this pattern aligns well with the movement of sectoral

productivity as agricultural productivity outpaces moderate sector productivity, pushing laborers into manufacturing and services sectors, creating transformation aligned with economic growth. Such framework align with observations by both Clark (1957) and Kuznets (1966) while also complementing the non-homothetic theory discussed by (Echevarria, 1997; Herrendorf et al., 2014; Kongsamut et al., 2001).

1.1.5 *Agriculture's Role in Cross-Country Productivity Differences:*

Restuccia et al. (2008) contribute substantially to the literature by offering a different understanding of aggregate productivity gaps by shedding light on the agricultural sector. Their discussion emphasizes how a high labor share in this traditional sector, combined with its low productivity level in developing economies, explains the aggregate productivity gap between developed and developing countries. While measuring GDP per worker provides a decent indicator of economic development, showing a 34-fold difference between rich and poor countries, the productivity gaps tend to be even higher, implying structural difficulties faced by developing countries in their efforts to enhance their development levels.

Restuccia et al. (2008) developed a multi-sector model focusing on the role of the agricultural sector in the transformation process. In their model, they relied on Schultz (1953)concept of subsistence food requirements, negative returns to workers in the traditional sector, and the lack of technological enhancements in agriculture. This model helped them study the role of inputs in the agricultural sector alongside labor market dynamics in explaining the process of labor reallocation.

Restuccia et al. (2008) concluded that the lack of modern inputs in the agricultural sector is possibly correlated with lower levels of productivity in the sector. Due to the food problem discussed by Schultz (1953), the employment share in agriculture in poorer countries tends to be high, aiming to meet subsistence levels. Additionally, sectoral productivity is negatively affected by labor market distortions and limited access to inputs. When calibrating their model while accounting for these barriers, they were able to significantly reduce the productivity gap with developed countries, implying that the

agricultural sector's challenges are a key reason behind the failure of catch-up between developed countries and emerging economies.

Restuccia et al. (2008) complement the literature of McMillan et al. (2014) and McMillan et al. (2014) by shedding light on and zooming in on the role of the agricultural sector, while the others address the transformation process more broadly, focusing on agriculture alongside the manufacturing and services sectors.

1.1.6 *Implications for Growth and Development Policies:*

While policies might have direct implications for structural transformation and economic development, Herrendorf et al. (2014) highlighted their significance. They discuss the role of policymakers in fostering economic growth by emphasizing the importance of structural change. Specifically, they underscore the role of policies affecting labor mobility, human capital investments, and technological adoption in enhancing economic growth. For example, industrialization policies in East Asia during the mid-to-late 20th century provide a significant benchmark of successful economic growth and structural transformation (Rodrik, 2008; Young, 1995).

McMillan et al. (2014), highlighted the role of targeted policy in smoothing the process of structural change through targeting premature deindustrialization and enhancing economic diversification. Taking into consideration in the East Asian case, political and monetary policies targeting exchange rate, industry, and trade openness opened the way to an effective transformation trajectory (Rodrik, 2008; Young, 1995).

Additionally, they showed that transformation does not occur without effective policy intervention. In particular, they emphasised that to achieve reasonable development and transformation in Africa and Latin America, policies encouraging diversification and promoting investments in modern sectors are essential.

As for policy implications discussed by Restuccia et al. (2008), they mentioned that introducing modern technology to agricultural production alongside enhancing rural infrastructure might eliminate the negative role of the agricultural productivity gap in the process of structural transformation.

From a policy standpoint, Ngai and Pissarides (2007) suggest that interventions aiming to accelerate structural change must account for underlying productivity trends rather than solely targeting sectoral employment shares. Attempts to "reindustrialize," for example, may struggle unless manufacturing TFP growth differentials are addressed.

Chapter 2

Country Analysis

In the section below, I explore the process of structural transformation in 15 countries selected from three main regions: East Asia, Africa, and Latin America. To do so, I graph sectoral employment shares and value added by industry against GDP per capita. Each country's time frame varies depending on data availability. Employment shares are expressed as a percentage of total employment, while value added is reported in local currency terms, adjusted to 2005 prices.

2.1 Hong Kong

We begin with the agricultural sector in Hong Kong. When examining the value-added by the sector and employment, both exhibited a decreasing pattern over the years, aligning well with the expectation of structural transformation theory. Notably, Hong Kong has not been significantly dependent on the agriculture sector since 1974. The share of total employment in the sector never exceeded 3.5% of total employment in the economy and declined over the years, reaching its lowest point of 0.5% in 2022.

Moving to the industry sector, employment doesn't fully exhibit the classical theory of structural transformation, which follows an inverted U-shaped pattern. However, it appears that employment was at its peak in 1974, as it exceeded 50% of the total labor force. From this point onward, the share started declining gradually, reaching its lowest point of 13% by 2022. Such a pattern shows only half of the inverted U-shape trend,

reflecting an elongated contraction rather than a short-term rise followed by a decline. Alternatively, the value-added by the sector exhibited an inverted U-shape, increasing over time until it reached a maximum of 20% of GDP, then starting to decline to 7% by the end of the period.

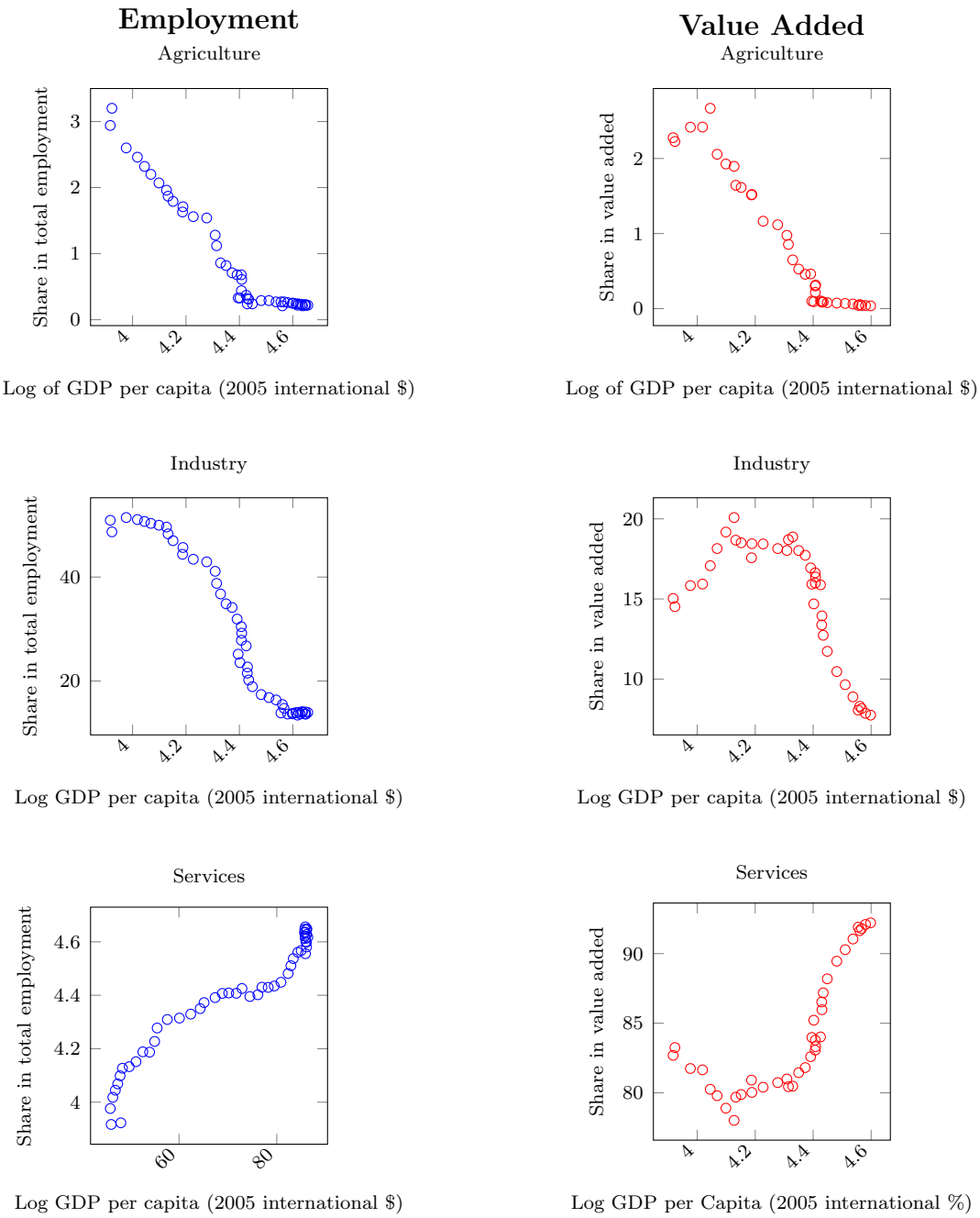

Figure 2.1: Sectoral shares of employment and value-added for Hong Kong. Source: Appendix A. Years: Employment Data 1974 - 2022, Value-added: 1974 – 2011

Finally, the services sector follows the structural transformation theory for both its

share in total employment and value-added. Employment share increased persistently from 48% in 1974 to around 85% in 2022. A similar trend is observed in value-added, as it rose from 82% in 1974 to 92% by the end of the period. However, a deviation occurred during the mid-period, as value-added declined, creating a U-shape. Such a reduction in the value-added by the service sector is not visible when examining value-added at current local prices. In that case, the increase was uninterrupted, with no negative shocks throughout the entire period.

2.2 Korea

Figure (2.2) examines changes in sectoral employment over time. Korea's transformation largely aligns with structural transformation theory. Starting with the agricultural sector, employment was highly concentrated in this sector, with over 60% of the labor force engaged in it during the early stages. This share followed a steady decline over the years, reaching a minimum of 5As for employment in the industrial sector, it follows a trajectory that reflects an initial increase during the early stages of economic development—from 11% to 35%—before gradually declining to 25% by the end of the period. This trend is consistent with the inverted U-shape characteristic of industrialization, signaling an initial rise as industries expand, followed by a decline as services become the dominant sector in the economy.

Moving to the value-added by sector, the agricultural sector experienced a steep decline in its contribution to GDP, dropping from 25% at the early stages of development to below 5% by the end of the period—which aligns well with structural transformation theory. Opposite trends are observed for both the services and industrial sectors. When measuring industrial value-added at constant 2005 local prices shows a steady upward trend in the industrial sector, increasing from 7.5% in the initial year to a peak of 46% in 2011. Nonetheless, when considering value-added at current prices, the trend shifts—it increases over time, followed by a period of stabilization, forming an incomplete U-shape. The services sector deviated from the norm by declining over time. Unlike typical devel-

opment expectations, its value-added decreased from 75% at the beginning of the period to 50% by the end. However, when using current prices instead of constant 2005 prices, the trend changes: the services sector shows an increasing trend, starting from a low percentage point and gradually rising as economic development progresses.

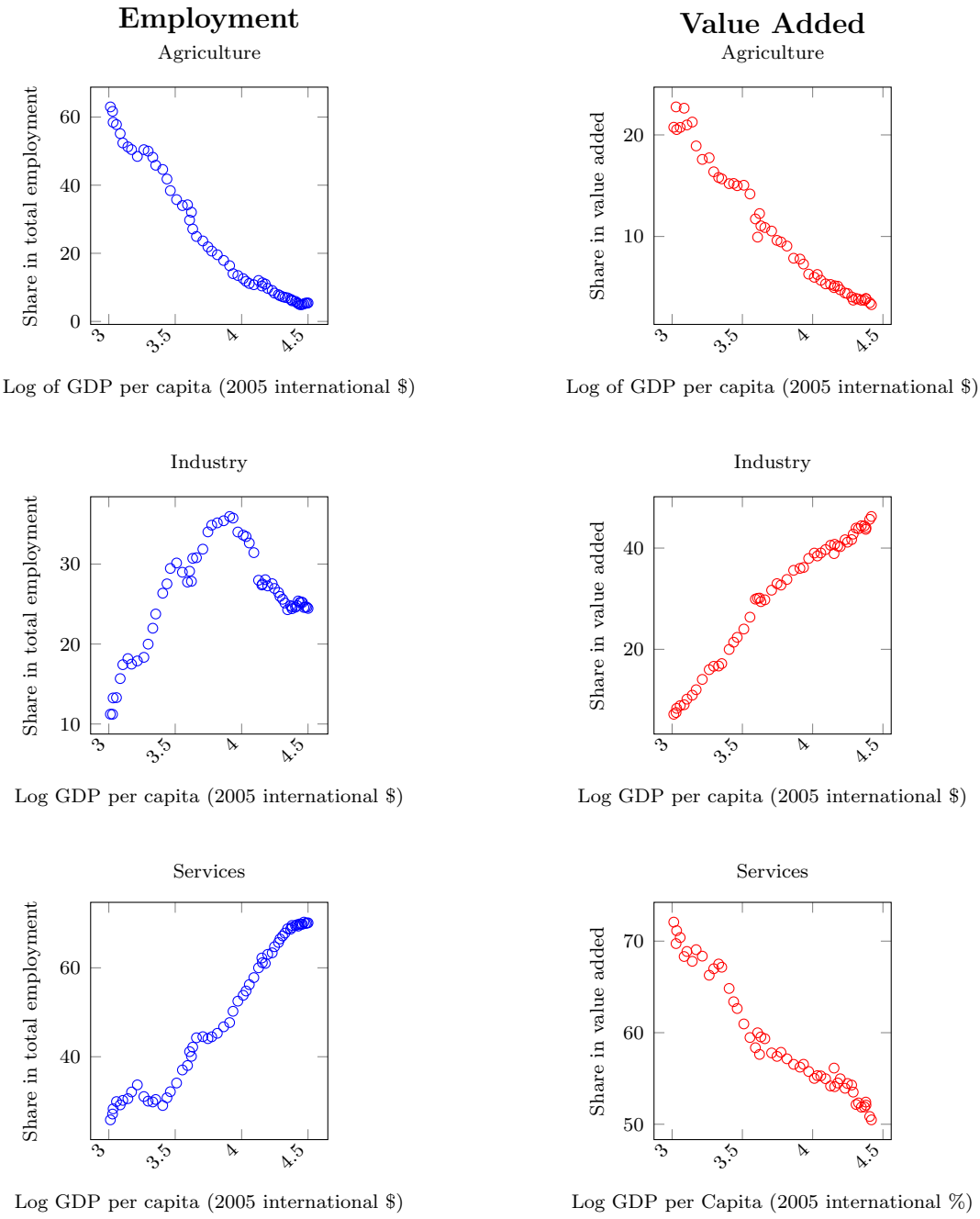

Figure 2.2: Sectoral shares of employment and value-added for Korea. Source: Appendix A. Years: Employment Data 1960 - 2022, Value-added: 1960 – 2011

The services sector deviated from the norm by declining over time. Unlike typical development expectations, its value-added decreased from 75% at the beginning of the

period to 50% by the end. However, when using current prices instead of constant 2005 prices, the trend changes: the services sector shows an increasing trend, starting from a low percentage point and gradually rising as economic development progresses.

2.3 China

Over a period of 72 years, Chinese GDP per capita has been associated with a permanent decline in both the employment share and value-added contribution of the agricultural sector. Starting with employment, the share declined substantially—from accounting for 85% of total employment at the beginning—to just 22% by 2022, marking a 53% drop. Similarly, the sector's value-added experienced a major reduction in its contribution to the economy, dropping from 68% in 1960—when the sector was the backbone of the economy—to less than 10% by 2011. Such a trend aligns well with the literature on structural transformation: a gradual shift of employment and value-added toward other sectors as economies develop.

Conversely, as GDP per capita increased, both employment and value-added in the industrial sector expanded. In 1960, the share of employment didn't exceed 9%; by 2022, it had risen to over 30%. Similarly, value-added grew from 10% to 56% over the same period. It is worth pointing out that such behavior diverges from classical structural transformation theory, which predicts a U-shaped trend—indicating that industrial shares should eventually decline as the services sector takes over. These trends suggest that China remains in its transformation process, as the industrial sector still plays a central role in economic progress.

Turning to the services sector, its trends closely follow GDP per capita growth. The employment share steadily rose from 6.5% in 1960 to 45% in 2022, making this sector dominant in the labor market, with the highest share of employment in the economy. As for value-added, it also expanded—increasing from 21% in 1960 to 33% in 2011. Though this trend aligns with economic theory, the data suggests that the economy remains heavily industrialised, as the industrial sector still contributes the most to GDP. It is clear that the Chinese economy continues to be dominated by the industrial sector, while

the services sector plays a secondary role—despite leading in employment share.

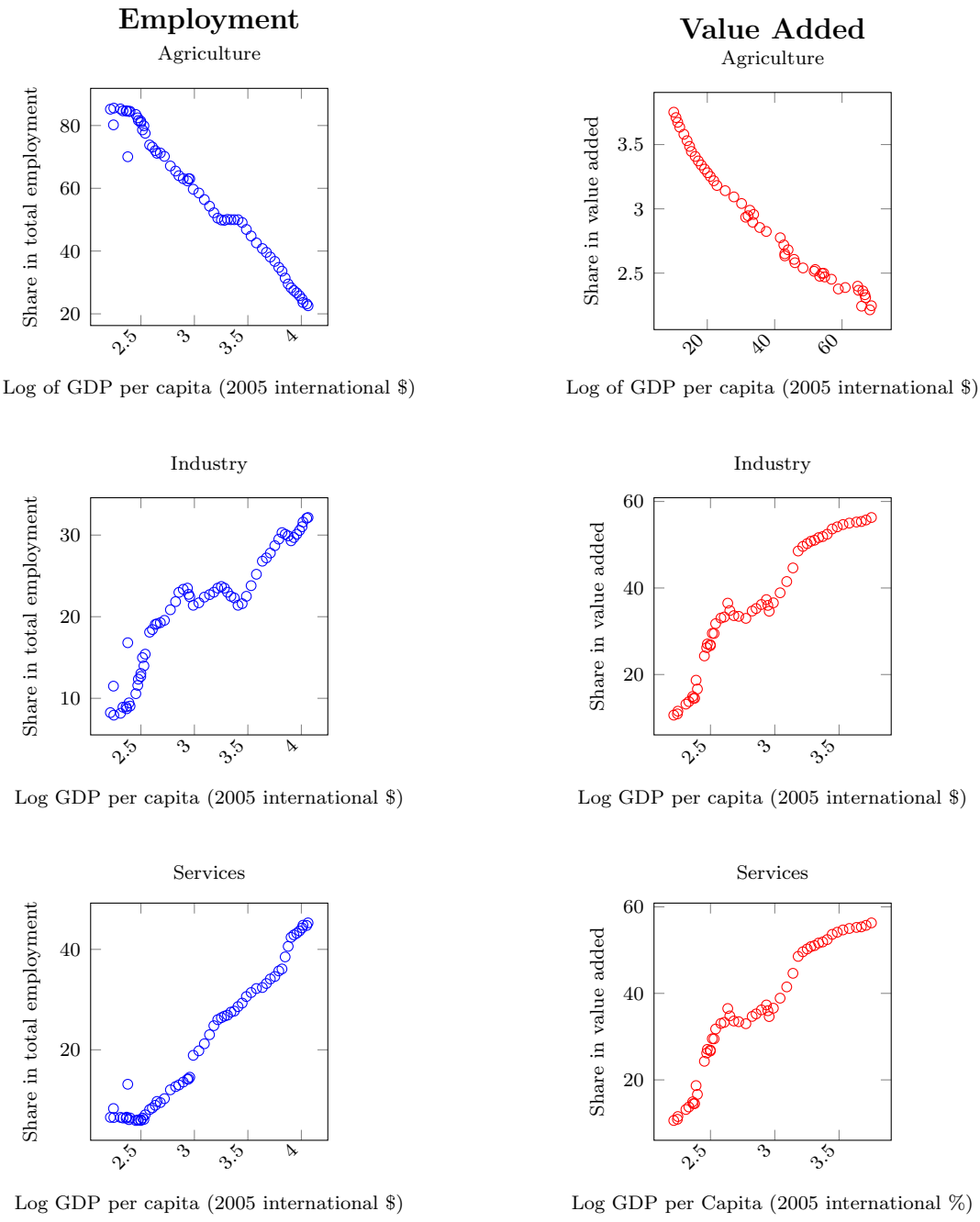

Figure 2.3: Sectoral shares of employment and value-added for China. Source: Appendix A. Years: Employment Data 1960-2022, Value-added:1960–2011

2.4 Singapore

Figure (4) presents the case of Singapore, tracing both value-added and employment shifts over time in relation to GDP per capita growth. Starting with changes in em-

ployment, the agricultural sector's employment share exhibited a steady decline as GDP per capita increased—aligning well with the literature. Remarkably, the sector's share of total employment did not exceed 4% throughout the entire period, indicating how little

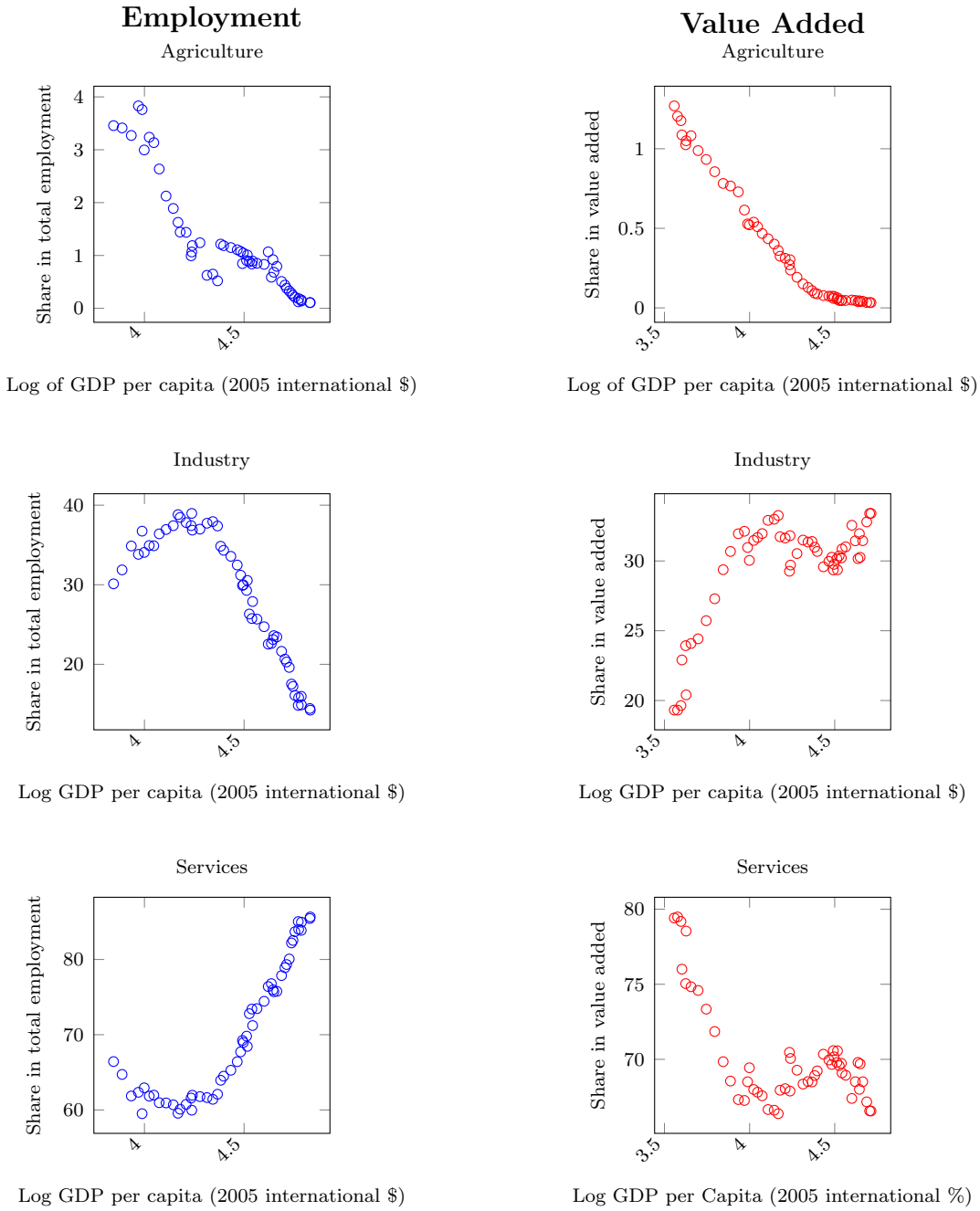

Figure 2.4: Sectoral shares of employment and value-added for Singapore. Source: Appendix A. Years: Employment Data 1960 - 2022, Value-added: 1970 – 2012

the sector played a role in the labor market. In contrast, the services sector experienced a steady increase in its share of total employment. In the early years, around 70% of the total labor force was employed in the sector; by the end of the period, this number

had surpassed 85%, showing how the sector became dominant in terms of employment. For the industrial sector, the pattern is consistent with economic development, showing an initial increase in employment before declining around the mid-period, forming an inverted U-shape.

For value-added, the agricultural sector followed a similar pattern to employment, declining as GDP per capita rose over time. In percentage terms, value-added didn't exceed 1.4% in the early years and dropped to nearly 0% by the end of the period, confirming once again the marginal role of the sector in Singapore's economic progress.

The industrial and services sectors both exhibited unexpected trends when using GDP per capita in 2005 constant local prices. Starting with the industrial sector, value-added continued to increase with GDP growth, rising from 20% to 35%. However, when measured in current prices, the relationship between GDP per capita growth and value-added followed an inverted U-shape . For the services sector, a negative relationship appears between value-added and GDP per capita in 2005 constant prices, with the share dropping over time by approximately 24 percentage points. However, when using local current prices instead, an increasing trend in value-added emerges.

2.5 Mexico

Figure (2.5) presents the Mexican case. Starting with employment in the agricultural sector, the share of people employed in the sector declined steadily as GDP per capita increased over time, aligning well with structural transformation theory. In the early stages, the agricultural sector dominated employment, with more than 55% of the labor force employed in it. Its share dropped over time to below 15%, reflecting a shift to other sectors.

As for the industrial sector, employment rose in relation to GDP per capita, peaking at 33% before dropping to 23% by the end of the period—a lower level than its starting point in 1965. Although the overall trend does not clearly show an inverted U-shape, it still aligns with the theory of increasing to a certain threshold before declining again.

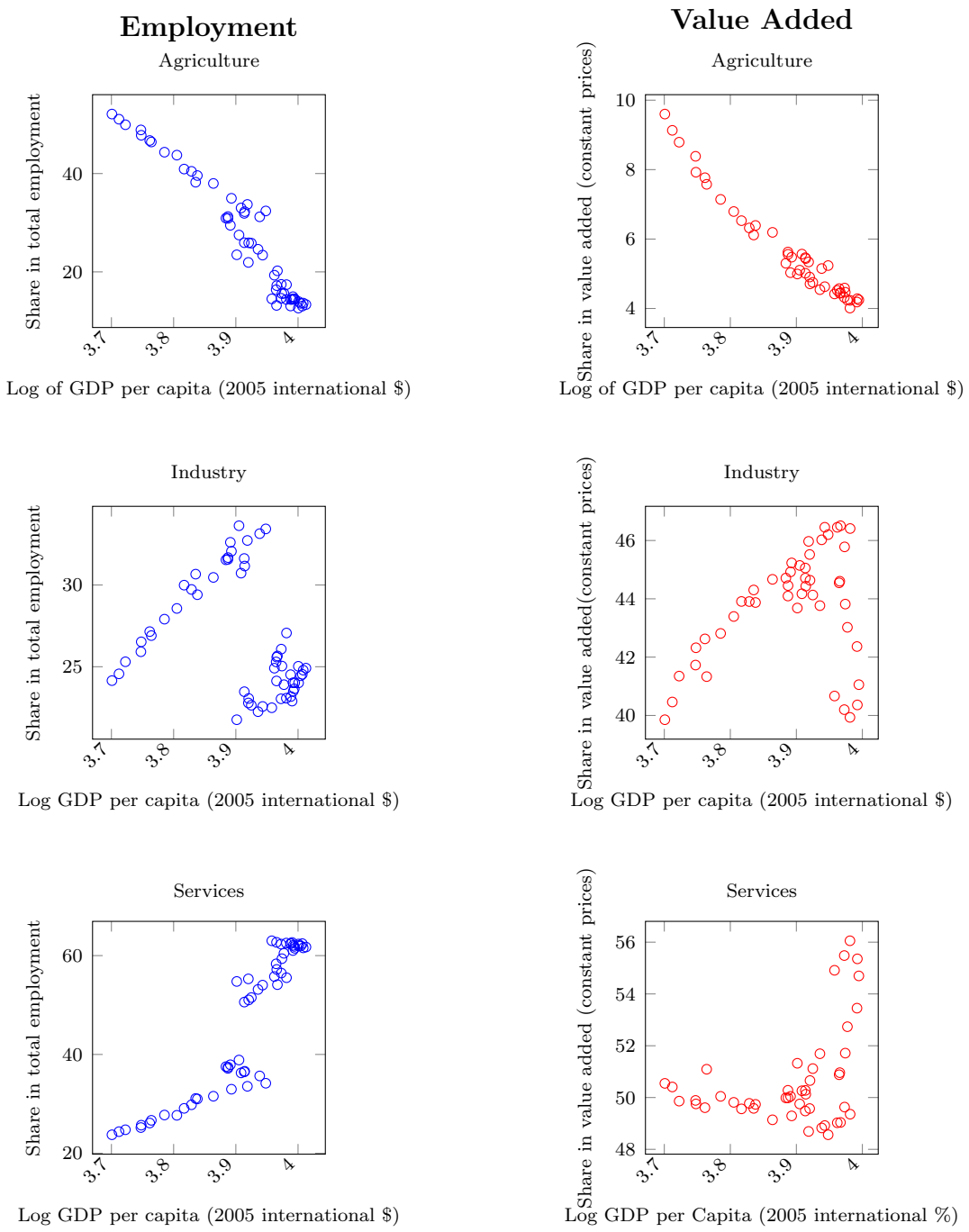

Figure 2.5: Sectoral shares of employment and value-added for Mexico. Source: Appendix A. Years: Employment Data 1965 - 2022, Value-added: 1965 – 2011

For the services sector, the trend between employment and GDP per capita growth followed the economic literature. The sector's share of the labor force rose from 22% to more than 65% toward the end of the period, making it increasingly prominent in the labor market.

Turning to value-added, both agriculture and industry align well with economic trans-

formation theory. For the agricultural sector, value-added (measured at constant 2005 prices) dropped from 10% to around 5% toward the end of the period. Despite its dominance in employment during the early stages, its value-added remained relatively low—raising questions about productivity levels within the sector.

The industrial sector exhibits a clear U-shaped pattern, with value-added rising alongside GDP per capita before declining again. Finally, for the services sector, value-added fluctuated between 50% and 52% for more than half of the period. However, toward the end, it rose and stabilized around 57%, indicating an expansion in the sector's contribution.

2.6 Colombia

Figure (2.6) plots the employment share and value-added by sector for Colombia. Starting with the agricultural sector, both employment share and value-added exhibit a negative correlation with GDP per capita growth. Employment in the sector dropped from 48% to 15%. Similarly, value-added (measured in 2005 constant prices) declined from 15% to 8%. Both trends reflect structural transformation theory, characterized by a decline in the role of the agricultural sector.

Moving to the industrial sector, it appears that the trend in both graphs showed two inverted U-shaped curves characterize the industrial sector. Such a trend indicates that the labor share increased alongside economic development, peaked, and then decreased to reach a minimum. Unlike most cases, once the labor share dropped to its minimum level, it began to rise again over time, forming an arc-like pattern that reached a new peak before declining once more. Similar behavior is also visible in value-added. In the early years, the share increased from 36% to 38.5%, then dropped below 36%. Another phase followed, as value-added rose again to around 41% before stabilizing at approximately 36For the final sector, employment in the services sector maintained a steady upward trend over 57 years, rising from 35% in 1965 to 65% in 2022. The value-added share of the sector also followed an increasing trend, growing by 6%. However, the increase in value-added by the services sector was interrupted around the mid-period, where it

declined. It is worth noting that this drop occurred during the same period when the industrial sector experienced its second peak.

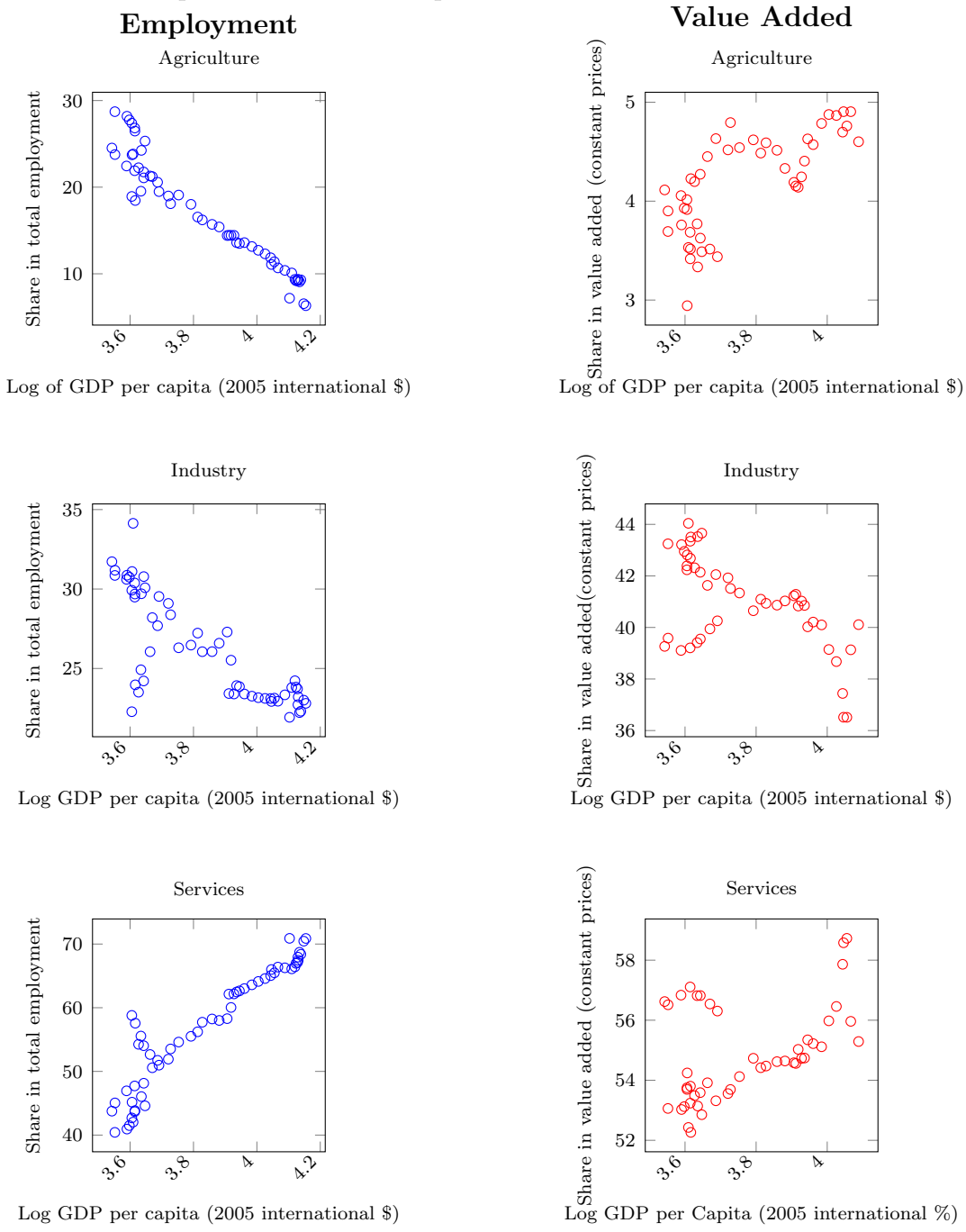

Figure 2.6: Sectoral shares of employment and value-added for Colombia. Source: Appendix A. Years: Employment Data 1965 - 2022, Value-added: 1965 – 2012

2.7 Chili

Figure (7) examines the agricultural sector. The share of employment in this sector dropped sharply from 29% of total employment to around 5% as GDP per capita rose.As

for value-added, the relationship with GDP per capita growth did not follow the expected negative correlation. Instead, the graph exhibited an arc-shaped trend with fluctuations over time. However, it is worth noting that the minimum value-added remained around 3% and never exceeded 5% throughout the period.

Moving to the industrial sector, the relationship between value-added and GDP per capita followed an inverted U-shaped pattern, consistent with structural transformation theory. Similarly, employment dropped from 31% to 22%, showing a shift away from industrial jobs as the economy evolved.

As we move to the services sector, it has dominated the labor market since the early years—starting with more than a 40% share of total employment and rising to over 70% by the end of the period. A similar pattern is observed in value-added: it began at 53% of GDP and gradually increased to 58% by 2011, reinforcing the sector's role in the country's economic growth.

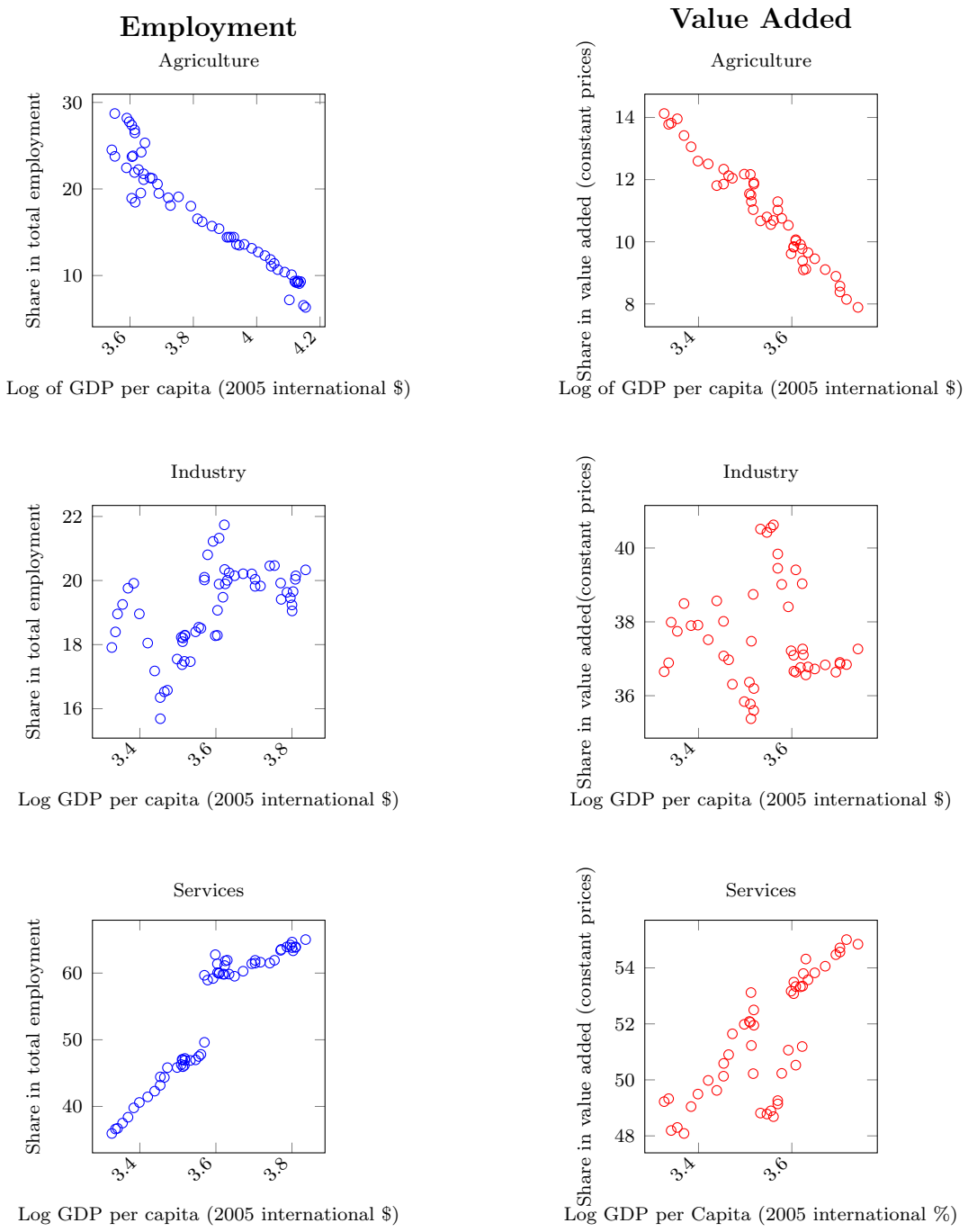

Figure 2.7: Sectoral shares of employment and value-added for Chili. Source: Appendix A. Years: Employment Data 1965 - 2022, Value-added: 1965 – 2012

2.8 Argentina

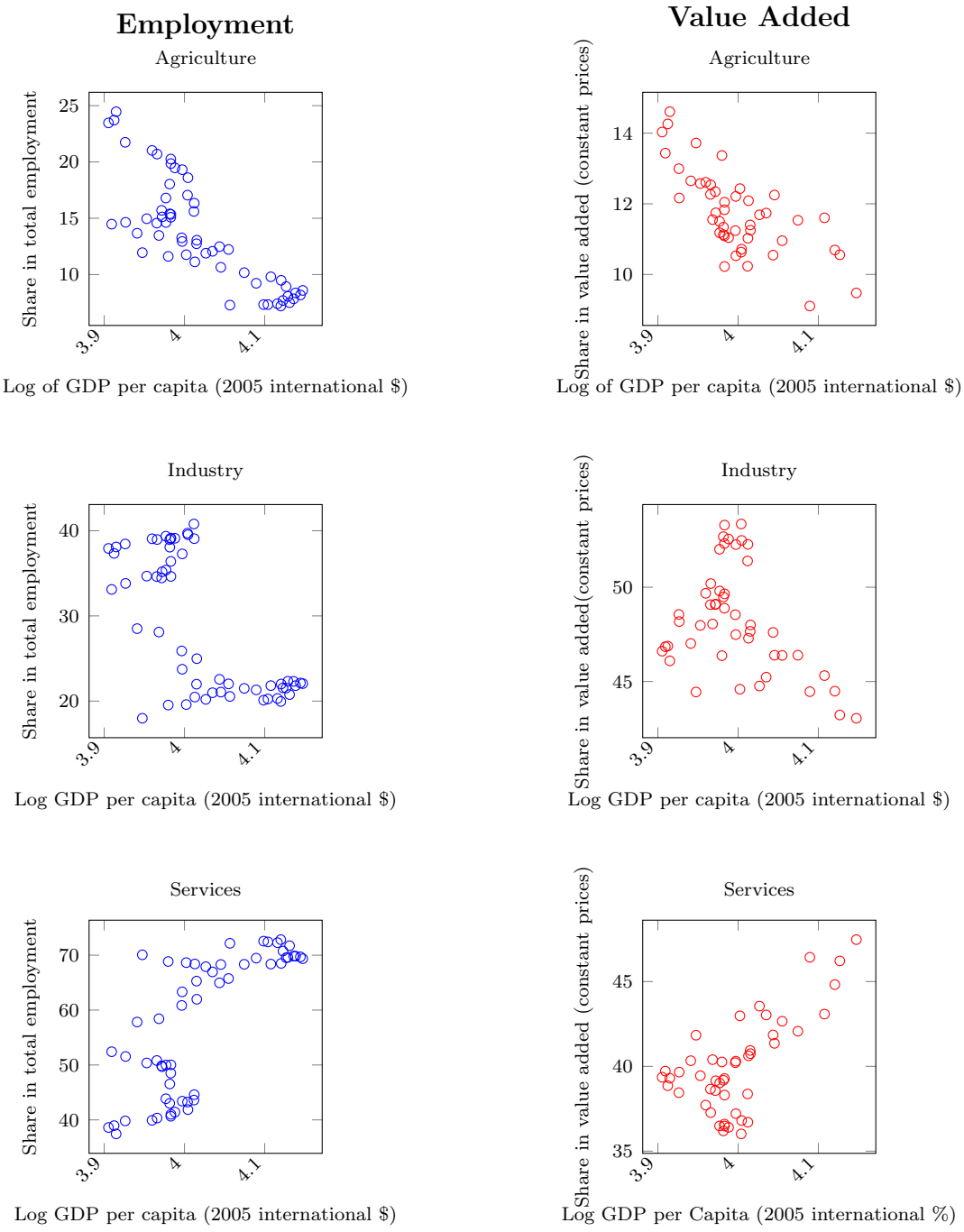

Figure 2.8: Sectoral shares of employment and value-added for Argentina. Source: Appendix A. Years: Employment Data 1965 - 2022, Value-added: 1965 – 2011

When plotting the share of employment by sector relative to log GDP per capita, the agricultural sector in Argentina closely followed economic theory, showing a decline in employment share as GDP increased. Over the years, agricultural employment declined by 15 percentage points, dropping from 24% in 1965 to around 9% in 2022. Similarly,

value-added decreased from 14% in 1965 to below 10As for the industrial sector, value-added followed an inverted U-shape—rising from 46% to a peak of 54% before shrinking again to 44% by the end of the period. Regarding the employment share, although the plot didn't exhibit a clear arc shape, it still declined from 38% in 1965 to around 22%, reflecting a shift of labor away from the sector.

For the services sector, employment dominated the labor market over the observed years. In 1965, the sector accounted for 38% of total employment and increased to around 70% by 2022. As for value-added, it also followed an upward trend, rising from 39% to 48% by the end of the period. Although this increase positioned the sector as the largest contributor to GDP, the gap with the industrial sector remained small—at just 4 percentage points. In contrast, in terms of labor share, the services sector surpasses the industrial sector by around 50 percentage points, raising questions about labor productivity differences between the two sectors.

2.9 Brazil

In the Brazilian agricultural sector, employment dropped significantly as GDP per capita increased. In the early years, around 57% of total employment was in agriculture, while this number fell to below 10% by the end of the period. Similarly, the value-added by the sector declined from approximately 13% in 1965 to below 8% in 2011. This discrepancy—a large workforce (57%) contributing only 13% to GDP—raises important questions about productivity in the sector.

For employment changes in the industrial sector, a pattern similar to the Colombian case emerges, with repetitive inverted U-shaped curves observed. Initially, employment in the sector rose alongside the increase in GDP per capita before declining again. Once it reached a minimum, the same sequence repeated, creating new peaks and troughs over the years.

A similar pattern may be observed when tracing changes in the industrial sector's value-added share—initially increasing over time to reach a peak, then declining, with this pattern repeating throughout the period. In terms of numbers, the overall change

between the starting and ending points is relatively minor: value-added stood at 36.5% in 1965 and rose slightly to just above 37% by 2011. For the last sector, employment in the

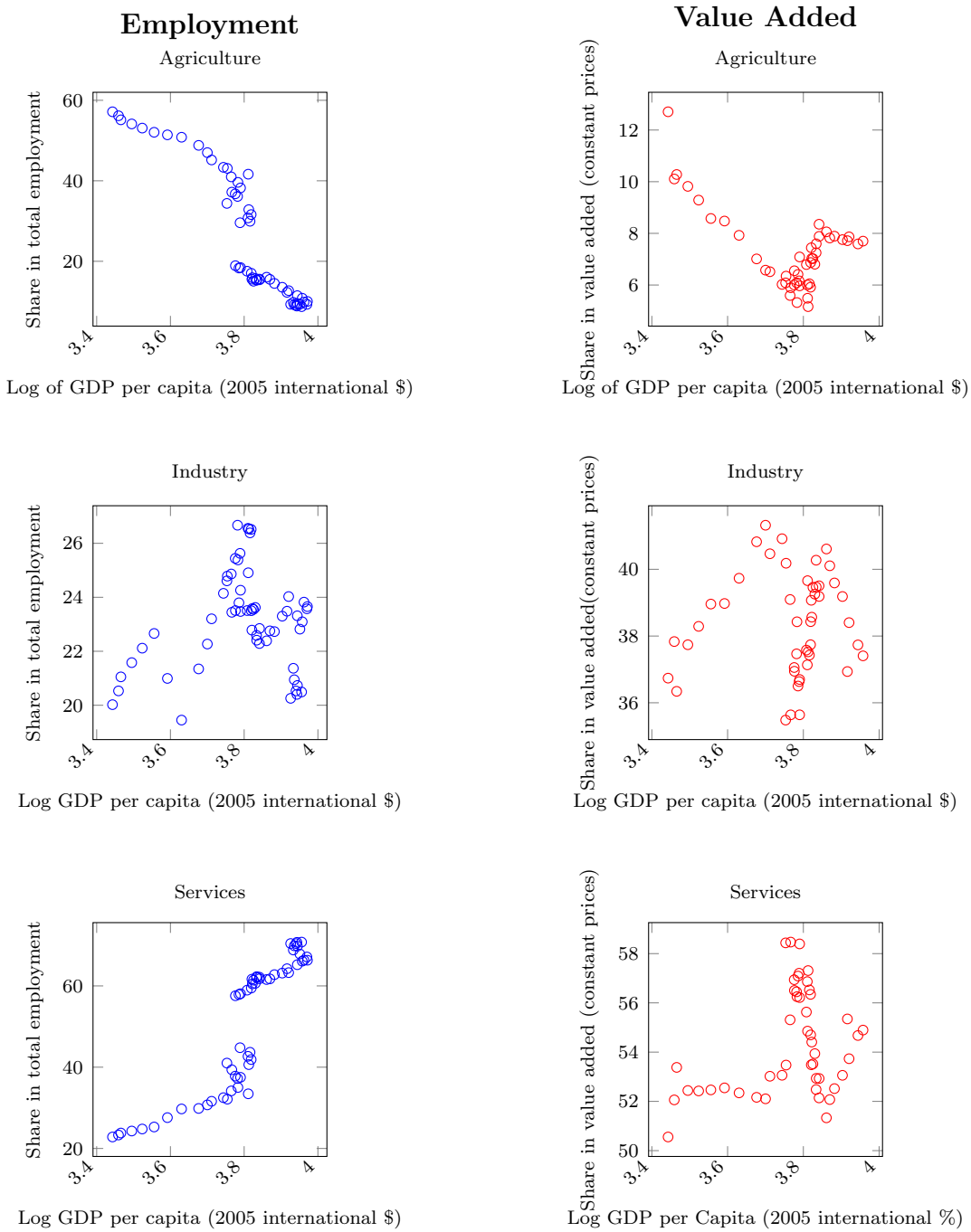

Figure 2.9: Figure x.x: Sectoral shares of employment and value-added for Brazil. Source: Appendix A. Years: Employment Data 1965 - 2022, Value-added: 1965 – 2011

services sector increased over 66 years, indicating a significant expansion of approximately 50 percentage points between 1965 and 2022. As for the value-added by this sector, the trajectory did not follow expectations precisely. For nearly one-third of the period, the

sector's value-added remained relatively stable, fluctuating between 53% and 59% before stabilizing at 55% by 2011.

2.10 South Africa

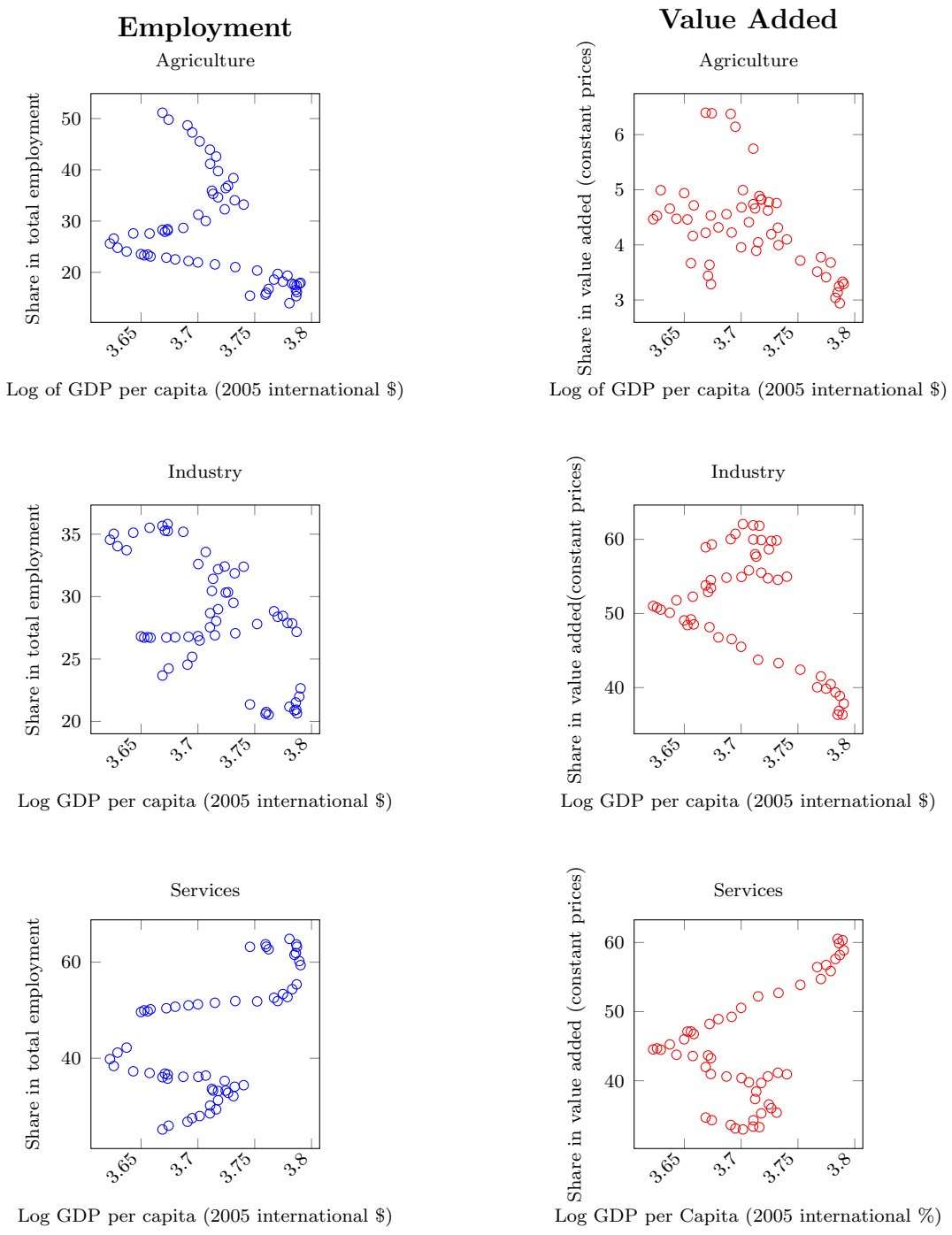

Figure 2.10: Sectoral shares of employment and value-added for South Africa. Source: Appendix A. Years: Employment Data 1960 - 2018, Value-added: 1960 – 2011

Figure (2.10) examines sectoral trends in South Africa. Starting with the share of employees in the agricultural sector, while the trend includes fluctuations, a declining trajectory

is evident when comparing the starting and ending points, as the employment share fell from 25% to approximately 17%. A similar pattern is observed in the industrial sector: the share of employment initially rose to a peak before declining again. In terms of numbers, the share declined from 35% to 22%. In the case of services, there is no clear upward trajectory due to significant fluctuations; however, the sector experienced a steady increase overall, with its share of total employment rising by more than 20 percentage points—from 40% to around 60% by the end of the period.

Moving to value-added, even though employment in agriculture exceeded 50% during certain periods, the sector's value-added remained limited—consistently less than 7% and declining from 4% to 3% over time. In the industrial sector, a clearer trend emerges, with value-added declining from 50% to below 40%. A slight hump-shaped trajectory is visible, indicating that the proportion initially increased before declining, forming the expected inverted U-shape. For the services sector, a strong upward trend is evident, positioning it as the dominant sector in South Africa. Value-added rose from 43% to 60%, highlighting the sector's growing economic role.

2.11 Ethiopia

Starting with employment share in the Ethiopian agricultural sector, the proportion of total labor in this sector declined from around 80% to around 60% (Figure 2.11). Although the decline over the years is significant—approximately 20 percentage points—the sector remains dominant in terms of labor allocation.

Moving to the industrial sector, employment exhibits an inverted U-shaped trend, as the share increased with GDP per capita growth, reached a peak, and then declined. However, this sector remains relatively insignificant in the labor market, as its share of total employment never exceeded 9% over the years. In contrast, the services sector in Ethiopia followed a different trajectory. The share of total employment in the sector doubled, rising from 15% to around 32% by the end of the period. This increase indicates that the services sector gained greater importance in the labor market and was able to absorb more workers over time.

As for value-added, the relationship with GDP per capita does not follow a clear

trend aligned with economic development theory. For the agricultural sector, overall value-added declined by more than 20 percentage points, dropping from around 70% to below 50%. However, during certain years, it surged to 85%, indicating fluctuation rather than a consistent downward trend.

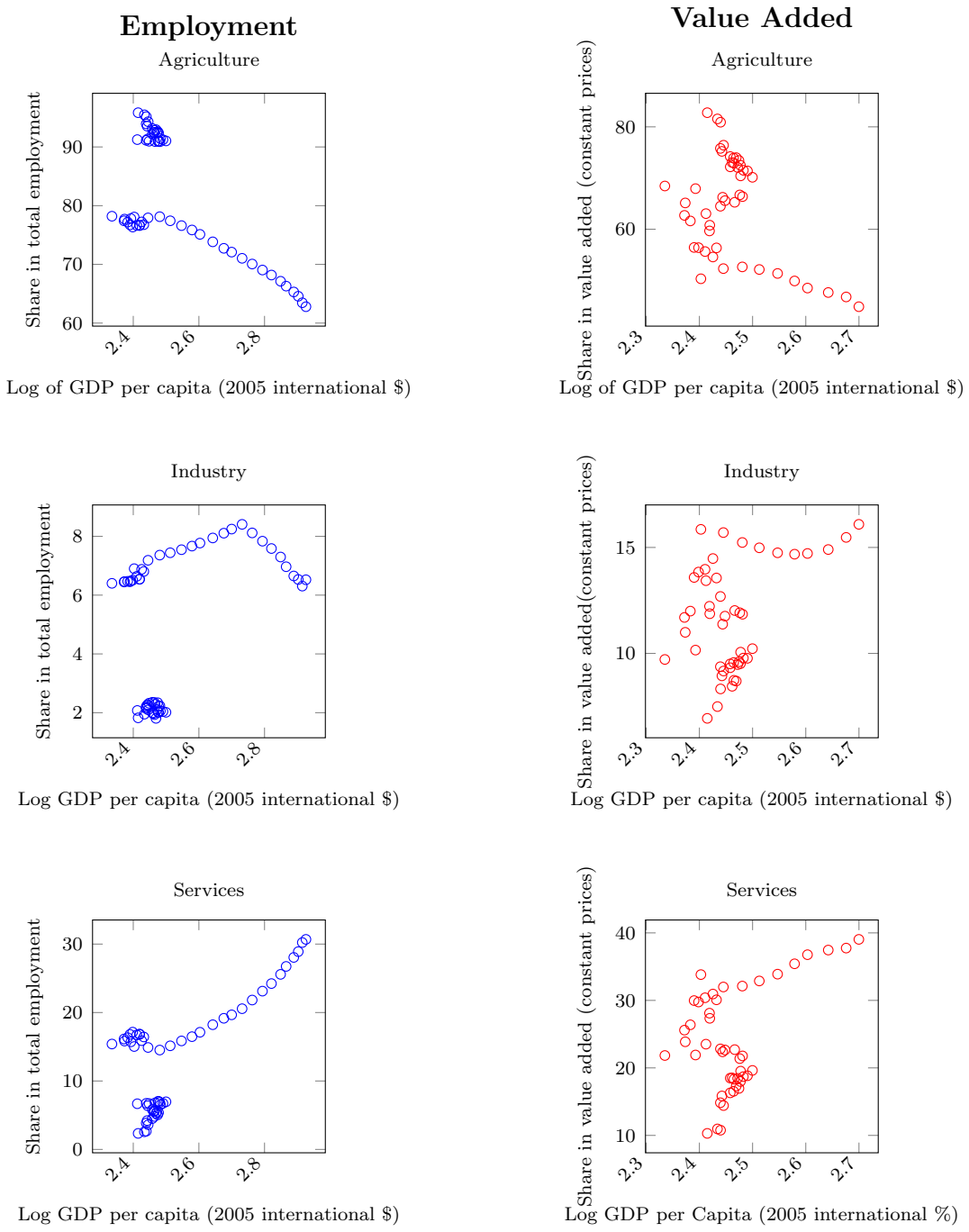

Figure 2.11: Figure x.x: Sectoral shares of employment and value-added for Ethiopia. Source: Appendix A. Years: Employment Data 1964 - 2022, Value-added: 1964 – 2011

As for the industrial sector, the expected inverted U-shape does not appear, as value-

added rose over time from 10% to 16% in 2012, deviating from standard theory and predictions. For the services sector, while the trend was somewhat unclear during the mid-years, value-added significantly increased from 22% in 1965 to around 40% in 2012—enhancing its role in the economy. Overall, the Ethiopian economy remains heavily reliant on the agricultural sector as its primary economic driver. However, the services sector is expanding and contributing increasingly to the development process. In contrast, the role of the industrial sector remains marginal in both employment and value-added.

2.12 Ghana

Moving to Ghana, the agricultural sector historically dominated the labor market, employing more than 70% of the labor force in 1965. By the end of the period, however, this share had dropped to approximately 39%. Such a shift in employment share relative to GDP per capita aligns well with economic development theory, as transformation typically leads to a decline in agricultural employment.

As for the industrial sector, and as seen in other African cases, the relationship between employment share and GDP per capita is less clear. Over the years, the share of laborers in the sector slightly increased from around 12% to 19%. Nevertheless, the trend fluctuated during certain periods; overall, the employment share remained between 10% and 20% throughout the observed period.

In contrast, the services sector showed a more pronounced transformation, similar to the agricultural trend. Over the observed years, the employment share more than doubled, making the sector the largest employer among the three sectors. In percentage terms, the share rose from 20% in 1965 to around 40% in 2022, highlighting its growing role in the country's labor market.

As for value-added to GDP, the agricultural sector's share declined over the years, falling from approximately 46% to below 30%. On the other hand, the services sector's value-added share increased during the same period, rising from 30% to approximately 41%. For the industrial sector, the relationship between value-added and GDP per capita remained ambiguous, with overlapping values throughout the period. However, the sector's share gradually increased from 25% to approximately 31%, reaching a peak of 39%

at one point.

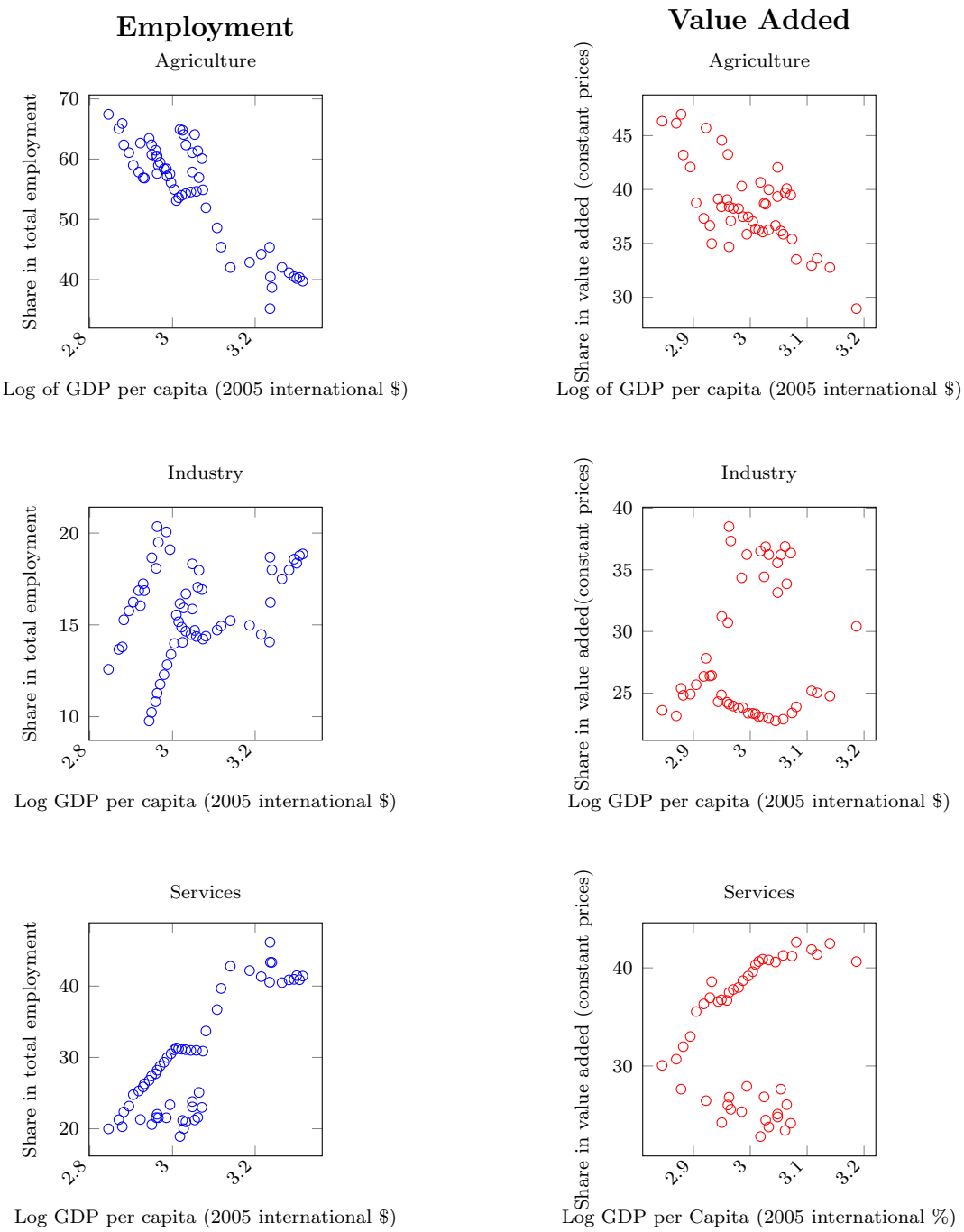

Figure 2.12: Sectoral shares of employment and value-added for Ghana. Source: Appendix A. Years: Employment Data 1965 - 2022, Value-added: 1965 – 2011

2.13 Kenya

Starting with the relationship between agricultural employment and GDP per capita growth in Kenya (Figure 13), the trend aligns well with the structural transformation literature. Over the years, the share declined from 83%—when it dominated the labor

market—to around 31% in 2022. In contrast, the case of the services sector followed the expected trajectory but in the opposite direction. The employment share increased from 10% in 1965 to more than 50% in 2022, making the sector the largest employer in the market. As for the industrial sector, and as expected after analyzing different African countries, the share rose from 5% to approximately 16%. However, contrary to typical theory, the data does not exhibit an inverted U-shape; the trend does not rise, peak, and then decline as usual.

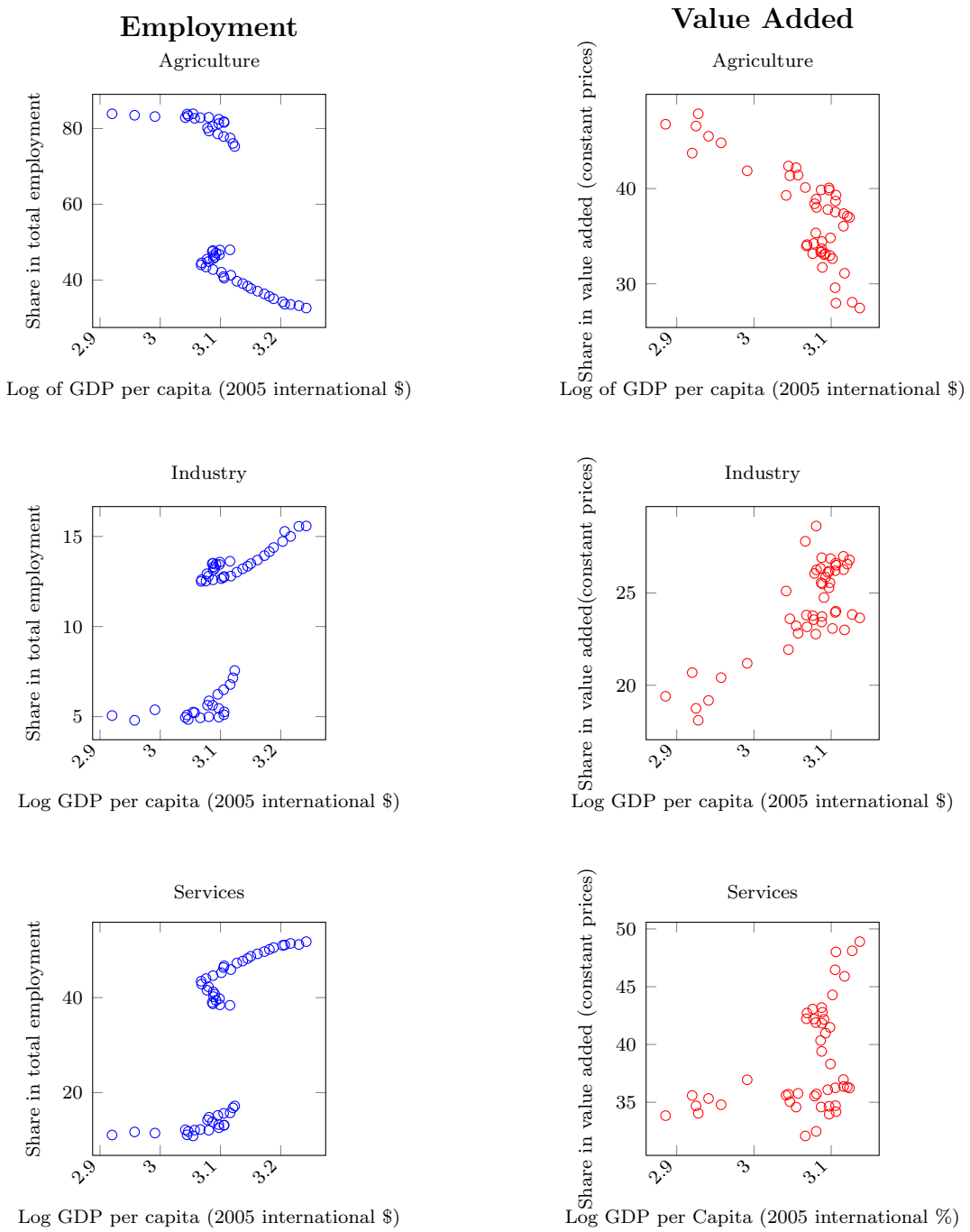

Figure 2.13: Sectoral shares of employment and value-added for Kenya. Source: Appendix A. Years: Employment Data 1965 - 2022, Value-added: 1965 – 2011

Moving to sectoral value-added contributions to GDP, the agricultural sector's share declined steadily over the years, from 48% to less than 30% between 1965 and 2012. From a different perspective, the services sector's share increased over the years, rising from 33% to around 50%, making it the leading sector in terms of contribution to Kenyan GDP. The industrial sector's value-added share also followed an upward trend, increasing by 5% from 20% to 25% over the years. Despite this slight increase, the industrial sector remained the smallest contributor to GDP, while the services sector dominated the economy.

2.14 Nigeria

Starting with employment in the agricultural sector, the relationship between labor share and log GDP per capita in Nigeria (Figure 2.14) aligns well with economic theory. Over the years, the share dropped from 74% in 1965 to less than 40% in 2022. Conversely, the services sector followed the opposite trend, with its share of total employment increasing from 20% to 50% over the same period. Such a shift positioned the sector as the dominant one in terms of employment. For the industrial sector, the share continued to rise from 7% to around 12% by the end of the period. Despite this 10% increase, industry remained the smallest in terms of employment, ranking third after agriculture and services.

Moving to value-added shares, over the years, the agricultural sector's value-added dropped from 70% to around 40%. In certain years, the share fell below 30%, but by the end of the observed period, it stabilized at 40%. For the industrial sector, although it doesn't exhibit the expected inverted U-shape, value-added increased from 15% and peaked above 70%, before settling at 35% in 2012. For the services sector, value-added to GDP remained stable for more than half of the period before rising to around 26 percentage points in 2012.

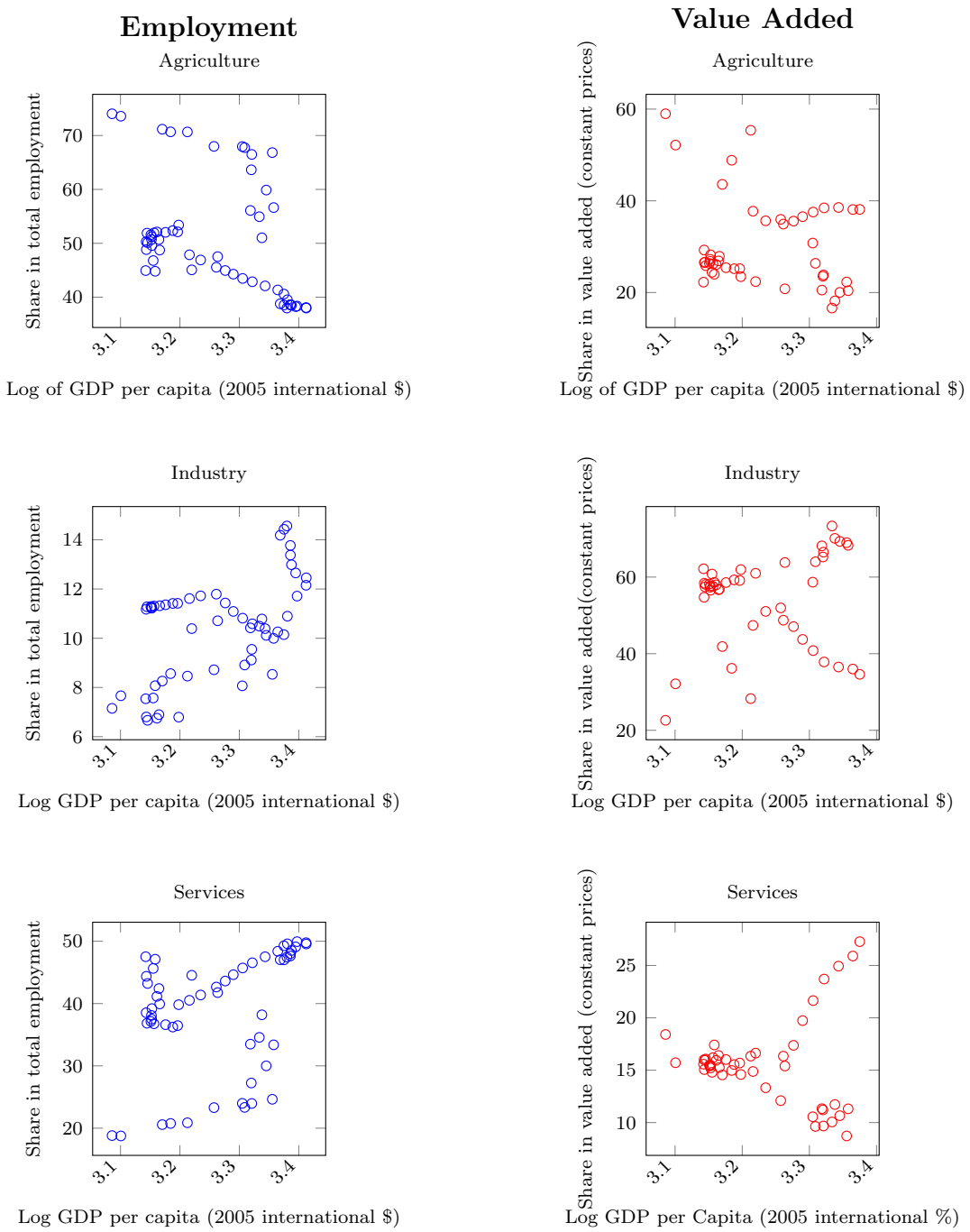

Figure 2.14: Sectoral shares of employment and value-added for Nigeria. Source: Appendix A. Years: Employment Data 1965 - 2022, Value-added: 1965 – 2011

Chapter 3

Economics Environment

Description

Aiming to understand the forces of labor reallocation and structural transformation in our test countries, we follow a simple multisector model, as proposed by Duarte and Restuccia (2007). At each point in time, three goods are produced in the economy: agriculture, manufacturing, and services. As for the forces behind structural transformation, the model assumes that non-homothetic preferences and the elasticity of substitution between services and manufacturing goods differ in one area, which are the main drivers behind the transformation.

3. The Economic Environment

3.1.1 Production:

At each point in time, three goods are produced in the economy: agriculture (a), manufacturing (m), and services (s), following a constant return to scale described by the production function:

$$Y_i \;=\; A_i \, L_i \qquad\qquad i \in \{a, m, s\}$$

Yi stands for output per sector i, Li for labor allocation in sector i, and Ai for technological advancement per sector.

3.1.2 Household:

The model assumes that there are infinitely lived households and normalised to one over time. At each point in time, household supplies one unit of labor to the market, making the labor supply inelastic. While also limiting the total labor share by all sectors, it is capped at 1 at any point in time. As for the utility preference relation for the household, it is described by :

$$\sum_{t=0}^{\infty} \beta^t u(c_t, c_{a,t}), \qquad \beta \in (0,1),$$

Household agricultural consumption is donated by $c_{a,t}$ while services and manufacturing consumption are associated with c_t. As for consumers' preference relation is given by:

$$u(c_a,\, c_t) \;=\; \log\big(c_t\big) \;+\; V(c_a),$$

where c_t is a composite of c_m as manufacturing consumption and c_s as services consumption, and $V(c_a)$ imposes a *subsistence requirement*:

$$V(c_a) \;=\; \begin{cases} -\infty, & c_a < \bar{a}, \\ \min\{\, c_a,\, \bar{a}\}, & c_a \geq \bar{a}. \end{cases}$$

Hence the household must consume *at least* $\bar{a}$ units of agriculture. In equilibrium, it will consume exactly $c_a = \bar{a}$. As for c_t,Non-agricultural consumption is aggregated by:

$$c \;=\; \Big[b\,(c_m)^{\rho} \;+\; (1-b)\,\big(c_s + \bar{s}\big)^{\rho}\Big]^{\frac{1}{\rho}}, \quad \rho < 1,\; b \in (0,1),\; \bar{s} > 0.$$

where $\bar{s}$ is a positive coefficient, $b \in (0,1)$, and $\rho < 1$, implying an income elasticity for services consumption greater than 1. The parameter *sbar* is defined as the constant level of home consumption for service goods.

3.1.3 Firms Problem

As for the firms, we assume that they operate in perfectly competitive markets for both output and inputs. At each point in time, given output prices p_i and wages w, firms in each sector solve their optimization problem as follows:

$$\max_{L_i>0} \ \Pi_i = p_i \, A_i \, L_i \ - \ w \, L_i.$$

where L_i is labor demand by firms in sector i and $L_i \geq 0$.

3.1.4 Household Problem:

As for the household problem, at each point of time and given prices, they choose consumption of goods that maximizes their utility while subjected to their utlity constraint characterised by:

$$\max_{c_i \geq 0} \ \log\Big[\, b \, c_m^{\rho} + (1-b) \, (c_s + \bar{s})^{\rho} \Big]^{1/\rho} \ + \ V(c_a) \, .$$

and are subjected to a budget constraint as their only income is from wages:

$$p_m \, c_m \ + \ p_s \, c_s \ + \ p_a \, c_a = \ 1$$

w is normalised to one.

3.1.5 Market-clearing conditions:

Aiming to create market-clearing conditions in the labor market, the labor demand by firms in the economy must equal labor demand by households at each period while also normalised to 1:

$$L_a \ + \ L_m \ + \ L_s \ = \ 1$$

Given this, Li's are used as labor shares by each sector from the country's data. As for the goods market, the following must be followed in aim to clear the market:

$$c_a = Y_a = A_a\, L_a, \quad c_m = Y_m = A_m\, L_m, \quad c_s = Y_s = A_s\, L_s.$$

3.2 Defining the Competitive Equilibrium:

A competitive equilibrium is a set of prices $\{p_a, p_m, p_s\}$, consumption allocation for household $\{c_a, c_m, c_s\}$, and labor supply by firms $\{L_a, L_m, L_s\}$. Given prices, firms allocate $\{L_a, L_m, L_s\}$ to solve their problem and maximize profits, while households allocate $\{c_a, c_m, c_s\}$ aiming to solve the house hold problem and maximizing their utilities and market clearing conditions follow section (3.1.4).

3.2.1 Sectoral Prices

In perfectly competitive markets, firms choose their labor demand Li aiming to maximizer their profits given:

$$\Pi_i = p_i\, A_i\, L_i - w\, L_i$$

First-order condition w.r.t. L_i:

$$\frac{\partial}{\partial L_i}\left[p_i\, A_i\, L_i - w\, L_i\right] = p_i\, A_i - w = 0$$

Hence:

$$p_i\, A_i = w \quad \Longrightarrow \quad p_i = \frac{w}{A_i}$$

If $w = 1$, **then:**

$$p_i = \frac{1}{A_i}$$

implies an inverse relation between prices and sectoral productivity, higher sectoral productivity A_i, reduces p_i - implying that more efficient sectors can produce cheaper output.

3.2.2 Agricultural Labor Allocation

Because $V(c_a) = -\infty$ for $c_a < \bar{a}$, we must have $c_a \geq \bar{a}$. But the utility from $c_a > \bar{a}$ does not increase further, so the household never wants to consume *more* than $\bar{a}$. Thus

$$c_a = \bar{a} \quad \Longrightarrow \quad \bar{a} \;=\; A_a\, L_a \quad \Longrightarrow \quad L_a = \frac{\bar{a}}{A_a}.$$

This pins down *exactly* how much labor goes to agriculture.

Manufacturing and Services

$$p_m\, c_m \;+\; p_s\, c_s \;=\; 1 \;-\; p_a\, \bar{a}$$

$$p_m\, c_m \;+\; p_s\, c_s \;=\; 1 \;-\; \frac{\bar{a}}{A_a}$$

$$L_a \;+\; L_m \;+\; L_s \;=\; 1$$

$$L_m \;+\; L_s \;=\; 1 \;-\; \frac{\bar{a}}{A_a}$$

Interpretation:

- Agriculture is pinned down by subsistence ($\bar{a}$), hence $L_a = \bar{a}/A_a$.
- Non-agricultural labor $L_m + L_s = 1 - L_a$ is split between m and s via the household's intratemporal condition (*i.e.*, the ratio of marginal utilities must match the ratio of prices).
- Over time, if A_a grows faster than $\bar{a}$ needs, L_a falls. If A_s grows slower or faster than A_m, the ratio L_m/L_s changes accordingly, driving structural transformation.

3.2.3 Solving the household problem

$$\max_{c_s,\, c_m} \big[\log\big(c\big) + V\big(c_a\big)\big]$$

$$\text{subject to} \quad p_a\, c_a \;+\; p_s\, c_s \;+\; p_m\, c_m \;=\; 1.$$

$$\mathcal{L} \;=\; \log\big(c\big) \;+\; \lambda\Big[1 - p_a\, \bar{a} \;-\; p_m\, c_m \;-\; p_s\, c_s\Big] \;+\; (\text{transfer term from } V(c_a)).$$

$$\text{F.O.C.:} \quad \lambda\, p_m \;=\; \frac{\partial\, \log\big(c\big)}{\partial\, c_m} \quad , \quad \lambda\, p_s \;=\; \frac{\partial\, \log\big(c\big)}{\partial\, c_s}.$$

$$c \;=\; \Big[b\,(c_m)^{\rho} \;+\; (1-b)\,\big(c_s + \bar{s}\big)^{\rho}\Big]^{\frac{1}{\rho}}, \quad \rho < 1,\; b \in (0,1),\; \bar{s} > 0.$$

$$\frac{\partial\, \log(c)}{\partial\, c_m} \Big/ \frac{\partial\, \log(c)}{\partial\, c_s} \;=\; \frac{p_m}{p_s}.$$

We know $p_m = \frac{1}{A_m}$, $p_s = \frac{1}{A_s}$. Meanwhile,

$$\frac{\partial\, \log(c)}{\partial\, c_m} \;=\; \frac{b\,\rho\,(c_m)^{\rho-1}}{\rho\left[b\,(c_m)^{\rho} + (1-b)\,(c_s+\bar{s})^{\rho}\right]},$$

and similarly for c_s. Dividing these partial derivatives gives

$$\frac{b\,(c_m)^{\rho-1}}{(1-b)\,(c_s+\bar{s})^{\rho-1}} \;=\; \frac{p_m}{p_s}$$

3.2.4 Preferences over Manufacturing and Services

Beyond the subsistence agricultural good, the household consumes a composite good:

$$c = \Big[b\, c_m^{\rho} + (1-b)\,(c_s+\bar{s})^{\rho}\Big]^{\frac{1}{\rho}},$$

where $0 < b < 1$, $\bar{s} > 0$, and $\rho < 1$. The first order condition (FOC) for the allocation of consumption between manufacturing and services implies

$$\frac{b}{1-b}\left(\frac{c_m}{c_s+\bar{s}}\right)^{\rho-1} = \frac{p_m}{p_s}.$$

Given that the prices are inversely related to productivity, i.e.,

$$p_m = \frac{1}{A_m} \quad \text{and} \quad p_s = \frac{1}{A_s},$$

the FOC becomes

$$\frac{b}{1-b}\left(\frac{c_m}{c_s+\bar{s}}\right)^{\rho-1} = \frac{A_s}{A_m}.$$

Rearrange to isolate the consumption ratio:

$$\frac{c_m}{c_s+\bar{s}} = \left(\frac{A_s(1-b)}{A_m\, b}\right)^{\frac{1}{\rho-1}}.$$

3.2.5 Substituting Production and Market Clearing

Since market clearing requires that

$$c_m = Y_m = A_m\, L_m \quad \text{and} \quad c_s = Y_s = A_s\, L_s,$$

we substitute these into the previous expression:

$$\frac{A_m\, L_m}{A_s\, L_s+\bar{s}} = \left(\frac{A_s(1-b)}{A_m\, b}\right)^{\frac{1}{\rho-1}}.$$

Multiplying numerator and denominator by $1/A_s$ yields:

$$\frac{\frac{A_m}{A_s}\, L_m}{L_s+\frac{\bar{s}}{A_s}} = \left(\frac{A_s(1-b)}{A_m\, b}\right)^{\frac{1}{\rho-1}}.$$

Define

$$x \equiv \left(\frac{b}{1-b}\right)^{\frac{1}{\rho-1}}\left(\frac{A_m}{A_s}\right)^{\frac{\rho}{\rho-1}}.$$

Then, the above relationship can be rearranged to give:

$$\frac{L_s+\frac{\bar{s}}{A_s}}{L_m} = x,$$

or equivalently,

$$L_s = x\, L_m - \frac{\bar{s}}{A_s}.$$

3.2.6. Using the Labor Resource Constraint

Recall that the total labor is normalized:

$$L_a + L_m + L_s = 1.$$

Substitute $L_a = \frac{\bar{a}}{A_a}$ and the expression for L_s:

$$\frac{\bar{a}}{A_a} + L_m + \left(x\, L_m - \frac{\bar{s}}{A_s} \right) = 1.$$

This simplifies to:

$$\frac{\bar{a}}{A_a} + (1+x)L_m - \frac{\bar{s}}{A_s} = 1.$$

Rearrange to solve for L_m:

$$(1+x)L_m = 1 - \frac{\bar{a}}{A_a} + \frac{\bar{s}}{A_s}.$$

Noting that $1 - \frac{\bar{a}}{A_a} = 1 - L_a$, we have:

$$L_m = \frac{(1 - L_a) + \frac{\bar{s}}{A_s}}{1+x}.$$

3.2.7 Final Expression

Thus, the share of labor in manufacturing is given by:

$$L_m = \frac{\left(1 - \frac{\bar{a}}{A_a}\right) + \frac{\bar{s}}{A_s}}{1+x}, \quad \text{with} \quad x = \left(\frac{b}{1-b}\right)^{\frac{1}{\rho-1}} \left(\frac{A_m}{A_s}\right)^{\frac{\rho}{\rho-1}}.$$

The remaining labor in services is then $L_s = 1 - L_a - L_m$.

Chapter 4

Aggregate Labor Productivity

The process of structural transformation and labor reallocation across our countries of interest is well documented in the figure. The reallocation process—from agriculture to manufacturing and from manufacturing to the services sector—is described previously in the literature as a process of structural transformation. This process is characterized by a decline in the agricultural share of employment, a hump-shaped pattern in the share of employment in industry, and an increase in the share of the services sector.

4.1 The behavior of aggregate labor productivity

In this section, we document the economic performance of the countries that will be calibrated against US data. The aim is to observe the forces behind transformation in different regions around the world while comparing them to the US process. Three countries from three different regions are chosen for this analysis. We will document the transformation processes of Mexico, Singapore, and South Africa relative to the US from 1960 to 2011, as well as the individual countries' processes based on the available data for each country.

Aiming to understand the forces behind economic performance, we focused on examining the labor productivity levels of our sample countries in relation to the United States. Figure (number) plots the relative labor productivity of Mexico, South Africa, Singapore, and Hong Kong in comparison to the US. Due to data limitations, the starting year is not consistent across all four countries.

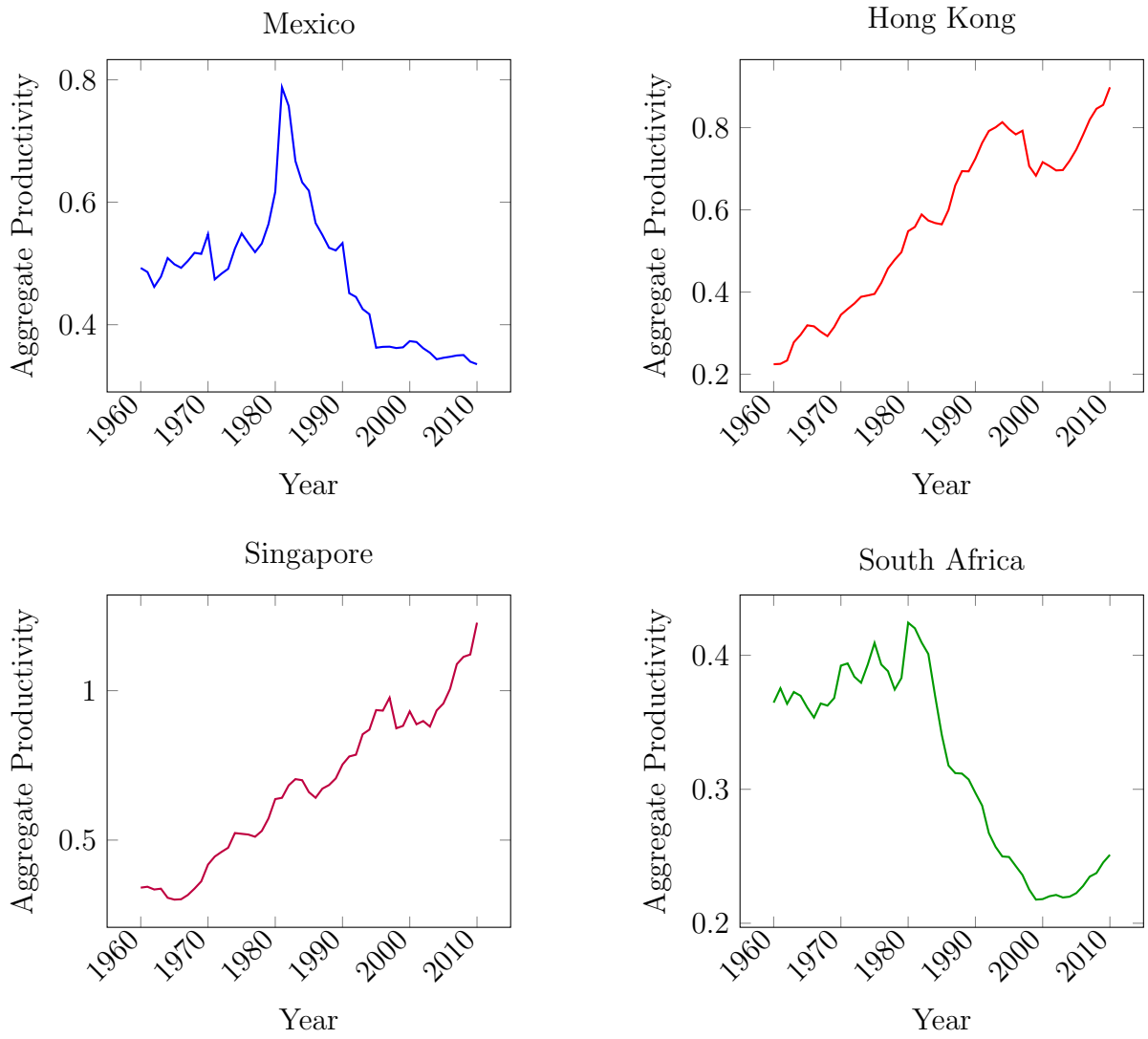

Figure 4.1: Labor productitiy in Mexico,Singapore,Hong Kong, and South Africa relatice to the Unites states. (Note: Labor productivity is GDP per worker from PWT7.1)

Starting with Mexico, over the course of 50 years, labor productivity increased by more than tenfold. This increase can be traced to two distinct periods. From 1960 to the early 1980s, productivity rose from 0.024 to 0.174, before declining again until the mid-1990s. It then rose once more, reaching 0.216 by 2012.

Moving to South Africa, relative labor productivity underwent substantial convergence with the US, increasing from 0.05 to around 0.4 between 1970 and 1996, before declining again. However, this decrease was followed by another rise in relative labor productivity, from 0.11 to 0.32 between 2003 and 2011. The overall increase in relative labor productivity in South Africa was significant, marking a sevenfold improvement over the years.

Moving to the countries in East Asia, the increase in aggregate labor productivity was more significant. Singapore experienced a substantial increase in relative labor productivity, rising from 0.059 in 1970 to around 0.976 in 2010, closely following the US aggregate productivity. It is worth noting that this increase was distorted in the early 2000s, during the tech bubble in East Asia and after the 2008 financial crisis.

Hong Kong, on the other hand, experienced a more sustained increase in its aggregate labor productivity, surpassing the aggregate productivity in the US in the mid-1980s. Ultimately, it reached a relative productivity level three times higher than that of the United States by 2011. Relative productivity in Hong Kong increased from 0.659 in 1974 to more than 3 in 2011.

Mexico's labor productivity experienced a tenfold increase over 50 years, marked by distinct periods of growth and decline, while South Africa showed substantial convergence with the US, reflecting a sevenfold improvement in its labor productivity. In East Asia, both Singapore and Hong Kong exhibited notable increases, with Singapore's productivity aligning closely with the US, and Hong Kong surpassing US productivity levels by 2011.

These findings highlight the diverse paths of economic transformation across different regions, demonstrating the unique challenges and opportunities faced by each country. The next step in this analysis will involve examining the factors that influenced these productivity trends and understanding how policies and external events shaped these outcomes.

Chapter 5

The Process of Structural Transformation:

This section examines the sectoral shifts in labor markets across several countries, focusing on the transformation from agriculture to manufacturing and services. By analyzing these shifts in relation to GDP per capita growth, we aim to explore the underlying forces driving structural transformation. Figures (5.1) and (5.2) illustrate the changes in employment shares across agriculture, manufacturing, and services sectors in the United States, Mexico, South Africa, Singapore, and Hong Kong from the mid-20th century to the present day. The data reveals how each country's economic development follows distinct trajectories, with labor reallocation occurring at different paces depending on regional and historical factors.

5.1 Structural Transformation in the United States

Each country experienced structural transformation at a different time. Figure (5.1) plots the share of employment across the three economic sectors in the United States between 1929 and 1960, while the remaining years are covered in Figure (5.2). The changes in employment share between agriculture, manufacturing, and services are consistent with the common structural transformation process discussed in both the literature and the previous section of this research. In 1929, the shares of employment in agriculture, manufacturing, and services were 18.9%, 30.4%, and 50%, respectively. By 1960, these shares

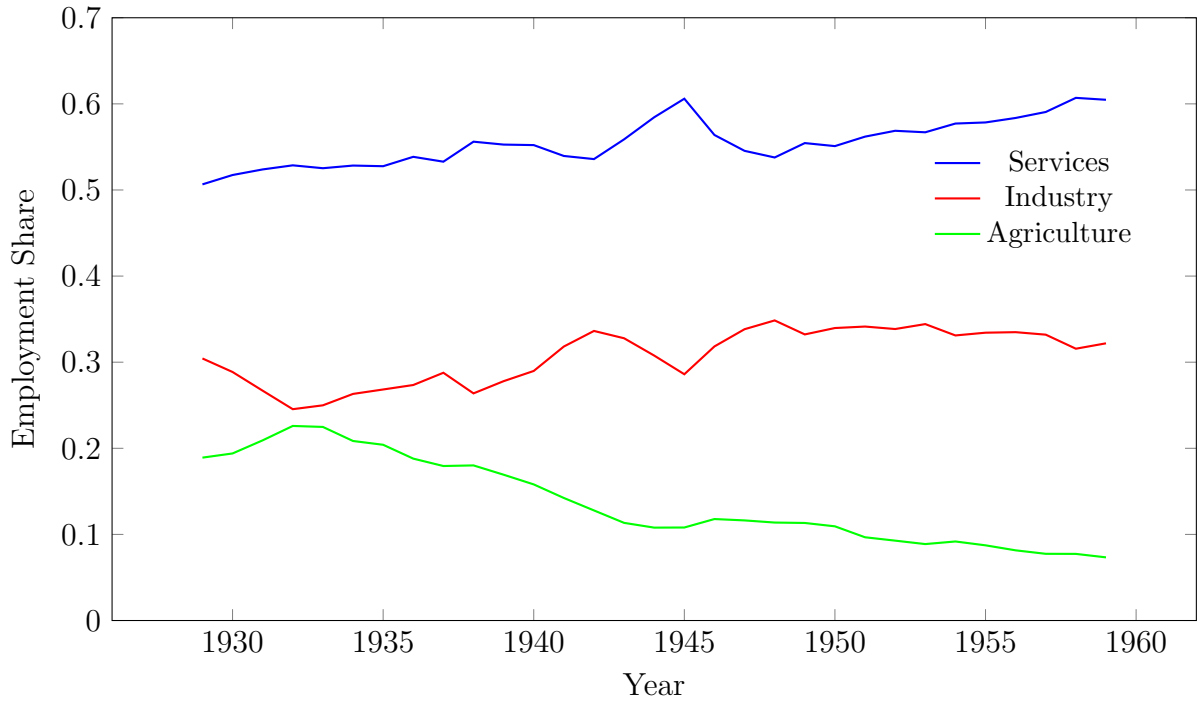

Figure 5.1: US Employment Shares (1929–1969)

had shifted to 6.96%, 31.8%, and 61.18%, respectively. The process of structural transformation continued in the form of sectoral reallocation, as observed in the figure. From 1970 onwards, the share of employment in agriculture in the United States declined from around 3.97% to 1.63%, while the share in manufacturing dropped by more than half, from 30.6% to 14.85%. On the other hand, the employment share in the services sector increased during the same period, rising from 65.4% in 1970 to 83.5% in 2015. This shift is indicative of the U.S.'s transition to a more knowledge-based and service-oriented economy, driven by technological advancements, globalization, and policy reforms. These changes also reflect broader trends such as urbanization and the rise of the digital economy, which have reshaped the labor market and contributed to higher income levels in the services sector.

5.2 Process of Structural Transformation with Respect to the United States

Mexico underwent the process of structural transformation, consistent with the experience of other economies. Figure (5.2) graphs the share of employment in agriculture,

manufacturing, and services in the country from 1960 to 2022. Over the course of 62 years, Mexico achieved substantial labor reallocation. The share of employment in agriculture decreased significantly, from more than 58% in 1960 to less than 14% in 2022. While it remains above 10%, such a decline is noteworthy. As for the share of employment in the services sector, it increased from about 25% to 59.8% in 2021, a trend consistent with that observed in other economies worldwide. Similar to other countries, the share of employment in the manufacturing sector followed a hump-shaped pattern, rising from 16% in 1960 to 28% in 1990 before dropping slightly to 26% in 2022.

Between 1960 and 2022, South Africa also underwent a well-documented structural transformation, consistent with the literature. In Figure (5.2), the graph depicting the labor sectoral shift between agriculture, manufacturing, and services shows substantial labor reallocation. The share of employment in agriculture fell from 51% to 19.3% between 1960 and 2022, while the share of employment in services increased from 25% to more than 62%. Within the same period, the sectoral shifts in manufacturing employment followed the inverted U-shaped pattern observed in other economies, indicating an increase in share from 23% in 1960 to 35.8% in 1981, followed by a decrease to 18% by 2022. While the share in both the agriculture and manufacturing sectors is still higher than the shares in the US, South Africa's reaction is still considered substantial and aligns well with the structural transformation hypothesis.

Singapore underwent structural changes similar to those experienced by other economies. While Singapore has barely relied on the agricultural sector, as shown in the data, sectoral shifts in both the services and manufacturing sectors align well with structural transformation theory. Graph (3) plots sectoral labor reallocation for agriculture, manufacturing, and services in Singapore between 1970 and 2022. The share of employment in the services sector increased from 66% in 1970 to 85.6% in 2022. Although this increase was just 20% over the 52-year period, Singapore's employment share in the services sector was already higher than the United States' share during the same year, and by 2015, the rates were almost equal.Similar to other countries, the share of employment in the manufacturing sector followed a hump-shaped trend, showing an increase from 30.1% in

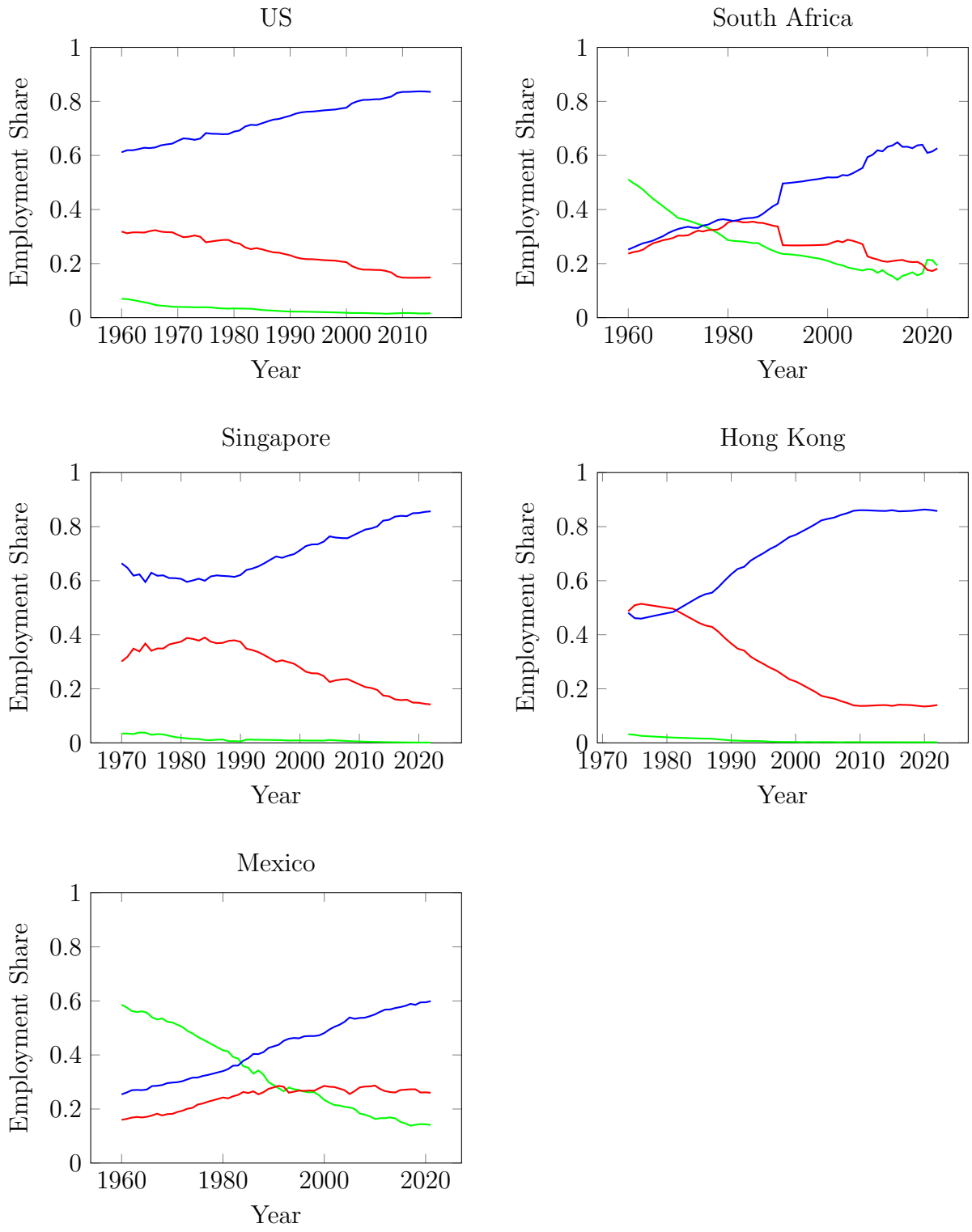

Figure 5.2: Employment. Agriculture (green), Manufacturing (red), Services (blue).

1970 to 38.96% in 1984, followed by a decline to 14.23% in 2022. Singapore achieved a sectoral labor reallocation closely aligned with that of the United States during the same period. As for the agricultural sector in Singapore, while the share of employment was already as low as 3.4% in 1970, it dropped to 0.1% by 2022.

Hong Kong underwent structural transformation similar to other cases discussed in the literature, especially when focusing on the sectoral shifts between the services and manufacturing sectors. When comparing the initial levels of labor employment in both the services and manufacturing sectors, the numbers are quite similar. The services sector's share of employment increased from 48.1% to 86% between 1974 and 2022. In comparison with the US, the services sector in the United States employed 66.3% of total employment in 1974, around 15% more than the rate in Hong Kong. By 2004, the employment share of Hong Kong's services sector had reached 82%, already higher than the US rate by 2%. This transformation in the services sector suggests that Hong Kong experienced faster labor reallocation compared to the US.

As for the manufacturing sector, its share dropped from 48.56% to 14% between 1974 and 2022. Comparing this with the US, a similar hypothesis can be applied: the sectoral shift in Hong Kong's manufacturing sector occurred at a faster pace, as its labor share was lower than that of the US starting in 2004. It is worth noting that in this analysis, the agricultural sector is excluded due to its minimal role in Hong Kong's economy, which significantly impacts labor mobility. Employment in the agricultural sector remained below 3% throughout the 50 years.

Chapter 6

Calibration:

For the calibration process of the model, I assume that the model duration is one year. The goal is to select values for the parameter b, ρ, $\bar{a}$, $\bar{s}$, nd for the sectoral productivity parameter Ai over the period we are examining. Table (6.1) displays the parameter values used for calibration.

Table 6.1: Parameter values and targets

Parameter	Value	Target US data
$A_{i,60}$	1.00	Normalization
$\{A_{a,t}\}_{t=1960}^{2011}$	0.038	Annual labor productivity growth in agriculture
$\{A_{m,t}\}_{t=1960}^{2011}$	0.033	Annual labor productivity growth in manufacturing
$\{A_{s,t}\}_{t=1960}^{2011}$	0.015	Annual labor productivity growth in services
$\bar{a}$	0.039	Share of employment in agriculture in 1960
$\bar{s}$	0.524	Share of employment in manufacturing in 1960
b	0.04	Weight on manufacturing in consumption (1960–2011)
ρ	-1.5	Aggregate labor productivity growth

6.1 Description - Step by Step Solution:

To obtain the parameter values, I began by normalizing sectoral productivity levels across the three sectors to one in 1960, $A_{i,60} = 1$ for i $\in \{a, m, s\}$. Secondly, I relied on United States data to obtain labor productivity growth rates[1]. Then, given$A_{a,60} = 1$ normalised, I get $\bar{a}$ by getting the United States labor share in agriculture in 1960, following the

[1]Annualized growth rates between 1960 and 2011 are computed using the following formula:

$$\gamma_{A_i} = \left(\frac{A_{i,2011}}{A_{i,1960}}\right)^{\frac{1}{51}} - 1$$

where $A_{i,2011}$ and $A_{i,1960}$ represent sectoral productivity levels in 2011 and 1960, respectively.

La equation discussed previously in my model section. Given the model's starting point and growth rates computed before, the share of employment in the agricultural sector matched the data and the model for the United States over the years. (Figure 6.1 reports the model results alongside actual data for the United States)

Following this, I used values for b and ρ matching the literature to avoid any miscalculation in generating the US model. So given the values of ρ and b, $\bar{s}$ was chosen to create a match between the model results and data of manufacturing employment in the United States in 1960. Given this alongside labor productivity levels, the model matches the time path of sectoral employment shares for both services and industry. Additionally, the annualized growth rates of labor productivity between, 1960 and 2011 for the United States is 1.86% matching closely the number recorded in literature, which implies the credibility of ρ.

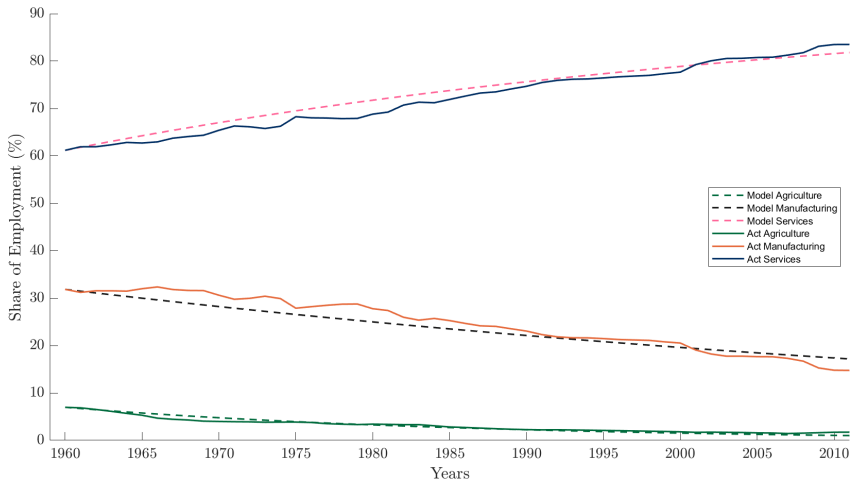

Figure 6.1: The structural transformation in the United States

6.2 Calibration Results of the Benchmark Economy:

When calibrating the model to the United States as my benchmark economy, I restricted the preferences and technology to match the process of structural transformation in the US between 1960 and 2011. Figure (6.1) shows the share of employment predicted by the model as a dotted line, compared to actual employment data from the United States, shown as solid lines. In general, the employment shares predicted by the model align well with the process of structural transformation and labor reallocation between 1960 and

2011 in the United States. While the agricultural sector is not well calibrated, the model still tracks the path of labor reallocation in this sector with minimal discrepancies. For manufacturing, the model predicts a decline in its share from 31.8% in 1960 to 17.17% in 2011. For the services sector, the model predicts an increase in its labor share from 61.18% in 1960 to 81.82% by 2011.

Chapter 7

Quantitative Analysis:

In the model below, I aim to use the calibrated model for the United States to examine the sectoral differences between the United States and four other countries: Singapore, Hong Kong, South Africa, and Mexico. After that, I performed several counterfactuals to explore the forces driving structural transformation in the countries under examination. My findings vary depending on the starting year for each country, based on data availability.

7.1 Country's specifics sectoral productivity at t=0:

Starting with Singapore, I set the sectoral productivity in 1970 to align the model's predictions with actual employment data. The calculation for this section relies on obtaining relative sectoral productivities based on the year 1970. Figure 7.1 presents the results of this experiment, where solid lines represent the actual data and dashed lines show the model's predictions. The model fits the agricultural trend well by capturing the decline in employment in this sector, with only slight gaps between the model and actual data. As for the services and manufacturing sectors, the model does not accurately capture the share of employment in either sector. Additionally, the model failed to capture the manufacturing boom that occurred in the early 1980s. For the services sector, although both the model and data show an increasing trend, the model overestimated the share of services employment. In contrast, the model underestimates the role of the manufacturing sector in terms of employment shares.

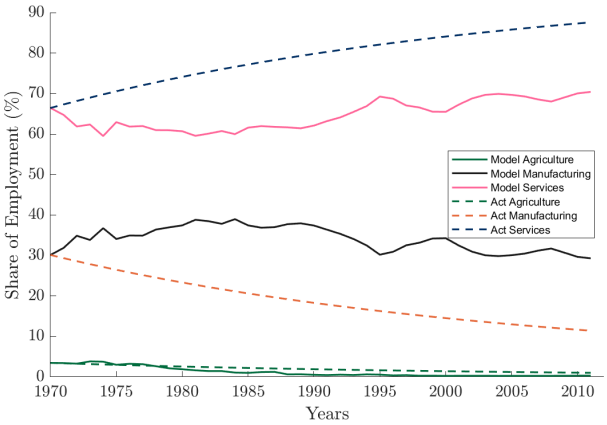

Figure 7.1: The structural transformation in Singapore

Figure 7.2 traces the same process and model discussed for Singapore, but this time calibrating it to South Africa between 1960 and 2011. The model captured the classical development pattern of structural transformation, with employment shifts between the agricultural sector and services. However, for the manufacturing sector, the model failed to align with the employment boom that occurred between the 1970s and 1980s, and also did not close the gap in the 1990s, when the data showed signs of stagnation in the sector. Focusing on the specifics, the model captured a decline in agricultural employment shares from around 50% to 15% between 1960 and 2011, although there were some deviations after the 1990s. For the services sector, the model overestimated the employment shares, while for the manufacturing sector, it both underestimated and failed to show any significant change.

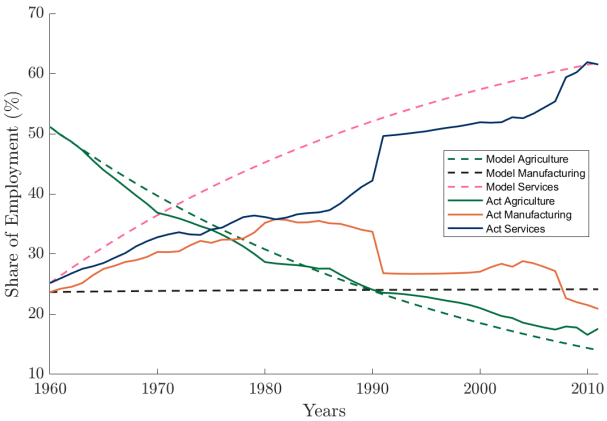

Figure 7.2: The structural transformation in South Africa

Figure 7.3 tracks the calibrated model for Hong Kong between 1974 and 2011. The

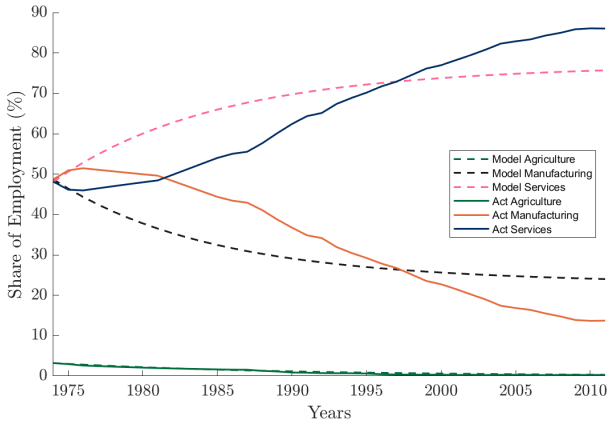

Figure 7.3: The structural transformation in Hong Kong

model captured the decline in agricultural employment well and aligned closely with the data. However, for the services and manufacturing sectors, the model created gaps, either overestimating or underestimating the employment share. In the case of the manufacturing sector, the drop in actual employment was much faster than the model predicted, indicating an underestimation of the pace of deindustrialisation. For the services sector, the long-run trend in the model aligned with the actual data, implying an increase in the services sector's employment share. However, the model overestimated the sector's position before 1995 and overestimated it again after this date.

7.2. Creating Barrier to Services :

When plotting sectoral productivity growth at time zero in the previous section, the model failed to capture the actual sectoral shifts between the manufacturing sector and services in the four countries. To better capture these shifts, I added a time-varying barrier to services, aiming to create a match between the model and actual data for the countries under study. This barrier assumes $\pi_s \geq 0$,This barrier affects the services sector's wage. Meanwhile, the manufacturing employment share is computed using the following equation:

$$\pi_t = \frac{L_{m,t}(1+x_t) - (1-L_{a,t})A_{s,t}}{\bar{s}} \tag{7.1}$$

The services barrier can be explained as increasing the impact of taxes and regulations affecting the services sector. After applying the barrier, the model was able to capture the sectoral labor reallocation between the manufacturing sector and services in the three

countries under examination.

Figure 7.4 tracks this relationship for Singapore between 1970 and 2011. After introducing a barrier to the services sector, the model's fit for Singapore improved significantly, particularly in capturing the evolution of employment shares over time. While agriculture remains negligible throughout the period—as accurately reflected in both the model and the data—the main improvement comes in the services sector. Without the barrier, the model had previously overestimated the speed of labor reallocation into services. With the barrier in place, the model now better reflects the gradual shift observed in the data, especially during the earlier decades, when frictions such as skill mismatches or institutional constraints may have limited service-sector expansion. The manufacturing sector remains well captured, with model predictions closely aligned with the data. Overall, the inclusion of a barrier to services allows the model to more realistically replicate Singapore's structural transformation, emphasizing the role of sector-specific frictions even in a highly open and rapidly developing economy.

Moving to South Africa, Figure 7.5 documents the model results after applying the ser-

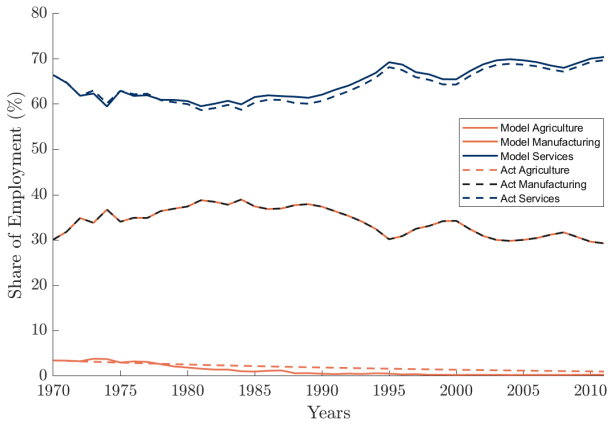

Figure 7.4: The structural transformation in Singapore

vices barrier. Similar to the other countries, the model results for the agricultural sector do not change after applying the barrier, as employment in the sector is unaffected by it. For the manufacturing sector, the model closely matches the actual data, though there are still minor gaps. A similar pattern is observed when tracking the services share: while the model is not able to capture the exact employment shifts in the sector, the gaps be-

tween the model's predictions and the actual data are minimal. The barrier successfully created an earlier limit to the services sector while correctly prioritizing the manufacturing sector as an intermediary before shifting employment to the services sector, as expected in the structural transformation process. Figure 7.6 shows this relation-

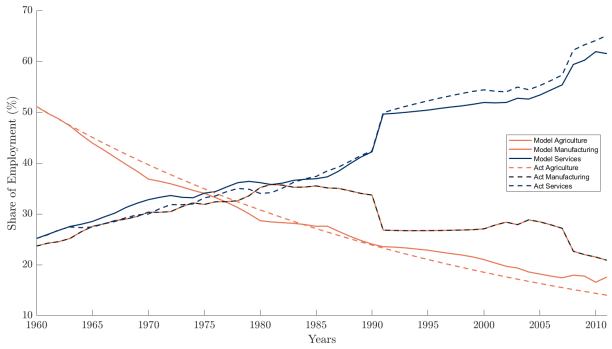

Figure 7.5: The structural transformation in South Africa

ship for Hong Kong between 1974 and 2011. The barrier caused the model to align well with the actual data, as there are no gaps between the data and the model's forecast for both services and manufacturing employment. Previously, the model failed to capture manufacturing employment, but after applying the services barrier, it was able to match the initial manufacturing boom of the 1970s and 1980s, while also capturing the decline post-1990s. This better fit may be related to the fact that the current model prevents the services sector from absorbing labor too quickly. In the services sector, the current model was able to match the actual pace of labor transition to the sector. Overall, the barrier helped delay the services sector's dominance in the economy, aligning more closely with historical trends.

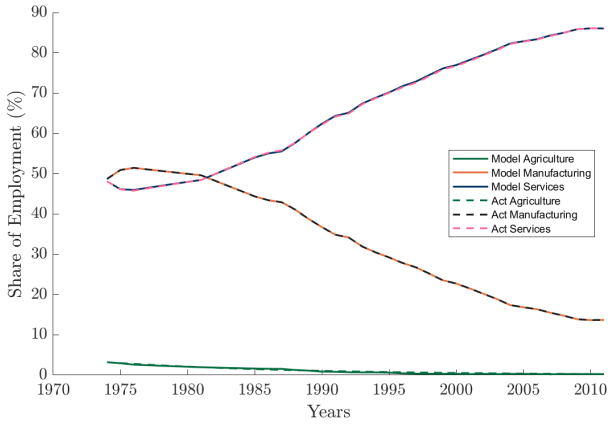

Figure 7.6: The structural transformation in Hong Kong

7.3 Relative Sectoral Productivity:

The model projects relative productivity for Singapore with respect to the United States from 1970 to 2011, showing a clear catch-up process. At the start of the period, relative labor productivity for both services and manufacturing was below the US level, with 0.35 for services and around 0.6 for manufacturing. Over the examined period, significant progress can be seen in manufacturing relative productivity, marking both a catch-up and even surpassing the US, with productivity reaching 1.35 by 2011. As for the services sector, slower but still significant improvement is observed, with relative labor productivity increasing to 0.65 by 2011. While both trends are notable, closing the aggregate productivity gap with the United States may depend more on the manufacturing sector, as it recorded a much higher growth rate. It is worth noting that, due to its insignificance to the Singapore economy, with limited employment and value-added, the agricultural sector was excluded from this analysis.

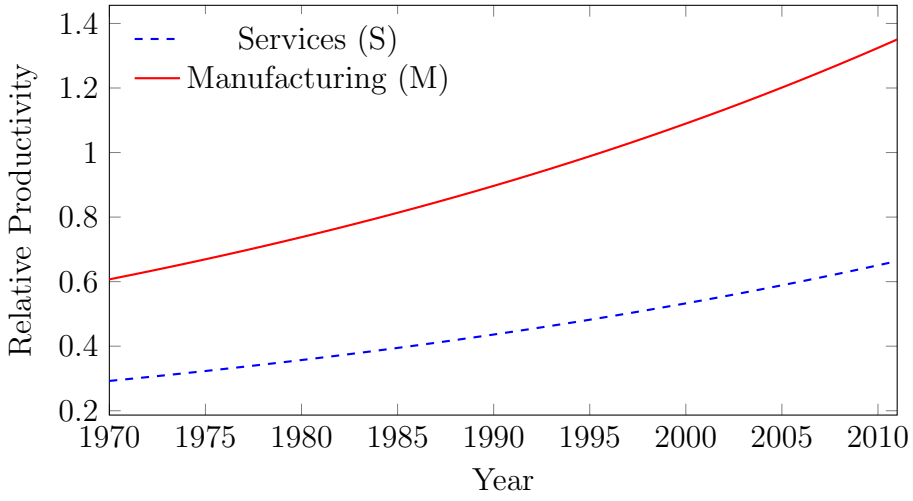

Figure 7.7: Sectoral productivity (SG/US)

The model in Figure 7.9 projects sectoral relative productivity between South Africa and the United States, presenting a clear and sobering picture of stalled structural transformation. Starting with the manufacturing sector, South Africa began in 1960 with high relative productivity levels, around 0.8, which was higher than any other country discussed in my research. However, instead of catching up with the US, the sector lost its momentum, with its relative productivity dropping to 0.25 by 2011. This decline may be linked to technological stagnation or a loss of competitiveness. This drop aligns with the

results from Section 4, where the aggregate relative productivity of South Africa declined significantly over the years in comparison to the US.

As for the services sector, its relative productivity remained almost flat over the 50 years, with no significant upward trend. This stagnation suggests that the country did not undergo the kind of modernization expected of emerging economies. Meanwhile, the agricultural sector maintained low productivity levels, hovering between 13% and 14% of US productivity throughout the period.

With the decline in manufacturing productivity, the stagnation in services productivity, and the minimal impact of the agricultural sector, the South African economic model failed to catch up with the US over the years. This also indicates that South Africa missed the window for a productivity-driven transformation. Figure 7.8 projects the relative

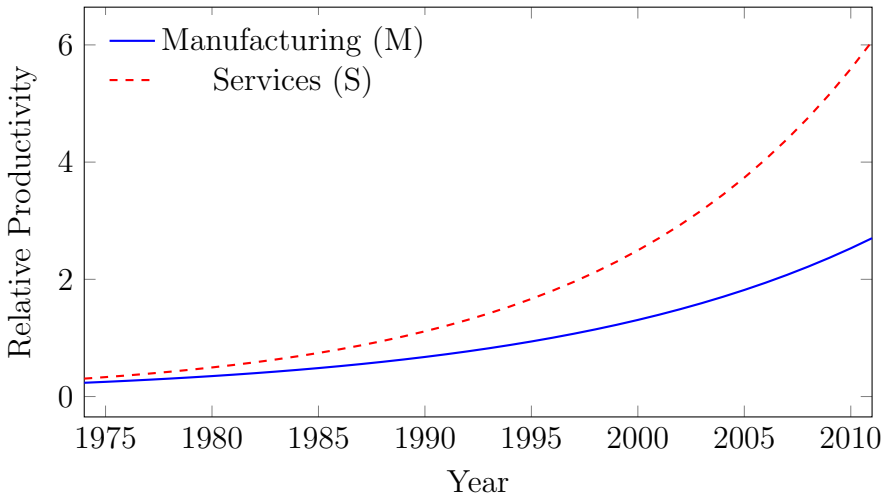

Figure 7.8: Sectoral productivity (HK/US)

productivity of Hong Kong and the United States between 1974 and 2011. Starting in 1974, relative productivity for both the manufacturing and services sectors was below the US level, with services at 0.3 and manufacturing around 0.23. Between 1974 and 2011, services' relative productivity increased from 0.3 to 6.6, surpassing the US level in 1986. For the manufacturing sector, relative labor productivity also surpassed the US, but not as quickly as the services sector, increasing from 0.23 to 2.7 between 1974 and 2011.

To explain the aggregate catch-up between Hong Kong and the United States, it is evident that the rapid convergence in services productivity may better explain the devel-

opment process than the manufacturing sector.

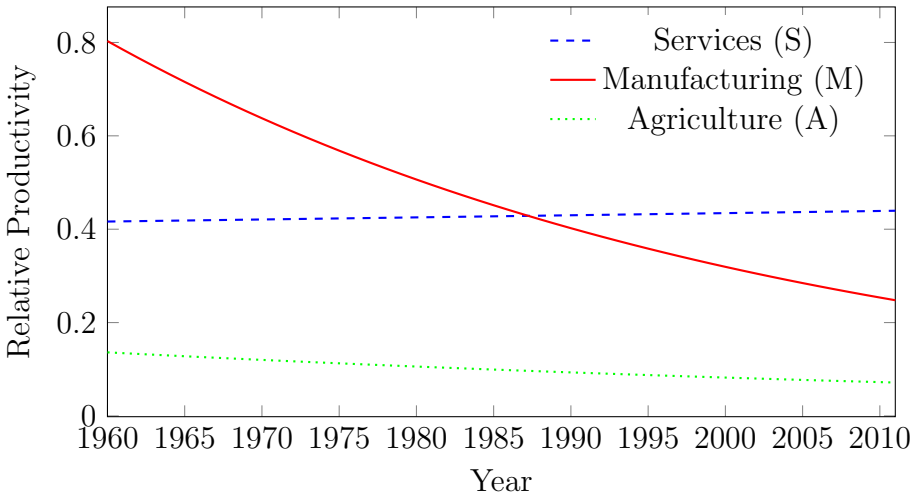

Figure 7.9: Sectoral productivity (SA/US)

Chapter 8

Conclusion

Structural transformation remains a fundamental force behind long-term economic development and rising living standards. However, the path toward higher productivity is neither uniform nor guaranteed. As this thesis demonstrates, the sectoral shifts of labor may lead to vastly different outcomes depending on a country's initial conditions, sectoral dynamics, and broader economic environment.

The analysis revealed that East Asian economies experienced successful transitions from manufacturing toward services, mirroring the trajectory historically observed in the United States while skipping the agricultural era. In these cases, sectoral shifts were closely associated with productivity catch-ups, allowing for significant convergence toward or even surpassing U.S. levels of aggregate productivity. Hong Kong, in particular, showcased a remarkable services-led catch-up, highlighting how structural transformation, when aligned with sectoral productivity growth, can drive sustained development.

By contrast, South Africa presented a markedly different narrative. While it underwent structural change, employment shifts was not consistently accompanied by increases in labor productivity. Signs of premature deindustrialisation emerged, with the manufacturing sector stagnating while the services productivity remained relatively stable and low. Such patterns suggest that the process of reallocation of laborers alone is insufficient alone for structural transformation; it matters critically how these shifts are done and whether these sectors can support productivity gains.

While the model used in this thesis provides valuable insights into sectoral shifts and

productivity dynamics, several limitations must be acknowledged. My economic environment focuses solely on labor shifts and sectoral productivity, excluding the important role of capital accumulation within sectors, which is often a key engine of productivity growth. Furthermore, historical and institutional constraints — such as the persistent effects of apartheid in South Africa — are not included in the model, which might influence the process of economic development and transformation path. Finally, the absence of policy variables, including industrial, educational, and macroeconomic policies, limits the ability to fully capture the forces that shape sectoral trajectories.

Ultimately, structural transformation is not only about reallocating labor across sectors; it is about reallocating labor into sectors where human capital becomes more productive and economically valuable to nations. Successful economic development hinges on ensuring that structural change leads to valuable productivity gains, not just changing sectoral employment rates. Future research should continue to explore the interaction between sectoral productivity, institutional factors, and policy interventions to deepen our understanding of how countries can achieve inclusive and sustainable growth.

Appendix A

Data Sources and Sector Assignments

1.1. Value-Added Data: Constant 2005 Local Prices

- **Hong Kong:** 1974–2011: Groningen Growth and Development Centre, 10-Sector Database, 2014 release.
- **Korea:** 1960–2011: Groningen Growth and Development Centre, 10-Sector Database, 2014 release.
- **China:** 1960–2010: Groningen Growth and Development Centre, 10-Sector Database, 2014 release.
- **Singapore:** 1960–2012: Groningen Growth and Development Centre, 10-Sector Database, 2014 release.
- **Thailand:** 1951–2011: Groningen Growth and Development Centre, 10-Sector Database, 2014 release.
- **Argentina:** 1950–2011: Groningen Growth and Development Centre, 10-Sector Database, 2014 release.
- **Brazil:** 1950–2011: Groningen Growth and Development Centre, 10-Sector Database, 2014 release.

- **Chile:** 1950–2011: Groningen Growth and Development Centre, 10-Sector Database, 2014 release.
- **Colombia:** 1950–2011: Groningen Growth and Development Centre, 10-Sector Database, 2014 release.
- **Mexico:** 1950–2011: Groningen Growth and Development Centre, 10-Sector Database, 2014 release.
- **South Africa:** 1960–2011: Groningen Growth and Development Centre, 10-Sector Database, 2014 release.
- **Senegal:** 1970–2011: Groningen Growth and Development Centre, 10-Sector Database, 2014 release.
- **Ethiopia:** 1960–2011: Groningen Growth and Development Centre, 10-Sector Database, 2014 release.
- **Ghana:** 1960–2011: Groningen Growth and Development Centre, 10-Sector Database, 2014 release.
- **Kenya:** 1960–2011: Groningen Growth and Development Centre, 10-Sector Database, 2014 release.
- **Nigeria:** 1960–2011: Groningen Growth and Development Centre, 10-Sector Database, 2014 release.

The value added by sector is reported in local currencies and was transformed into percentages.

1.2. Employment by Sector Data

- **Hong Kong:** 1974–1990: Groningen Growth and Development Centre, 10-Sector Database, 2014 release; 1991–2022: World Bank Development Indicators.
- **Korea:** 1960–2022: World Bank Development Indicators.

- **China:** 1953–1990: Groningen Growth and Development Centre, 10-Sector Database, 2014 release; 1991–2022: World Bank Development Indicators.
- **Singapore:** 1970–1990: Groningen Growth and Development Centre, 10-Sector Database, 2014 release; 1991–2022: World Bank Development Indicators.
- **Thailand:** 1960–1990: Groningen Growth and Development Centre, 10-Sector Database, 2014 release; 1991–2022: World Bank Development Indicators.
- **Argentina:** 1950–1990: Groningen Growth and Development Centre, 10-Sector Database, 2014 release; 1991–2022: World Bank Development Indicators.
- **Brazil:** 1950–1990: Groningen Growth and Development Centre, 10-Sector Database, 2014 release; 1991–2022: World Bank Development Indicators.
- **Chile:** 1950–1990: Groningen Growth and Development Centre, 10-Sector Database, 2014 release; 1991–2022: World Bank Development Indicators.
- **Colombia:** 1950–1990: Groningen Growth and Development Centre, 10-Sector Database, 2014 release; 1991–2022: World Bank Development Indicators.
- **Mexico:** 1965–1990: Groningen Growth and Development Centre, 10-Sector Database, 2014 release; 1991–2022: World Bank Development Indicators.
- **South Africa:** 1950–1990: Groningen Growth and Development Centre, 10-Sector Database, 2014 release; 1991–2022: World Bank Development Indicators.
- **Senegal:** 1970–1990: Groningen Growth and Development Centre, 10-Sector Database, 2014 release; 1991–2022: World Bank Development Indicators.
- **Ethiopia:** 1960–1990: Groningen Growth and Development Centre, 10-Sector Database, 2014 release; 1991–2022: World Bank Development Indicators.
- **Ghana:** 1960–1990: Groningen Growth and Development Centre, 10-Sector Database, 2014 release; 1991–2022: World Bank Development Indicators.

- **Kenya:** 1969–1990: Groningen Growth and Development Centre, 10-Sector Database, 2014 release; 1991–2022: World Bank Development Indicators.
- **Nigeria:** 1960–1990: Groningen Growth and Development Centre, 10-Sector Database, 2014 release; 1991–2022: World Bank Development Indicators.

1.3. Sector Assignment

The paper uses three sectors: *Agricultural*, *Industrial/Manufacturing*, and *Services*. The sectors are divided based on the composition provided in the Groningen Growth and Development Centre 10-Sector Database (2014 release) as follows:

- **Agricultural Sector:** This sector combines the following activities: Agriculture, Hunting, Forestry, and Fishing.
- **Industrial Sector:** This sector includes activities related to: Mining, Manufacturing, Utilities, and Construction.
- **Services Sector:** This sector encompasses: Trade, Restaurants and Hotels; Transport, Storage, and Communication; Finance, Insurance, Real Estate, and Business Services; Community, Social, and Personal Services.

1.4. US Data Sources:

- Historical data on sectoral employment in the United States was collected from the U.S. Bureau of Labor Statistics (BLS) for the period spanning 1929 to 2011.
- Value-added data by sector for the United States was sourced from the Bureau of Economic Analysis (BEA) for the years 1960 to 1997. For the period 1998 to 2011, value-added data was supplemented using the World Development Indicators (WDI) database.

1.5. GDP and GDP per capita:

- For the countries under examination in this study, data on GDP and GDP per capita (both in current USD and constant 2010 USD) was obtained from the World

Bank's World Development Indicators database.

1.6. Penn World Table

- Data on GDP per worker used in Chapter 3 was sourced from the Penn World Table (PWT) version 7.1, specifically using PPP-converted GDP chain per worker at 2005 constant prices.

Bibliography

Baumol, W. J. (1967). Macroeconomics of unbalanced growth: The anatomy of urban crisis. *The American Economic Review*, *57*(3), 415–426.

Buera, F. J., & Kaboski, J. P. (2009). Can traditional theories of structural change fit the data? *Journal of the European Economic Association*, *7*(2-3), 469–477.

Cavalcanti Ferreira, P., & Rossi, J. L. (2003). New evidence from brazil on trade liberalization and productivity growth. *International Economic Review*, *44*(4), 1383–1405.

Chari, V. V., Kehoe, P. J., & McGrattan, E. R. (1996). *The poverty of nations: A quantitative exploration* (Working Paper No. No. 5414). National Bureau of Economic Research. https://doi.org/10.3386/w5414

Chenery, H. B., & Syrquin, M. (1975). *Patterns of development, 1950–1970*. Oxford University Press for the World Bank.

Clark, C. (1957). *The conditions of economic progress*. Macmillan.

Duarte, M., & Restuccia, D. (2007). The structural transformation and aggregate productivity in portugal. *Portuguese Economic Journal*, *6*, 23–46.

Echevarria, C. (1997). Changes in sectoral composition associated with economic growth. *International Economic Review*, *38*(2), 431–452.

Eslava Mejía, M., Haltiwanger, J., Kugler, A. D., & Kugler, M. (2009). *Trade reforms and market selection: Evidence from manufacturing plants in colombia* (Discussion Paper No. 4256). IZA (Institute of Labor Economics).

Gollin, D., Parente, S. L., & Rogerson, R. (2004). Farm work, home work and international productivity differences. *Review of Economic Dynamics*, *7*(4), 827–850.

Harris, J. R., & Todaro, M. P. (1970). Migration, unemployment and development: A two-sector analysis. *The American Economic Review*, *60*(1), 126–142.

Herrendorf, B., Rogerson, R., & Valentinyi, Á. (2014). Growth and structural transformation. In P. Aghion & S. N. Durlauf (Eds.), *Handbook of economic growth* (pp. 855–941, Vol. 2). Elsevier.

Kongsamut, P., Rebelo, S., & Xie, D. (2001). Beyond balanced growth. *The Review of Economic Studies*, *68*(4), 869–882.

Kuznets, S. S. (1966). *Modern economic growth*. Yale University Press.

Kuznets, S. S. (1973). Modern economic growth: Findings and reflections. *The American Economic Review*, *63*(3), 247–258.

Lewis, W. A. (1954). Economic development with unlimited supplies of labor. *The Manchester School*, *22*(2), 139–191.

Maddison, A. (1980). Economic growth and structural change in the advanced countries. In *Western economies in transition: Structural change and adjustment policies in industrial countries* (pp. 41–65).

McMillan, M., Rodrik, D., & Verduzco-Gallo, Í. (2014). Globalization, structural change, and productivity growth, with an update on africa. *World Development*, *63*, 11–32.

Ngai, L. R., & Pissarides, C. A. (2007). Structural change in a multisector model of growth. *American Economic Review*, *97*(1), 429–443.

Parente, S., & Prescott, E. (2000). *Barriers to riches*. MIT Press.

Pavcnik, N. (2002). Trade liberalization, exit, and productivity improvements: Evidence from chilean plants. *The Review of Economic Studies*, *69*(1), 245–276.

Prescott, E. C. (1998). Lawrence r. klein lecture 1997: Needed: A theory of total factor productivity. *International Economic Review*, *39*(3), 525–551.

Restuccia, D., Yang, D. T., & Zhu, X. (2008). Agriculture and aggregate productivity: A quantitative cross-country analysis. *Journal of Monetary Economics*, *55*(2), 234–250.

Rodrik, D. (2008). *Normalizing industrial policy* (Working Paper No. 3). Commission on Growth, Development, International Bank for Reconstruction, and Development / The World Bank.

Schultz, T. W. (1953). *The economic organization of agriculture*. McGraw-Hill.

Syrquin, M. (1988). Patterns of structural change. In H. Chenery & T. N. Srinivasan (Eds.), *Handbook of development economics* (pp. 203–273, Vol. 1). Elsevier.

Young, A. (1995). The tyranny of numbers: Confronting the statistical realities of the east asian growth experience. *The Quarterly Journal of Economics*, *110*(3), 641–680.