PRODUCTIVITY GROWTH IN THE MANUFACTURING SECTOR

MITIGATING GLOBAL RECESSION

MIHIR KUMAR PAL

Productivity Growth in the Manufacturing Sector

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Productivity Growth in the Manufacturing Sector: Mitigating Global Recession

EDITED BY

MIHIR KUMAR PAL

Vidyasagar University, West Bengal, India

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Foreword

As a consequence of the Covid-19 emergency and the lockdown, the manufacturing industry suffered problems such as a drop in turnover, liquidity shortages, and interruption of production chains. The industry is, thus, struggling with a crisis that has few precedents in history. The global economy led by the highly developed countries has been facing a recession in output and employment growth which has been causing a decrease in the world demand. The effects of this crisis are multiple, as well as the attempts to respond to it, which depended not only on the resilience of the companies but also on the measures put in place by the various national governments.

The manufacturing sector provides approximately 16% of the global gross domestic product (GDP), and it employs 14% of the workforce. This sector's relative size in an economy varies with its stage of development. When economies industrialize, employment and output in manufacturing both rise rapidly, but once this sector's share of the GDP peaks at 20 to 35%, it falls in an inverted U pattern, along with its share of employment. The reason for this is that, as wages rise, consumers have more money to spend on services, and the latter's growth accelerates. It follows that the growth of the manufacturing sector is essential to accelerate the growth of the service sector.

Despite the deindustrialization and the differences between the most important Western economies, their manufacturing sector plays a key role in the evaluation of the economic cycle. In particular, all these economies show a close link between the expansionary and negative phases of GDP and the production cycles. Therefore, the manufacturing sector remains a significant factor of oscillation. Furthermore, this correlation increases during recessions, showing that the production cycle is a powerful transmission channel in difficult times. The leading indicators of the industry offer timely and quality information on the state of an economic cycle. Therefore, the modest recovery observed following the global financial crisis can be partially explained by the weak recovery in the manufacturing sector, which resulted in a lack of investment.

A new global consuming class has been emerging in recent times, and most of the consumption is taking place in developing economies. This will create rich new market opportunities. It is, thus, essential for companies to develop a highly detailed understanding of the specific emerging markets, as well as the needs of their existing customers.

The manufacturing sector may flourish by increasing its productivity. Productivity growth is essential not only to increase output but also to improve the

competitiveness of an industry both in the domestic and international markets. Two distinct sources govern the growth of an economy, so that growth can be input-driven and productivity-driven. Input-driven growth is achieved through the increase in factors of production, which is inevitably subjected to diminishing returns and is not sustainable in the long term. Productivity-driven growth is due to a growth in output that cannot be explained by the growth in total inputs. It is normally credited to the improvement in knowledge, organizational structure, human resources management, skills attainment, information technology, and efficient use of factors of production.

A very delicate open issue concerns the question of the origin of the different performances of companies. The ability of production systems to react to changes and to new technologies depends on it. And on it depends the keeping and relaunching of the productive system and, consequently, the social fabric which forms its basis and which receives the benefits of employment and income.

Against this background, the present book focuses on the empirical verifications of the productivity and efficiency of the manufacturing sector of the world economy, with special emphasis upon the emerging economies during the pre- and postglobal financial crisis.

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It is a matter of great pleasure for me to complete the proposed book titled, *Productivity Growth in the Manufacturing Sector: Mitigating Global Recession*, after giving over a long time on the stages from proposal writing to final submission. I have run into large debts to a number of persons in the course of this huge task. It would be blameworthy if I do not recognize the contributions of the concerned academicians and the other members of the society directly or indirectly attached to the project.

At first, I must acknowledge the Emerald Publishing Ltd. Team for approving the proposal and continuously guiding me at all stages of developments of the book. Secondly, I should be grateful to my colleague Dr Ramesh Chandra Das, Associate Professor of Economics, Vidyasagar University, India, who left no stone unturned in his constant help and support at every stage of this volume, and my PhD supervisor Dr Madhusudan Datta, Professor of Economics, Kalyani University, India, from whom I got the basic conceptual ideas in respect of this field of research. Thirdly, I am grateful to Dr Purnendu Sekhar Das, Professor (Retd.) of Economics, Vidyasagar University and VGSOM, IIT, Kharagpur, India, with whom I discussed various issues connected with this project and got valuable suggestions. Fourthly, I must express gratitude to Professor Enrico **Ivaldi, University of Genova, Italy, and Centro de Investigacionesen Econometría – CIE, University of Buenos Aires, who took lot of pains in writing the foreword of this book inspite of his busy** schedule, Dr Hasan Dinçer, Professor of Finance at Istanbul Medipol University, Faculty of Economics and Administrative Sciences, Istanbul-Turkey, Professor Begum Sertyesilisik, Izmir Democracy University, Turkey, Dr Pulak Mishra, Professor, Department of Humanities and Social Sciences, IIT Kharagpur, India, Dr Arpita Ghose, Professor of Economics, Jadavpur University, India, and all my colleagues in the Department of Economics, Vidyasagar University, India, for their constant help and support. Fifthly, I am highly indebted to my Doctoral Research Scholar Md Rakibul Hasan, who was constantly by my side during the whole project and helped me to go through the rough terrain of this work. Fifthly, I should pay gratitude to all the contributing authors for their valuable chapter contributions and showing their patience for such a long length project. I must acknowledge the values they added to the existing literature through this volume.

Last but not the least, I must be grateful to my parents, wife and son, brothers, and other members of the family for their continuous influence, supports, and sacrifice in carrying out the extensive project. Of course, no one other than me, as the editor, discloses to remain entirely responsible for any errors still stay behind the book.

Mihir Kumar Pal
Editor

Introduction

The global economy headed by the highly developed and partly upcoming developing nations has been facing prolonged downturn in its output and employment growth which has been pulling down the magnitudes of world demand and thereby provoking the economies into disgruntlement trade and political relations. The recent US–China trade retaliation is one of such jeopardized situations in world trade. Not only the impact of this retaliation is confined to these two economies, its ramifications are worldwide. Overemphasizing upon service-led growth, the manufacturing sectors have been given less importance, although, nurturing the sector in proper channel might be helpful in strengthening the base of the economies. Focusing on increasing the productivity and efficiency of this sector may lead to absorbing economic shocks that the so-called developed economies have been witnessing so far.

The feeling that a substantial part of output growth in the rapidly growing economies is attributable to technological progress has given rise to intensive research on the analysis of productivity growth over the last four decades. These studies have proposed and chiseled toward perfection of new concepts and have opened up an entirely new area of research.

Productivity growth is essential to increase output as well as to improve the competitiveness of any industry for both domestic and international markets. In economic theory, technological progress and total factor productivity (TFP) are often used synonymously, though there is a conceptual distinction between them. Technological progress is the advances in knowledge and its application to the art of production (invention, innovation, and diffusion), and on the other hand, TFP is defined as the ratio of output to a weighted combination of inputs. The latter is a boarder concept which includes technological progress, change of technical efficiency, and change of scale. Technical efficiency includes inputs productivity, capacity utilization etc. TFP can be improved through smart technologies, smart workforce, and innovations. Productivity-driven development can be enabled by the enhanced TFP covering technological progress, technological efficiency, and change of scale.

Economies need to be resilient as countries having resilient economy that can enhance welfare of their people and achieve sustainable development. Resilience of the economy is related to its ability to cope with the challenges (e.g. economic shocks and environmental crises). It requires holistic and systematic, as well as strategic approach as it is directly related with the sustainable development of the countries. Enhancing resilience of each country's economy can enhance resilience

of the global economy as countries economic status can influence each other. In other words, there is a need for resilient global economy. Manufacturing industries is one of the pillars of the production, sustainable development, and global economy. Intellectual capital is also regarded as one of the significant determinants of efficiency, profitability, and ultimately value of a manufacturing firm. Exploration of the changing dynamics in the relationship between intellectual capital and firm-level efficiency in the face of global economic crisis is becoming a special matter of interest. During postglobalization period, tariff imposition on manufacturing trade has a significant effect on their economy of developed and developing nations. Along with the volume and balance of trade, both export and import has separately observed a significant change under tariff regime and made contrasts between the developing and developed countries.

The next era of global growth and innovation may be considered as the era of manufacturing sector. It is also observed that globally, manufacturing sector significantly continues to grow. Manufacturing sector serves as one of the major shares in global economy. Its relative size varies with the stage of development of the economy. Employment and output increase rapidly in well-industrialized economy which can further accelerate the growth of the service sector as consumers have more money to spend on services.

Under the milieu, the present book has covered different issues related to the productivity growth of manufacturing sector and its implications to mitigate recessionary situations in the economies. It has been structured into two sections. Section I covers the discussion on the related aspects of manufacturing sector for the global level, and Section II covers the same issue on Indian perspectives. Section I contains 9 chapters, and Section II contains 10 chapters. The brief outlines of all the chapters are presented below.

Section I: Manufacturing Productivity at the Global Perspectives

Chapter 1 aims to explore econometrically, whether productivity growth across countries can be a remedial measure toward mitigating global recession considering six economies like Korea Republic, Japan, India, China, US, UK as well as world economy as a whole during the period 1990–2018. The empirical findings disclosed that the impacts on the growth of economies from the growth rates of the manufacturing sector, productivity, and labor quantity are positive and statistically significant, while the effects of growth of the capital deepening and labor composition on economic growth of those sampled countries are statistically significant but negative. Some key factors are facilitating global learning spillovers; allowing productive firms to thrive; and making the most of human capital that should be taken care of.

Chapter 2 makes an analysis to the relationship between Labor Productivity, Manufacturing Output, and Growth of GDP, for 25 major economies across the globe, covering the period 2000–2015. Findings suggest that in most of the nations these variables have significant impact on one another, but there are exceptions as well. Apart from that, there are variables like Energy Consumption, Health

Status, Life Expectancy, foreign direct investment (FDI), etc. which are significant in influencing these variables.

Chapter 3 accounts for both export and import separately in order to observe their dynamisms under tariff regime and make comparisons between the developing and developed countries using the World Development Indicators and World Integrated Trade Solution databases of World Bank (2020) on China (developing nation) and the United States (developed nation) during 1970–2019. Cointegration tests and vector error correction models indicate that the relationship between tariff and manufacturing trade is positive and statistically significant.

Chapter 4 aims to determine the relationship between labor productivity and economic development of Turkey over the period 1970 to 2017. Results show that there is a causal relationship from labor productivity to economic growth in Turkey, and it can be said that labor productivity should rise in order to increase economic development and suggest measures to thereof.

Chapter 5 analyzes the contribution of allied sectors over GDP considering manufacturing as a separate entity under the regional variation and different income classification using World Bank data set of 2010 and 2018 for cross-sectional analysis of GDP growth incorporating regional variation and income classification as discrete variables. Region specific and income classification specific regression identifies the variations in scores and changes in importance of different allied sectors.

Chapter 6 develops a model to examine ways for enhancing resilience of the global economy through smart, circular, and competitive manufacturing industry. TFP can be improved through smart technologies, smart workforce and innovations, which requires holistic, systemic as well as strategic approach as it is directly related with sustainable development of the economy.

Chapter 7 conducts segmentwise analysis of commodities (based on processing) in relation to international trade by building a theoretical model considering three types of goods segments and international trade dynamics for the United States and China. Results show that, in segment of raw goods, cost can boost the international trade whereas, in finished goods segment, variety helps.

Chapter 8 tries to explore, whether manufacturing sector productivity growth was one of the reasons that the crisis worsened in India or was it because of the crisis that India's manufacturing sector went into a deep recession, considering Centre for Monitoring Indian Economy (CMIE) Prowess database, during the period July 2007 to July 2010. It is based on the causality results that it was because of the subprime crisis that India's manufacturing sector went into a deep recession.

Chapter 9 empirically investigates the ramifications of the intellectual capital on the level of efficiency of the firm. It also explores the changing dynamics in the relationship between intellectual capital and firm-level efficiency in the face of global economic crisis during 1999–2000 to 2013–2014. Empirical results reveal that intellectual capital significantly determines the efficiency of the manufacturing firms. However, the impact of financial crisis is not robust in changing the synergy

between efficiency and intellectual capital. Along with its size, age and leverage were found to be significant determinants of efficiency of manufacturing firms.

Section II: Manufacturing Productivity at Indian Perspectives

Chapter 10 examines whether increase in wages, salaries, and other benefits can necessarily motivate the workforce at workplace and enhance their productivity and efficiency. Long-term trends show that while the share of wages, salaries, and also that of total emoluments have increased in recent years; such changes are not reflected in higher productivity.

It suggested that, in addition to incentives in the form of higher wages, salaries, and other benefits, enhancing efficiency and productivity of human resources requires adequate emphasis on human aspects as well, through proper human resource management policies.

Chapter 11 tries to examine the sources of total factor productivity growth (TFPG) of the 2-digit manufacturing industries as well as total manufacturing industry of Gujarat during 1981–1982 to 2010–2011. The empirical finding clearly reveals that although factor accumulations as well as resource allocations in most of the 2-digit manufacturing industries of the state have improved during the postreform period, technological progress and technical efficiency change of the same have deteriorated in most of the industries of the state, which requires government intervention.

Chapter 12 attempts to estimate the output growth and TFPG in Indian Manufacturing Industry over the period 1987–1988 to 2016–2017 and also aims to find a possible way out of mitigating global recession by establishing a link between TFPG and indicators of economic growth. On an average, TFPG of Indian Manufacturing Industry is negative, and it has a declining trend. This study considers India's exports of manufacturing products to 27 destination countries.

Chapter 13 analyzes the growth and productivity of unorganized manufacturing enterprises (UMEs) on the basis of the latest two rounds of National Sample Survey Office (NSSO) unit level data incorporating all states and union territories (UTs) of India. It reveals that the growth of UMEs, employment, gross value added (GVA), and fixed assets widely varied across states/UTs, and these growth rates were substantially high in a number of states during 2010–2011 and 2015–2016. The government has to make deliberate attempts to increase the growth of UMEs on one side and raise productivities of UMEs through skill developments on the other side.

Chapter 14 attempts to measure TFPG of Indian textile firms during 1995–202016. It also examines the impact of withdrawal of multifiber trade agreement (MFA) since 2005. TFPG has increased in 1999–2000, 2000–2001, 2009–2010, and 2012–2013. After dismantling of MFA, Malmquist productivity index (MPI) level has significantly declined, with an increase in its growth rate; but the increase is not statistically significant. The study also clearly indicates that marginal effect of exports, imports, and advertisement expenditures are positive;

increase in these variables promotes TFPG. The greater role of advertisement expenditures over marketing expenditures is also evident.

Chapter 15, using cluster sampling method of collecting data from 166 manufacturing firms in India and taking help of five-point Likert scales, tries to analyze the potentiality of different manufacturing industries in eastern India. It is found that liberalized FDI policy, focus on export, focus on increasing rural consumption, delicensing of industries, and financial sector liberalization significantly influence manufacturing productivity and hence sustainable economic development.

Chapter 16 aims to investigate the changing growth pattern of India's ready-made garment export and also the impacts of trade openness based on secondary data complied from various issues of "Handbook of Statistics on Indian Economy" for the period 1987–1988 to 2018–2019. Results show a declining growth rate, and the industry may benefit from trade openness.

Chapter 17 tries to investigate the behavior of relative wage rate, TFPG, and also attempts to explore the causal relationship between relative wage rate and productivity of labor as well as relative wage rate and TFPG in food and beverage industry in India over the period 1980–1981 to 2017–2018. A significant break, during 1984–1985 is found for relative wage rate and labor productivity, but it is 2007–2008 for TFPG. For the three variables, growth rate has increased after the break.

Chapter 18 attempts to find the role and prospects of Food Processing Industry (FPI) in Indian economy and also tries to highlight the present and future role of the same. Results disclose that this industry helps to earn foreign currency by exporting processed food products and attracts FDI. So, in the context of present global recession, this industry is the lifeline to the Government of India to combat the recessionary scenario.

Chapter 19 tries to examine the impact of car selling across the states in India due to the variation in income, tax levied on petrol and diesel for the period 2018–2019. It has been found that, higher income of a state has a positive impact whereas higher tax on petrol and diesel which varies across the states has a negative impact on car selling. Again, it also examine whether there exists any neighborhood impact on growth rate of car selling of different tax rate on petrol and diesel on the basis of Moran's Index. It is witnessed that there exist a high level of spatial autocorrelation among the different states in case of growth of a car selling, tax imposition on diesel as well as on petrol.

The essence of the chapters covered by the book reveal that emerging economies as well as developed ones has been facing several recessionary scenario during the recent decades. Substantial increase in TFPG of the manufacturing industries may be one of the possible ways out in mitigating global recession. Total factor productivity can be improved through smart technologies, smart workforce, and innovations. It requires holistic and systematic as well as strategic approach as it is directly related with the sustainable development of the countries and welfare of their people. Resilient economy can enhance welfare of their

people and achieve sustainable development. The next era of global growth and innovation may be considered as the era of manufacturing sector. The policy suggestions provided by the authors in the book will inexorably help to strengthen the manufacturing industry to combat any recessionary shock.

Mihir Kumar Pal
Editor

Section I

MANUFACTURING PRODUCTIVITY AT THE GLOBAL PERSPECTIVES

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Chapter 1

Is Productivity Growth in Manufacturing Sector a Driving Force Toward Mitigating Global Recession? A Cross-Country Explanation from Panel Data: 1990–2018

Abhijeet Bag, Sarbapriya Ray and Mihir Kumar Pal

Abstract

In view of discussion of two crises, Asian Financial crisis, 1997 and global meltdown, 2008 spreading over more than two decades, the objective of this article is to present econometrically whether productivity growth across countries can be a remedial measure toward tackling global recession pervaded during recent two or three decades worldwide and also to shed light on the aspect of whether productivity can truly act as a driver of growth of selected six economies like Korea Republic, Japan, India, China, USA, UK, and world economy as a whole. The panel data for the six selected countries for the period 1990–2018 were constructed keeping eyes on the 1997 Asian financial crisis and then the 2008–09 global economic crisis and a random effects model was applied after Hausman test. The empirical findings disclosed that the impacts on the growth of economies (represented by growth of GDP) from the growth rates of the manufacturing sector, labor productivity of manufacturing sector, and labor quantity are positive and statistically significant; while the effects of growth of the capital deepening and labor composition on economic growth of those sampled countries are statistically significant but negative. Some key factors that are likely to affect future productivity performance are centered on some issues like facilitating global learning spillovers; allowing productive firms to thrive; and making the most of human capital that should be taken care of.

Keywords: Productivity; growth; manufacturing; global; recession; drivers

JEL Classification: O47; N10; E32; C33

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1. Introduction

Asian financial crisis, also called the "Asian Contagion," which started as an economic crisis in 1997 and 1998, is considered to be a major global financial crisis (GFC) that destabilized the neighbouring Asian economies like Indonesia, Malaysia, South Korea, etc., as well as the world economy by the end of the 1990s. The currency markets first failed in Thailand as the result of the government's decision to no longer peg the local currency to the US dollar (USD). As a result, currency declines stretch rapidly throughout East Asia, in turn causing stock market declines, reduced import revenues, and government upheaval. Collectively, the economies most affected saw a drop in capital inflows of more than $100 billion in the first year of the crisis. Significant in terms of both its magnitude and its scope, the Asian financial crisis became a global crisis when it spreads to the Russian and Brazilian economies.

The financial crisis of 2007–08, also known as the GFC, led to a global economic recession in 2009, the most severe in 50 years. GDP fell 3.2% in high-income economies and grew only 1.2% in developing economies. The effects of the crisis were transmitted from high-income economies to developing economies as exports, private capital flows, commodity prices, and workers' remittances declined. Among developing country regions, Europe and Central Asia fared the worst, as GDP fell 6.2%. **[Annual GDP Growth, 2005-10, Country Profile, Source: IMF, 2010 (compiled)]**. Latin America and the Caribbean economies contracted 2.6%, with Mexico – relying almost solely on the US market for its exports – the worst off. China and India managed to continue growing at nearly the same rate as before the crisis, but other economies in Asia did not do as well. Growth in the Middle East and North Africa dropped to 2.3% on lower oil prices and exports to Europe. Sub-Saharan Africa barely grew, hurt by falling export commodity prices, falling remittances, lower tourism revenues, and declining private capital flows. Sub-Saharan Africa has been subject to the most severe consequences of the crisis. Low-income households, at risk of being pushed into poverty, have suffered from deteriorating health and lost education opportunities.

An economic crisis is an unexpected shock in supply or demand with large effects throughout the economy of financial system. The main impact deriving from all of these crises was the lowering of demand for raw materials and primary commodities and this had a strong direct impact on economic growth. The decline in exports of primary commodities resulted, in turn, in a dive in volumes of manufacturing exports (Hussain, Mlambo, & Oshikoya, 1999; Khalafalla & Webb, 2001). The current crisis has resulted in decreased demand for commodity exports and trade-related services, especially in the outward-oriented emerging economies (Borchert & Mattoo, 2009).

If household consumption in high-income economies continues to decline, new drivers of global economic growth will be crucial. China and India might become new drivers, but large differences between the scale and structure of their economies and of the US economy will delay their replacing the US role in the global economy. Developing economies have growth potential because they have room for productivity gains from increased investment. High-income economies face

overcapacity that could limit recovery, but they are investing in transforming their economies through technological innovations to protect the environment and combat global warming. Although the world avoided the most catastrophic potential effects of the crisis, the resulting conditions require careful navigation and eventual resolution. The crisis has given impetus to rebalancing the economies of China and the United States. China focused on domestic sources of growth in its 11th five-year plan, and in the United States, the *2010 Economic Report of the President* proposed a transition from consumption-driven growth to an emphasis on investment and exports. Consumers in high-income economies have reduced spending, and imports have declined faster than exports. In 2008 and 2009, private consumption expenditures declined in the United States. In China, imports outpaced exports, driven by domestic demand as the government increased spending on infrastructure, social programs, and environmental protection.

It is a well-established notion in growth economics that productivity can be the ultimate engine of growth in global economy amidst crises. Therefore, raising productivity is the crucial challenge among countries globally irrespective level of income to combat global recession pervaded all over world. Paul Krugman noted in 1994: "productivity isn't everything, but in the long run it is almost everything." Productivity is about "working smarter," rather than "working harder." It reflects our ability to produce more output by better combining inputs, owing to new ideas, technological innovations, and business models. At the same time, productivity is expected to be the main driver of economic growth and well-being over the next 50 years, via investment in innovation and knowledge-based capital (KBC). Thus, it is of little surprise that the recent productivity slowdown has sparked widespread interest, with the debate centering on the extent to which the productivity slowdown is temporary or a sign of more permanent things to come.

In view of the above prelude regarding discussion of two crises spreading over more than two decades, the objective of this article is to present econometrically whether productivity growth across countries can be a remedial measure toward tackling global recession pervaded during recent two or three decades worldwide and also to shed light on the aspect of whether productivity can truly act as a driver of growth of selected six economies like Korea Republic, Japan, India, China, USA, and UK, as well as world economy as a whole undertaken into our investigation.

2. Material and Methods

The present study is based on the secondary data and covers a period of 29 years ranging from 1990 to 2018. The purpose of considering such a longer time frame is to avoid factors like temporal instability and business cycles that might influence the results of the study.

However, panel data comprise both cross-sectional and time series elements, i.e., it has space as well as time dimension. In the present study, to examine the

possible effect of drivers of productivity growth on economic growth, a panel of 6 countries (also including world) is studied over a period of 29 years. Thus, panel data analysis has been used because the data set includes both cross-sectional and time series data. Moreover, as each cross-sectional unit in the data set has the same number of time series observations, the study has used balanced panel.

Therefore, panel data consist of {29 *years* × 7 *countries* × 6 *crosssections* (*variables*) = 1218 *observations*} a total of 1218 pool (balanced) observations.

2.1 Choice of Pooling Technique

Random effects models (REMs) or fixed effects models (FEMs) include object-specific time-invariant effects but have different assumptions about their essence.

> In FEM, the intercept in the regression model is allowed to differ among individuals in the recognition of the fact that each cross-sectional unit may have some special characteristics of its own. To take into account the differing intercepts, dummy variables can be used. The FEM using dummy variables is known as the least squares dummy variable model. FEM is appropriate in situations where the individual specific intercept may be correlated with one or more regressors. (Gujarati, 2004)

Therefore, an FEM assumes that differences across countries can be captured by differences in the constant term.

In REM, it is assumed that the intercept of an individual unit is a random drawing from a much larger population with a constant mean value. REM is appropriate in situations where the intercept (random) of each cross-sectional unit is uncorrelated with the regressors (Gujarati, 2004).

This assumption seems appealing because this study analyzes six countries along with world average while there are many countries presently in the world. The model has a few typical assumptions.

- The common intercept is a representation of mean value of all the countries' intercepts.
- Also, the model assumes the individual error components are not correlated with each other and not autocorrelated both among the countries and over time.
- This model assumes the error term is not correlated with any explanatory variables, a crucial assumption for the model to construct an efficient estimator (Law, 2012).

The procedures used to carry out tests between the models are as follows. First, it is worth determining whether the fixed effects are necessary or not. To do this, the model is estimated using common coefficients and tested against the fixed effects specifications using the F-test of the joint significance of variables that are

presently included in a panel or pool equation. EViews also provide built-in tool, i.e., redundant fixed effects–likelihood ratio for testing the joint significance of the fixed effects estimates in least squares specifications. The redundant fixed effects test also assists in determining whether the fixed effects are necessary or not.

The second test is used to choose between a fixed and random effects specification. However, for the REM estimators to be unbiased, the effects must be uncorrelated with the explanatory variables (an assumption that is often unrealistic). The Hausman test is used to test whether the explanatory variables are uncorrelated with the effects. The Hausman test is a test of the significance of the difference between the fixed effects estimates and the random effects estimates (the difference between the two estimates by analyzing a chi-square test statistic). The Hausman test tests the null hypothesis that the coefficients estimated by the efficient random effects estimators are the same (no correlation) as the ones estimated by the consistent fixed effects estimators.

H0. There is no correlation between the explanatory variables and the random effects.

H1. There is a correlation between the explanatory variables and the random effects.

In other words, in a fixed effects kind of case, the Hausman test is a test of *H0* – that random effects would be consistent and efficient – versus *H1* – that random effects would be inconsistent. (Note that fixed effects would certainly be consistent.)

So, if the Hausman test statistic is large (that is, low *p*-value and *p* is significant), one must use fixed effects. If the statistic is small (that is, high *p*-value and *p* is insignificant), the null hypothesis will be accepted and the one may get away with random effects.

The regression model employed in this study is shown below:

$$\begin{aligned}\mathrm{GDP\_G_{i\,t}} &= \mathrm{C} + \mathrm{PROD\_G_{i\,t}} + \mathrm{LCOM\_G_{i\,t}} + \mathrm{LQTY\_G_{i\,t}} + \mathrm{CDEP\_G_{i\,t}} \\ &\quad + \mathrm{MVAG\_G_{i\,t}} + \mu_{it}\end{aligned}$$

where i refers to the ith economy and t represents the tth time point; C is the constant term; $\mathrm{GDP\_G_{i\,t}}$ is the growth rate of GDP; $\mathrm{PROD\_G_{i\,t}}$ is the growth rate of labor productivity of manufacturing sector; $\mathrm{LCOM\_G_{i\,t}}$ is the growth rate of labor composition; $\mathrm{LQTY\_G_{i\,t}}$ is the growth rate of labor quantity; $\mathrm{CDEP\_G_{i\,t}}$ is the growth rate of capital deepening; and $\mathrm{MVAG\_G_{i\,t}}$ is the growth rate of manufacturing value added. μ_{it} is the error term.

The data have been collected from the World Bank online database, World Development Indicators (WDI), and ILOSTAT website for the period 1990–2018.

For the panel analysis, the variables of the growth rates for labor productivity, GDP, labor composition, labor quantity, capital deepening, and manufacturing value added have been chosen in order to investigate the relationship among the growth of different drivers of economies and the overall growth of the economies for these six sampled countries including world average.

Actually labor productivity is obtained by simply dividing gross domestic product of manufacturing sector by number of labor engaged in the manufacturing

sector, and labor quantity is the total number of laborers in the economy. For computing labor composition index, the data required for composition index are employment by sex, age, and education. For easy accessibility of data from the World Bank as well as simplicity of calculation, we have used labor force of different sampled countries having age above 15 and below 64. Employment by sex is identified by male and female participation rate, and Gender Parity Index (GPI)[1] has been used as proxy to identify education level of male and female workforce. Capital deepening (capital intensity) growth rate has been computed with the help gross fixed capital formation and labor force of each country. Gross fixed capital formation is defined as expenditures by government and the business sector on buildings, engineering, construction, and machinery and equipment.

3. Interpretation of Results

3.1 Graphical Analysis

From cross-country perspective, the trajectory of labor productivity growth (LPG) has accelerated from 1990 until the eve of the Asian crisis, during which Japan and Korea Republic, two of the biggest Asian power, show negative growth rate but moderate growth rates are noticed in other developed economies including India which is over and above the world's average.

However, in the post-2008 crisis period, there was relatively weak growth in productivity (LPG) in most of our sampled countries excluding China, which reflects the efficiency with which inputs are used – via improvements in the management of production processes, organizational change, or R&D and innovation more generally (Fig. 1.1a). Thus, much of the growth in the labor productivity of emerging markets which showed enhanced productivity growth during crisis period (for example, China) reflects increased capital deepening (Fig. 1.1b).

The acceleration in productivity growth in the United States from the mid-1990s largely reflected the rapid diffusion of ICT, but these benefits were not necessarily realized in all economies, with Europe in particular falling behind. This was reflected in the direct contribution of ICT capital to LPG. From 2004, the benefits from the ICT revolution began to diminish (in the United States), and LPG in the most recent period has been the weakest on record in most of our sampled countries except China. The crisis left a bequest of slower productivity growth in many economies, but labor productivity had slowed in a number of sampled countries (USA, Japan, UK, and Korea) even before the crisis (e.g., during the 2000–2007 period; Fig. 1.1a).

Fig. 1.1c depicts the GDP growth rate of sampled countries where it is found that Asian crisis of 1997 affects the growth structure of economies like Japan and Korea severely, whereas 2008 global economic slowdown affects adversely most of the sampled economies like India, USA, Korea, Japan, UK, and a whole world economy, but China's growth rate remained steady at round 10% p.a. which looks peculiar but true. This may perhaps be due to the reason that China has been succeeded to keep its productivity growth rate and capital deepening growth rate intact as before (Fig. 1.1a and b).