INTERNATIONAL JOURNAL OF BUSINESS EDUCATION AND MANAGEMENT STUDIES (IJBEMS)
A Peer Reviewed (Refereed) International Journal
Impact Factor 4.308 | http://www.ijbems.com | ISSN:2941-9638
Vol.10. Issue 1. 2021 (October)

GLOBAL PRODUCTIVITY DURING THE COVID -19 PANDEMIC: CASE OF A MALTHUS – SWAN – SOLOW MODEL

Boniphace Albert Chacha
Email: cboniphace3@gmail.com
Phone: +255 767 11 61 29
Curtin University – Australia

Abstract:

The potential impacts of the COVID-19 global pandemic have been identified in the contraction of global productivity in terms of production inputs (human labour supply), production outputs (GDP), production value, and efficiency. The present study is focusing on analysing global productivity across regions, countries, and sectors while identifying impacts, trends, and characteristics of global productivity during the COVID-19 global pandemic. Methodologically, the study employed a Malthus–Swan–Solow Model accompanied by theoretical and empirical findings to meet the objective of the study. Focusing on the main actor of the study (human labour supply), study findings revealed a positive relationship between global productivity and capital income, further justifying that there is a strong positive relationship between the Covid-19 global pandemic and global productivity. Ultimately, the study shows the impacts, trends, and characteristics of global productivity during the Covid-19 pandemic and recommends measures to enhance global productivity during the Covid-19 pandemic.

Global Productivity; the COVID-19 pandemic; the Malthusian-swan-Solow model; human labour supply; factor productivity

Introduction & Theoretical Background

The potential impacts of the COVID-19 global pandemic have been identified in the contraction of global productivity in terms of production inputs (human labour supply), production outputs (GDP), production value, and efficiency. The potential impacts of the Covid-19 global pandemic in the contexts of production inputs, outputs, GDP, value and efficiency of production have been identified through the study of (Cross, Ng, and Scuffham 2020), where the study findings emphasise that the dire economic impacts of the pandemic have been demonstrated through the contraction of production inputs (human labour supply), production output (GDP), product value and efficiency (Cross, Ng, and Scuffham 2020). From that perspective, this study is focusing on analysing global productivity across global regions, countries, and sectors while identifying the potential impacts, trends, and characteristics of global productivity during the COVID 19 global pandemic.

Contraction of Global Productivity Performance in Numbers

Global production statistics exhibit a significant contraction in the number of employees across all global regions, countries, and sectors due to the potential impact of the COVID-19 global pandemic. Global productivity means the global output produced during a specific period of time divided by the inputs employed to generate the final product for exchange in the market. The pragmatic example of the output can be the global GDP, while the example of inputs can be the human labour supply, technology, and institutes (OECD 2015). Towards demonstrating the trends of global productivity during the Covid-19 global pandemic (the year 2020), the study will refer to one country (China) representing other states, because at the time the study was undertaken, the complete set of data about global productivity had not yet been published. The study will focus on important elements of global productivity (GDP) to make a trend comparison from the year of 2019 to the year of 2020 for China. Statistics show that there will be a dramatic contraction in the Gross Domestic Product (GDP) of China from the year 2019 to the year 2020 due to the impact of the COVID-19 pandemic on production. Exemplifying the contraction of the China Gross domestic product (GDP) from the year of 2019 to the year of 2020, (UNIDO 2020) the trends of GDP revealed to be [2019- Quarter1 – 6.4, Quarter2- 6.2. Quarter3 – 6, and Quarter4-6] following the contraction in the year of 2020 as follows [2020 - Quarter1 – -6.8(Negative 6.8), Quarter2- 3.2. Quarter3 – 4.9, and Quarter4- 6.5], (UNIDO 2020).

The Theoretical Background

The theoretical part of the study plays the linkage role between the COVID-19 global pandemic and global productivity. The linkage and relationship between the COVID-19 global pandemic and global production is demonstrated through the cross-cutting theoretical construct of human beings and human labour supply (which happens and plays a role in both parties). The linkage between the COVID-19 pandemic and global production is well demonstrated through the two theories of the epidemic theory and the labour theory of value. Both theories possess the theoretical construct of human beings. This theoretical linkage between the Covid-19 global pandemic and global productivity in fact justifies and solidifies that the Covid-19 global pandemic caused the contraction of global productivity.

Considering the fact that the growing body of literature evidence suggests that the Covid-19 global pandemic caused the potential contraction of global productivity in terms of production inputs (human labour supply), production outputs (GDP), production value, production efficiency, and production revenue across all global regions, countries, and sectors, establishing a theoretical understanding of the linkage between the Covid-19 global pandemic and global productivity happens to be inescapable. From that perspective, the present study carefully reveals the theoretical linkage between the Covid-19 global pandemic and global productivity through the main actor of human labour supply (cross-cutting factor). To achieve that theoretical goal, the two theories of epidemic theory and the labour theory of value play that commitment. Both

theories possess the theoretical construct (actor) of human concern. Human beings' theoretical constructs play the linkage role in connecting the Covid-19 pandemic and global productivity, because humans play a part in both parts. The Epidemic theory has three main actors: agent, host, and environment, who reveal the extent to which human labour may be affected by the infectious contagious and the consequences that will be observed in human activities, including global productivity.While the labour theory of value holds that the relationship between the amount of labour force employed in production and the value outcomes is complex and uncertain. the case of the Covid-19 global pandemic, the labour theory of value proved that the extent the labour supply is affected by the Covid-19 virus is also reflected in the value and efficiency of the final goods, which also deteriorated.

Motivation for the Study

It has been remarkable that the Covid-19 global pandemic is an unprecedented global pandemic in human history. Furthermore, the proliferated literature evidence supports that the Covid-19 global pandemic caused a significant contraction in global productivity in terms of the global GDP (Global Output), global production inputs such as human labour supply, production value, production efficiency, and production revenue. From this point of view, it has become a significant alarm for researchers to undertake the study and analyse the relationship between the Covid-19 global pandemic and global productivity through focusing on showing the impacts, trends, and characteristics.

The potential impacts of the Covid-19 global pandemic in the contexts of production inputs, outputs, GDP, value and efficiency of production have been identified through the study of (Cross, Ng, and Scuffham 2020), where the study findings emphasise that the dire economic impacts of the pandemic have been demonstrated through the contraction of production inputs (human labour supply), production output (GDP), product value and efficiency (Cross, Ng, and Scuffham 2020). Focusing on the trends of global productivity during the pandemic, the study of (Gajdzik and Wolniak 2021) undertaken to analyse the trend of steel production (sector) in the country of Poland, study findings emphasised that the production trends were serious not stable (instability) due the disruption of demand and supply chain of the goods and raw materials as well as the decline of supply of labour force due to deaths or restrictions in response to the Covid-19 pandemic, (Gajdzik and Wolniak 2021). In exemplifying the increase of costs due to the pandemic outcomes the pragmatic example is the garment manufacturer sector, this was identified by the International labour Organization in their study of recommendations measures for garment manufactures in response to the Covid-19 global pandemic, the study shows that the growing number of deaths from the labour force supply triggered the production costs to increase in replacing the man power in production, further insists the disruption of demand and supply chain as well caused the increase of the production costs, (ILO 2020).

The Significance of the Study

The study has the potential to sustain and improve global productivity across all global regions, countries, and sectors because it will be useful in decision-making, particularly in the areas of: (1) establishment of a unified, integrated, and coordinated resilience plan; (2) review and reform of United Nations, global regions, countries, and sector policies to improve sustainable investments and productivity; and (3)(3) Relevant to the advancement of debate and knowledge in future research

Research Questions & Methodology

Research Questions

The study is profoundly focused on observing and answering the following three key research questions:

1. Is there any relationship between the COVID-19 global pandemic and global productivity?

2. Is there any relationship between factor productivity and the capital labour ratio?

3. Are there any impacts, trends, and characteristics of global production in relation to the COVID-19 pandemic?

The Methodology

Methodologically, the study employed a Malthus–Swan–Solow Model accompanied by theoretical and empirical findings to meet the objective of the study.

A Malthus-Swan-Solow Model has been employed in demonstrating the relationships between factor productivity and capital labour ratio (per capital income) through the focus and determination of human labour supply on the occasion of finding an equilibrium state. Furthermore, these have been applied in proving and justifying the relationships between the Covid-19 global pandemic and global productivity. Human labour supply, as a main study actor and cross-cutting notion of the study, has been used to show the relationships between the factors of production and capital labour ratio, furthermore proving the relationship between the Covid-19 global pandemic and global productivity.

Theoretically, the study has employed two theories (The Epidemic Theory and the Labor Theory of Value) in demonstrating the profound theoretical linkage between the Covid-19 global pandemic and global productivity. The theoretical linkage has come into reality through the cross-cutting theoretical construct (actor) of human labour supply, considering the fact that

human labour supply happened and played a role in both the Covid-19 global pandemic and global productivity.

Empirically, 30 literature reviews have been carefully reviewed to identify the potential and possible impacts, trends, and characteristics of global productivity across all regions, countries, and sectors during the COVID-19 global pandemic.

Findings of the Study & Practical Implications

The findings of the study are divided into three parts (Model – Quantitatively, Theoretically, and empirically) as follows:

The study shows that, with human labour supply as the determination factor of production, there is a strong positive relationship between the factor productivity and the capital labour ratio. It further reveals that the amount of increase in the factor productivity might cause a decrease in the per capita income/capital labour ratio. Ultimately, the model supports the relationship between the Covid-19 global pandemic and global productivity by showing that there is a positive relationship between the Covid-19 pandemic and global productivity, which is profoundly connected through human labour supply.

Theoretically, the study demonstrated and proved the profound theoretical linkage between the COVID-19 global pandemic and global productivity. The theoretical linkages were made possible through the two theories of the epidemic theory and the labour theory of value. The cross-cutting theoretical construct (actor) of human labour supply is employed to show the linkage between the pandemic and global productivity, because human labour played a role on both sides (cross-cutting theoretical construct).

The study findings revealed that there are potential negative impacts of the Covid-19 global pandemic on global productivity in terms of contraction of global production inputs such as human labour supply, contraction of global outputs such as GDP, contraction of production value, contraction of production efficiency, and contraction of revenue. Furthermore, the study revealed that there is an unstable trend in production accompanied by a declining motion, caused by the disruptions in the demand and supply chain as well as the loss of human labour supply through the Covid-19 pandemic. Finally, the study exhibits that global productivity is being characterised by an increase in production costs due to the disruption of the supply of raw materials.

The study's practical implications are as follows: the study will be used to improve global productivity and decision-making in three ways: establishing a global unified resilience plan; reviewing and reforming global states' and regions' policies; and conducting additional research.

The Study's Objectives

The present study is focusing on analysing global productivity across regions, countries, and sectors while identifying impacts, trends, and characteristics of global productivity during the COVID-19 global pandemic.

Summary of the chapter

Towards achieving the main goal of the study, the following parts of the study made significant contributions: (1) Theoretical Linkage of the Covid-19 Global Pandemic and Global Productivity, (2) Empirical Analysis of the COVID-19 pandemic's Impacts, Trends, and Characteristics for global productivity, (3) Methodology-A Malthus-Swan-Solow Model (4) Study Findings and Practical Implications,(5) Recommendations and Conclusion,(6) Acknowledgement; (7) Declaration of Research Interest Statement; (8) References

Theoretical Linkage between the COVID-19 Global Pandemic and Global Productivity

The theoretical part of the study plays the linkage role between the COVID-19 global pandemic and global productivity. The linkage and relationship between the COVID-19 global pandemic and global production is demonstrated through the cross-cutting theoretical construct of human beings and human labour supply (which happens and plays a role in both parties). The linkage between the COVID-19 pandemic and global production is well demonstrated through the two theories of the epidemic theory and the labour theory of value. Both theories possess the theoretical construct of human beings. This theoretical linkage between the Covid-19 global pandemic and global productivity in fact justifies and solidifies that the Covid-19 global pandemic caused the contraction of global productivity.

Considering the fact that the Covid-19 global pandemic impacted negatively and worsened global productivity, this study carefully reveals the theoretical relationship between the Covid-19 global pandemic and global productivity. The profound relationship between the Covid-19 pandemic and global productivity is well analysed through the mutual connection and cross-cutting of notions (Human theoretical actors) between the two theories, from the perspective of the Covid-19 global pandemic and the side of global productivity. The repercussions of this linkage happen on the occasion that human beings are affected by the COVD-19 pandemic virus or restrictive measures to combat the virus, and the outcome results reveal the negative impacts on global production such as the contraction of production inputs (human labour supply), production outputs (GDP), production value and efficiency, and ultimately the contraction of business revenue. The other outcomes are revealed through the instability of the trends of production, which exhibits the declining motion of global productivity. And finally, the outcome observed through the characteristics of the increase in production costs in the process of fixing the scarce inputs of production (human labour supply death from the COVID-19 pandemic) and the ultimate outcome is the dramatic contraction of global revenues. The study will employ two theories in explicating the notion of theoretical relationships. These theories are the Epidemic

Theory and the Labor Theory of Value. The Theory of Epidemic will be used to explain the COVID-19 global pandemic, whereas the Labor Theory of Value will be used to explain global productivity. Both these two theories are well connected by the cross-cutting theoretical construct (actor) known as "Human".

The human theoretical actor (Construct) plays the linkage role between the Covid-19 global pandemic and global productivity, which happens to be a cross-cutting theoretical notion which acts in the Covid-19 global pandemic through the theory of epidemic, and further acts in global productivity through the theory of labour theory of value. Exemplifying the linkage role of the human actor within the theoretical construct, observe the following two kinds of circumstances, one from the theory of the epidemic and the other from the Labor Theory of Value. The Epidemic theory is well constructed through the three key theoretical constructs, which are: the agent, the host, and the environment. The Epidemic theory focuses on addressing the circumstances where the agents (infectious pathogens) are delivered to the host (human beings, animals, or rats) and the outcome (diseases and death) is carefully observed. From the Epidemic theory, the host (human beings) is the linkage theoretical construct (actor), which has already acted in the Epidemic theory, and will further act and happen in the Labor Theory of Value. The second circumstance is the demonstration of the labour theory of value as representing global productivity. The labour theory of value focuses on explaining the relationships between human labour and the value of the output produced. The theory emphasises that the amount of human labour employed in production has a direct impact on the final product's value. From this point, human labour is playing the theoretical linkage between the COVID-19 global pandemic (as shown through the Epidemic theory) and global productivity as it has an impact on the final output produced in production. Consider the following explanations of the epidemic and the labour theory of value for a comprehensive theoretical understanding.

The Epidemic Theory

The epidemic theory is profoundly focused on describing the circumstances whereby the infectious pathogens spread out and are given to rats, and furthermore, the outcomes in terms of disease prevalent and deaths are carefully observed. The epidemic theory is well formulated through the three theoretical constructs, which are: the agent (infectious pathogens), the host (rats/living organisms), and the environment. In the epidemic theory, the agent represents the infectious pathogens, while the host represents the living organism, such as rats, and the environment represents the places where the living organisms live and the infectious pathogens can be kept and spread out (Heesterbeek and Dietz 1996). Refer to table number 1 for a complete understanding of the theoretical constructs of the epidemic theory.

According to the Epidemic theory, the host (Living organisms/Rats/Human beings) is the theoretical construct (actor) that acts as a link between the Covid-19 global pandemic and global productivity because it occurred and is mentioned in both theories (Cross-cutting theoretical construct).

1st Table

The following table exhibits and explains the three theoretical constructs which make up the theory of epidemics.

The number	Theoretical Construct (Actor)	Explanations
a single agent		The theoretical actor agent, meaning the infectious pathogens delivered or introduced to a particular colon where the living organs are present, and the effect is observed.
2	Host	The theoretical actor host, meaning the living organism to whom the infectious pathogens are given, followed by the effect to be observed. Environment 3
		The theoretical actor environment explains the areas and places where the host is living.

Heesterbeek and Dietz, 1996).

The Labor Theory of Value

The labour theory of value explains the understanding that the labour supply employed in the production process is the key factor and determinant of the value of the goods or services delivered in the market for exchange (Dooley 2005). The theory's main notion is well constructed through the two main actors (theoretical constructs), which are the labour supply (Human labor) and the value of the goods or services given out after the production process ends. The theory emphasises the understanding that the amount of human labour available and employed in the production process is the sole determinant of the final value of the output produced or services rendered in the market (Dooley 2005).In addition to that, the study of (Whitaker 2001) as well emphasised that the theory of labour value endeavours to explain the relationships between labour supply and the value of the goods produced for money exchange. Focus on Table 2 for a comprehensive understanding of the Labor Theory theoretical constructs.

Human labour supply theoretical constructs reveal and play the linkage role between global productivity and the Covid-19 global pandemic. Consider the epidemic theory in the context that the infectious pathogens are delivered and the human beings (living organisms) are affected or die. The same human beings affected by the infectious pathogens are the same human beings needed for production of output. The logic is that human beings are a cross-cutting theoretical construct between the pandemic and global productivity. In the circumstance that human beings are affected by the infectious pathogens, they must also affect production and global productivity at large.

Table No. 2

The following table explains the theoretical actors (theoretical constructs) employed in the theory of labour of value.

The number	Theoretical Construct (Actor)	Explanations
1Human labour supply is the amount of labour force employed in the production process, and it is a key determinant of the market value of the final outcome good/product/service.		
2	Final goods/service value is	the final outcome generated in the production process through the employed human labour supply and sent to the market for monetary exchange.

(Dooley, 2005)

Other Research Is Being Conducted to Extend Theoretical Contributions on the Relationship Between the Covid-19 Pandemic and Global Productivity

Other studies have demonstrated the applicability of the epidemic theory in responding to and controlling contagious diseases such as the Covid-19 global pandemic. In a pragmatic example, the study of Patten and Arboleda-Flórez (2004) focusing on discussion of the epidemic theory in a group of violent individuals revealed that the epidemic theory might be applicable to address the emergence of contagious diseases through the construction of a mathematical model in reflection of the pandemic theory (Patten and Arboleda-Flórez 2004). Apart from that, the study (Dooley 2005) focused on analysing the labour theory of value, profoundly discussing the labour theory of value, and stating that the labour theory of value focuses on the two key theoretical actors, which are labour supply and the final value of goods in the market. From that perspective, the amount of labour supplied in the production process is the key determinant of the value of the goods/services offered in the market for money exchange (Dooley 2005). In addition to that, the study identified that labour supply is the only scarce production input and the need to pay the costs to obtain a reasonable amount of labour supply in the production process, meaning that the cut in labour supply or failure to obtain the amount of labour supply in the production process

might trigger a dramatic increase in the production costs (Dooley 2005). In the discussion of the labour theory of value, some studies discussed the criticism of the theory. In a pragmatic example, the study of (Ehrbar and Glick 1987) revealed that one criticism of the theory is that some goods in the markets with exchange value are not the outcome of labor.

Generally, theoretically, through the two theories of the Epidemic Theory and the Labor Theory of Value, with their cross-cutting (playing part in both theories) theoretical construct of human beings, it has been proven that there is a profound theoretical linkage between the Covid-19 global pandemic and global productivity. The repercussions of this linkage happen on the occasion that human beings are affected by the COVD-19 pandemic virus or restrictive measures to combat the virus, and the outcome results reveal the negative impacts on global production such as the contraction of production inputs (human labour supply), production outputs (GDP), production value and efficiency, and ultimately the contraction of business revenue. The other outcomes are revealed through the instability of the trends of production, which exhibits the declining motion of global productivity. And finally, the outcome is observed through the characteristics of the increase in production costs in the process of fixing the scarce inputs of production (human labour supply death from the COVID-19 pandemic), and the ultimate outcome is the dramatic contraction of global revenues.

Empirical Analysis of the COVID-19 pandemic's Impacts, Trends, and Characteristics for Global Productivity

The study findings revealed that there are potential negative impacts of the Covid-19 global pandemic on global productivity in terms of contraction of global production inputs such as human labour supply, contraction of global outputs such as GDP, contraction of production value, contraction of production efficiency, and contraction of revenue. Furthermore, the study revealed that there is an unstable trend in production accompanied by a declining motion, caused by the disruptions in the demand and supply chain as well as the loss of human labour supply through the Covid-19 pandemic. Finally, the study exhibits that global productivity is being characterised by an increase in production costs due to the disruption of the supply of raw materials.

From the fact that tremendous literature evidence keeps on emphasising that the Covid-19 global pandemic demonstrated an unprecedented contraction of global productivity in terms of global GDP, global general output, and global production value and efficiency, the evaluation of the relationship between the Covid-19 global pandemic and global productivity has become indispensable. The study is rigorously observing the relationship between the Covid-19 global pandemic and global productivity indicators (human labour supply, production output, factor productivity, production value, and efficiency) while focusing on pointing out the impacts, trends, and characteristics of the Covid-19 global pandemic on global productivity.

Considering the impacts, trends, and characteristics of the Covid-19 global pandemic on global productivity, the growing body of literature evidence indicates that the Covid-19 global

pandemic has negative impacts on global productivity, while the trend of global productivity during the Covid-19 pandemic happens to be flexible and in decline motion, and furthermore, global productivity is characterised by the increase in costs of production in a process of compensation for the loss of inputs of production, such as the death of human labour supply.

An Examination of the Effects of the COVID-19 Global Pandemic on Global Productivity

Recent proliferated literature evidence reveals that the Covid-19 pandemic negatively impacted global productivity. The impact of the pandemic has particularly been revealed in the contraction of global production inputs such as human labour supply, the decline in global output such as GDP, and the deterioration of global production value and efficiency. In a pragmatic example, in the Asia Pacific region (Australia), the study of (Kpmg 2020) emphasised that the pandemic caused the decline of production inputs and outputs.

The growing body of literature evidence supports the notion that the Covid-19 global pandemic has caused a contraction of global productivity in terms of production inputs (human labour supply), production outputs (GDP), production value of goods, and production efficiency, where the repercussions as well as the contraction of the revenue of the global regions, countries, and sectors. The following literature strongly supports those commitments: The potential negative effects of the COvid-19 pandemic have been revealed in the Asia Pacific Region, particularly in Australia, where a study (Kpmg 2020) revealed a contraction in production inputs (human labour supply), production outputs (GDP), production value, and efficiency as a result of the pandemic's outcomes. The International Labor Organization (ILO) has made significant efforts to analyse the impacts of the COVID-19 global pandemic on global work. The analysis reveals that the COVID-19 global pandemic has potential negative impacts on the global production and labour market (I L O 2020). The International Labor Organization (ILO) reports further demonstrated the areas which profoundly impacted global production, which were revealed to be the demand and supply of goods, investments, and consumption (I L O 2020). In a special circumstance regarding the disruptions to global productivity revealed in Asia, where the outcome of the disruptions to the production process by the Covid-19 global pandemic has been extended to across the world, (ILO 2020). Concerning the impact of the Covid-19 pandemic on Asia regional production, the consequences include business decline and closure, job loss, and a continuous contraction of business revenue (I L O 2020).The pragmatic example of the impact of the Covid-19 pandemic on production is well identified through the study of the World Bank Group while assessing the impact of the pandemic on labour supply in Turkey. The study findings show that the production in put (human labour supply) is at risk due to the death of the virus and other outcomes such as the 7 million employees losing their jobs in Turkey during the year 2020 (Seker, Ozen, and Erdogan 2020). Exemplifying the scenarios of the impacts of the pandemic on global productivity, the literature (Jung et al. 2016) shows that the pandemic has a strong impact on consumer behaviors, which has repercussions for the contraction of production due to changes in consumer consumption. In a pragmatic example of the impacts of the Covid-19 pandemic on global production, the special report of the European Union revealed that the covid-19 pandemic has significantly disrupted the productivity of the European region due to the strong restrictions

in response to the pandemic, which revealed the fall in trade, the fall in demand and supply, revenue, and eventually productivity (Delivorias and Scholz 2020). To overcome adversity during and post-crises such as the COvid-19 global pandemic, the study (Obrenovic et al. 2020) recommends global business enterprises focus on establishing a resilience plan and implementing it carefully for the thrive of their enterprises and global productivity at large. The impacts of the COVID-19 pandemic across global regions, countries, and sectors have been identified through the contraction of production inputs (human labour supply), production outputs (GDP), production value, production efficiency, and ultimately production revenues.

Analysis of the Trends in Global Productivity during the COVID-19 global pandemic

Focusing on the trends of global productivity during the Covid-19 global pandemic, the growing body of literature evidence emphasized that productivity is flexible, unreliable, and happens to be in a declining motion due to the uncertainty of production inputs such as human labour supply since the number of deaths due to the Covid-19 pandemic has increased across the world. The instability of the productivity trends that happen to global production inputs (Human labour supply death), the repercussions of which are the contractions of global outputs (GDP), and eventually the decline in both production value and efficiency. In a pragmatic example, (Fao 2020) mentioned Tanzania, Uganda, Kenya, Rwanda, and Burundi as countries which revealed the decline and instability trends in agriculture and food production due to the potential destruction of the demand and supply chain across the world.

Recently, tremendous literature evidence keeps on emphasizing that the trends in global productivity across global regions, countries, and sectors are not stable (instability) accompanied by a declining motion due to the outcomes of the Covid-19 global pandemic. The following literature strongly supports that notion of the study: The potential research study of food and agriculture in the United Nations shows that the Covid-19 pandemic triggered the decline and instability trends in agriculture and food production in the region of Eastern Africa (Fao 2020).

The research study undertaken by the International Labor Organization (ILO) focusing on analysing the impacts of the Covid-19 global pandemic on the global work for policies revealed that the trends of global production happen to be uncertain with flexibility, which results in the continuous decline of global production, employment, and revenue (I L O 2020). Focusing on global production uncertainty trends, the literature (ECLAC 2020) emphasised that the restrictions imposed in response to the Covid-19 global pandemic had a negative impact on trade and logistics, with repercussions on the flexibility and uncertainty of global productivity (ECLAC 2020).In a pragmatic example, (Fao 2020) mentioned Tanzania, Uganda, Kenya, Rwanda, and Burundi as countries which revealed the decline and instability trends in agriculture and food production due to the potential destruction of the demand and supply chain across the world. In a pragmatic example, the study (Taqi et al. 2020) conducted in order to identify the possible measures for mitigating the impacts of the Covid-19 global pandemic revealed that the trend of production during the Covid-19 global pandemic is not stable (instability) and not reliable due to the devastating negative impacts of the Covid-19 pandemic on the supply chain

(Taqi et al. 2020). Apart from that, other studies have come up with recommendations and measures to overcome the crazy and flexible trends of global production during the emergence of new emergences such as the Covid-19 pandemic. In a pragmatic example, the study (IDB 2020) identifies science measures in response to the Covid-19 pandemic, production innovation, and changes in production strategies as the key measures to adopt in response to the pandemic and re-store sustainable global productivity (IDB 2020). In conclusion, the literature observed that the potential impact of the COVID 19 pandemic across global regions, countries, and sectors triggered the instability trend in production in declining motion. This is potentially caused by the significant disruptions in demand and supply chain, as well as the loss of human labour supply due to death or responding to the movement restrictions imposed as measures in response to the pandemic.

Analysis of the characteristics of global productivity during the COVID-19 global pandemic

The main characteristics of global productivity during the COVID-19 global pandemic were revealed to be the increase in production costs across all global regions, countries, and sectors. The increases in production costs have been triggered by the process of replacing lost production inputs (human labour supply death) to meet the desired planned production goals, and the disruptions in demand and supply. In a practical example, the European Union reports that industrial production costs shifted higher due to the significant disruption of the demand and supply chain in response to the Covid-19 pandemic, (EuropeanUnion 2020).

The proliferated literature evidence suggests that the Covid 19 pandemic has triggered an increase in production costs in the global regions, countries, and sectors that might be specifically subject to serious disruptions in demand and supply, as well as the loss of human labour supply from death occurrences or movement restrictions in response to the pandemic measures. The following literature provides illustrations of the increase in costs of production during the pandemic as an important characteristic identified: Consider the case of European region production during the Covid-19 pandemic. The study (EuropeanUnion 2020) shows that production costs will increase due to the disruption of supply in the supply chain and labour supply as the potential outcome of responding to the Covid-19 pandemic, (EuropeanUnion 2020). The study (Martin S. Eichenbaum;, Sergio Rebelo;, and Trabandt 2020) focusing on the macroeconomics of pandemics revealed that one of the key factors triggering the dramatic increase in production costs (Martin S. Eichenbaum;, Sergio Rebelo;, and Trabandt 2020).Consider the circumstances of South Asia. The study (Islam et al. 2020) was undertaken to analyse the potential economic impact of the pandemic on the region. The study findings emphasised that there is an increase in production costs due to the disruption of supply such as raw materials and human labor. (Islam et al. 2020). In a practical example, the European Union reports that industrial production costs shifted higher due to the significant disruption of the demand and supply chain in response to the Covid-19 pandemic, (EuropeanUnion 2020). In a pragmatic example, the study of the OECD discussing exploitative pricing during the Covid-19 global pandemic shows that the disruption of the global supply chain has triggered the

continuous increase in prices and production costs during the Covid-19 global pandemic (OECD 2020). Exemplifying the increase in the costs of production during the Covid-19 global pandemic, the study (Dooley 2005) revealed that labour supply is the only scarce resource in the production process and the need to incur a reasonable number of costs is the genuine factor for the increase in the production costs. The cut in labour supply during the emergence is the genuine factor for the increase in the costs of production. Towards addressing the increases in costs during the pandemic, the literature (Dimitri 2015) significantly recommends the proper allocation of resources during the production process and optimal utilisation of resources as the best approach to overcome the increases in costs due to the disruptions in business and production during the pandemic. Generally, the scarcity of human labour supply (production in puts) and the serious disruptions of demand and supply have been identified as the factors that triggered the increase in cots of production during the Covid 19 pandemic, and that is the important characteristic of the pandemic.

In summary of the impacts, trends, and characteristics of global productivity during the Covid-19 global pandemic, the study has carefully observed and analysed the impacts, trends, and characteristics of the Covid 19 pandemic on global productivity, particularly across global regions, countries, and sectors, and further comes up with the following core study findings: The study identified potential negative impacts of the Covid-19 pandemic on global productivity in terms of the contraction of production inputs (human labour supply), production outputs (GDP), production value, production efficiency, and ultimately production revenue across global regions, countries, and sectors during the Covid-19 pandemic. The study further identified the unstable trends of production with declining motion as triggered by the Covid 19 pandemic, particularly due to the significant disruption of demand and supply, as well as human labour supply scarcity. Finally, the study revealed that production was characterised by an increase in production costs which was triggered by the demand and supply chain disruptions due to the pandemic restrictions on transportation.

The methodology

- **A Malthus-Swan-Solow Model**

In this study, towards analysing global economic productivity during the Covid-19 global pandemic, we focus on the labour supply notion of the Solow-Swan growth model, particularly on Malthusian notions. In that regard, we focus on evaluating the relationship of factor productivity against the capital labour ratio towards finding steady and stable equilibrium states.

Focus on the notion of the study in the context of the linkage and relationship between the study quantitative model (A Malthus – Swan – Solow Model), the theoretical part of the study, and the empirical part of the study. The study argues that human labour supply is the driver and linkage of the three parts of the study (quantitative model, theoretical part, and empirical part) because it is a cross-cutting factor (happens and plays a role in all parts of the study). From that fact, human labour supply (factor of production/production put) solidifies and justifies the linkage and

relationships between the Covid-19 global pandemic and global productivity. This argument solidifies the empirical study findings that the Covid-19 global pandemic has had negative impacts on global productivity in terms of contraction of the inputs of production, output, global GDP, and value and efficiency of produced goods. These effects are accompanied by insecurity trends in the manufacturing process, which are characterised by an increase in production costs, with the end result being a reduction in revenue across global industries, countries, and sectors at large.

Assumptions

1. Consider the Cobb-Douglas production function [Y = AK1L] according to the model's first assumption. The focus will be on the two main factors of production, which are: labour (L) and capital (C). From the above equation, the meaning is that the economy is delivering a unique good named Y, whereby the unique good can be consumed as either a consumption good or an investment good. From the above proposed equation, A represents the factor productivity. A factor of production, in its definition, is an economic factor which can be taken and applicable to affect the final output of a production. The pragmatic examples of the factors of production are technology, institutions, or human capital.

2. Considering the operating firm which hires labour and capital for production undertakings and further pays wages (w) for the labour and rent (r), from this given economic assumption, the firm's core goal is profit maximization. From that regard, the first condition of the firm's profit maximisation will be represented by the following equation; = AK1L1=Ak1 from the above equation K – represents the economic factor Capital-Labor Ratio.

3. Third, focus on the capital accumulation assumption. Consider the scenarios where consumers make the determined fixed income proportion named S. With regard to the capital accumulation equation, it will be; K = sY dK. From this equation, K is escalated in K, and the variable generic Z represents the growth rate amount named gz. Considering those assumptions, the following equation can be written as follows:

4. gK = s Y K d = sAk d, up to this point of view and assumption. This is known as the Swan-Solow Model.

5. From the context and discussion of the Swan-Solow Model, the component (segment) of the Malthusian is further introduced. The first assumption of the model is that the percentage growth rate of labour throughout depends on the real wages given. This can be written and further represented in the following equation [Gl = g (w)].

6. Considering the model assumption that the increase in population might be the linear function of the proposed real wage, thus the equation will be [Gl = -c + bw, where by b is greater or equal to 0.]. In fact this is the general assumption of the model (Solow-Swan Model) that the rate of the population growth is always given through the assumption (In

which the case b = 0 and case c <0). Considering the assumption that population grow in a scenarios if w> c/b. From that regards, c/b can be described as the given wages to help the substance of the labor.

Conclusions:

7. Focusing on the results, we can solve the model as follows; Consider equation numbers (2) and (5). The outcomes of the calculations will be expressed in the equation; From this equation, assume gk = Gk – Gl is assumed to be the capital-labour ratio of the rate of growth. The following are the results of using equation numbers (4) and (7):

8. From this equation, the capital labour ratio will be k*, meaning that gk = 0. In this regard, consider the following 5 consecutive series of prepositions to address the model and the results:

Proposition No. 1:

Considering the assumption that the Malthus-Swan-Solow Model (MSS) has a SS

Proof of this

Keeping in mind; [s AK (-Thita) (-d) (-g) (Thita AK (1-Thita)]During K–0, it always tends to + (Alpha).The proposed continuous function takes positive values in the set of different intervals near to zero. In the k---Alpha scenarios, this equation tends to –d-g [(Thita AK (1-Thita)], with K being negative, because g (w) > d.Alpha (w) > w'. From that regard, the interpretation is that the intermediate value theorem stands for the results.

From that point of view, consider the following assumptions and conditions:

9. 1 A (1) (k) sA (k) sA (k) sA (k) sA (k) sA(A (k) 1) g 0g'() is derived from g(). The assumption at this level (9) is that at level 8, the slope of the right hand side may not be zero at any time, but its value is zero.Considering preposition 1 and the above assumption in level number 9, we further focus on the following preposition, considered to be preposition number 2.

Preposition 2

A Malthusian-Swan-Solow Model has an odd number of SS at level 9.

Proof of this

Remember the preposition number – 1 assumption that the right side of the level number – 8 behaves as +& at k---0 and when k---& is negative.Considering level-9 and assuming the right side of level-8 has a non-vanishing slop in the point of k*, the intersection number in this equation (function) with the k axis is ODD.

In the following example (Third example), the assumption is that the possibility of having more than one SS exists.

Exemplification 3

Assuming that g (w) =min [0, *AK (1-*) – (*AK (1-*) 2)],The assumption is that the population rate will increase and real wages will increase up to a certain point. We further assume that if wages tend to increase, the outcome is that the population increase rate tends to decrease, but not surpass ZERO.

Further, let S=3, A=1, *=5, d=1, further assumption. In a while, without considering non-negative constraints (on the occasion when k > 4), the function and equation to classify SS will be;

0.3/k (0.5 power) – 0.5k (0.5 power) + 0.2k (1.0 power) – 0.1 = 0

We further study the stability of SS. We assume that a SS value of k, let us call it k*, is stable if a small perturbation of k* produces a dynamic in level number – 8, resulting in k tending to k*.

10. A (1) (k) g 0 (A (k) 1) > 0 sA (k) 1 + A (1) (k) g 0 (A (k) 1)

The following results are the outcome of proposition number 2:

Proposition number four

In the case of level 9, the steady state values were found to be stable for both the largest and smallest values.SS? Alternatives for stable and unstable Remember that Level number 9 generalises to Level number 6. Furthermore, the capital labour ratio in the SS, k*, tends to be with self-features and remain stable because the level number – 8 may resemble the equation below in level 11.

11. gk = sAkd + c bAk1

In fact, the right side of level 11 tends to decrease in k.

On one hand, the economy might be locked into a SS which has a low per capita income, but on the other hand, the other SS might have a large per capita income. Remarkably, we argue that profit maximisation might not be determined by the difficult process of obtaining a high level of per capita income.

We further focus on studying the SS Comparative statics. The following results reveal that on the occasion when technological parameter a has to increase, it might have an impact on the MSS model, which might be in a different form from the Swan-Solow model.

Proposition No. 5

Considering the circumstance of the stability of the SS. As a result, the small increase in assume – A may also increase k* iff s > k g 0 (A (k) 1), whereas in Level-6, iff d > c

The proof

When the right side of the level number – 8 on the occasion is equal to zero, the results are as follows; (Shown in level – 12)

12. dk/dA = s k g 0 (A(k) 1)/As(k)1 + (1) dk/dA = s k g 0 (A(k) 1)/As(k)1 + (1) dk/dA =(A (k) 1) Ag0

Remember that in the SSM model (Solow-Swam Model) g'() = 0, therefore in the trend of increases of assume – A, the repercussion might be on increasing k* as well. However, in a Malthus – Swan – Solow Model (MSS), technology might be increasing and the outcome might be a decrease in the capital labour ratio, simply because it has increased Gl.

The final study and results will concentrate on SS (y*) analysis to express the impact of the assumed technology parameter – A on per capita income.

Sixth proposition

Considering the occasion, the SS is in stable condition, thus the small amount of increase is assumed to be the outcome of an increase in per capita income.

The proof

We know from previous research that y = A (k) 1.Thus,

13. (k) 1 + A (1) (k) dk/dA = (k) 1 + A (1) (k) dk/dA

14. As(k) /As(k)1 + (1)Ag0A (k)

The level number – 14 in the example is the result of plugging the level number-12 into the level number-13.

We conclude this segment by arguing that, on occasion, the SS tends to be stable, k* tends to be increasing in the savings rate S, and further, the depreciation rate d.

Specifically, methodological findings revealed that by focusing on human labour supply on the occasion of finding the equilibrium states, the increase in factor productivity might cause a decrease in capital income. Meaning that there is a positive relationship between factor productivity and capital income via the actor of human labour supply, and that there is a strong positive relationship between the Covid-19 pandemic and global productivity via the actor of human labour supply as well (since human labour supply is a cross-cutting actor).

In sum, methodologically

A Malthusian – Swan – Solow Model demonstrated the relationships between the factors productivity and capital labour ratio, while focusing on the amount of labour supply in production, in order to find a steady and equilibrium state in economic production.Meaning that during the production process while focusing on the human labour supply (production factor and input of production), in the event of an equilibrium state, the amount of increase in a factor of production might result in a decrease in the capital labour ratio. The model improves understanding of the relationship between the COVID-19 global pandemic and global productivity by focusing on the production input – factor of production (human labour supply).It has been revealed that human labour supply as a production input (factor of production) happens to be a cross-cutting factor which happens in all determinants of global productivity as well as in the COVID-19 global pandemic concerns.

Focusing on human labour supply (production input/factor of production), we argue that there is a strong positive relationship between the factor of production and the capital labour ratio. Also, there is a strong positive relationship between the Covid-19 global pandemic and global productivity and revenue at large. In addition to that, further explanations might be through focusing on the notion of the study in the context of the linkage and relationship of the study quantitative model (A Malthus – Swan – Solow Model), theoretical part of the study, and empirical part of the study. The study argues that human labour supply is the driver and linkage of the three parts of the study (quantitative model, theoretical part, and empirical part) because it is a cross-cutting factor (happens and plays a role in all parts of the study). From that fact, human labour supply (factor of production/production put) solidifies and justifies the linkage and relationships between the Covid-19 global pandemic and global productivity. This argument solidifies the empirical study findings that the Covid-19 global pandemic has had negative impacts on global productivity in terms of contraction of the inputs of production, output, global GDP, and value and efficiency of produced goods. These effects are accompanied by insecurity

trends in the manufacturing process, which are characterised by an increase in production costs, with the end result being a reduction in revenue across global industries, countries, and sectors at large.

Other studies undertaken through the methodology of the Malthus–Swan–Solow Model

The research study undertaken by (Corchón 2016) focused on analysing a Malthus–Swan Solow model through focusing on human labour supply. The study findings revealed that in an equilibrium stable state during the production process, the amount of increase in the factor productivity might be decreased, (Corchón 2016). The findings of (Corchón 2016) are more similar to our study findings because they reveal the relationship between factor productivity and capital labour ratio while focusing on human labour supply on the occasion of determining the equilibrium state, because the study findings emphasise that an increase in factor productivity may result in a decrease in the capital labour ratio.

Other studies have been conducted to investigate the COVID-19 Global Pandemic and Global Productivity.

The potential study of the World Bank group undertaken to evaluate the global productivity in terms of drivers, trends, and policies across different countries, sectors, and times, from the year of 1990 to 2020, one of the study findings revealed the contraction of the global productivity during the global crisis of 2008 and during the Covid 19 global pandemic during the year of 2020, (Dieppe et al. 2020). The study by Obrenovic et al. 2020, focusing on evaluating global productivity and business firm sustainability during the Covid-19 global pandemic, carefully suggests that in order to overcome the diversity of emergences such as the Covid-19 pandemic, the focus must be on establishing an effective resilience approach plan which will be implemented in response to the emergence outcome and finally restore business firm performance and global productivity at large. (Obrenovic et al. 2020). In the context of the macroeconomics and pandemics analysis, the study of (Martin S. Eichenbaum;, Sergio Rebelo;, and Trabandt 2020) revealed that human beings' response to the pandemic through the cut in labour supply or consumption of goods is among the factors that exacerbate the recession of the Covid-19 global pandemic, (Martin S. Eichenbaum;, Sergio Rebelo;, and Trabandt 2020). The International Labor Organization's study focusing on the analysis of the Covid-19 global pandemic to global work outcomes and global productivity reveals that the pandemic has changed the entire global work paradigm, environment, and work outcome from a normal situation to an economic and human labour market crisis, with the repercussions manifested through the contraction of global productivity and revenue of business firms and governments (I L O).

Findings of the Study & Practical Implications

The findings of the study are divided into three parts (Model – Quantitatively, Theoretically, and Empirically) as follows:

The study shows that, with human labour supply as the determination factor of production, there is a strong positive relationship between the factor productivity and the capital labour ratio. It further reveals that the amount of increase in the factor productivity might cause a decrease in the per capita income/capital labour ratio. Ultimately, the model supports the relationship between the Covid-19 global pandemic and global productivity by showing that there is a positive relationship between the Covid-19 pandemic and global productivity, which is profoundly connected through human labour supply.

Theoretically, the study demonstrated and proved the profound theoretical linkage between the COVID-19 global pandemic and global productivity. The theoretical linkages were made possible through the two theories of the epidemic theory and the labour theory of value. The cross-cutting theoretical construct (actor) of human labour supply is employed to show the linkage between the pandemic and global productivity, because human labour played a role on both sides (cross-cutting theoretical construct).

The study findings revealed that there are potential negative impacts of the Covid-19 global pandemic on global productivity in terms of contraction of global production inputs such as human labour supply, contraction of global outputs such as GDP, contraction of production value, contraction of production efficiency, and contraction of revenue. Furthermore, the study revealed that there is an unstable trend in production accompanied by a declining motion, caused by the disruptions in the demand and supply chain as well as the loss of human labour supply through the Covid-19 pandemic. Finally, the study exhibits that global productivity is being characterised by an increase in production costs due to the disruption of the supply of raw materials.

The study's practical implications are as follows: the study will be used to improve global productivity and decision-making in three ways: establishing a global unified resilience plan; reviewing and reforming global states' and regions' policies; and conducting additional research.

Conclusion & Recommendations

The potential impacts of the COVID-19 global pandemic have been identified in the contraction of global productivity in terms of production inputs (human labour supply), production outputs (GDP), production value, and efficiency. The potential impacts of the Covid-19 global pandemic in the contexts of production inputs, outputs, GDP, value and efficiency of production have been identified through the study of (Cross, Ng, and Scuffham 2020), where the study findings emphasise that the dire economic impacts of the pandemic have been demonstrated through the contraction of production inputs (human labour supply), production output (GDP), product value

and efficiency (Cross, Ng, and Scuffham 2020). From that perspective, this study is focusing on analysing global productivity across global regions, countries, and sectors while identifying the potential impacts, trends, and characteristics of global productivity during the COVID 19 global pandemic.

Focusing on the main actor of the study (human labour supply), study findings revealed a positive relationship between global productivity and capital income, further justifying that there is a strong positive relationship between the Covid-19 global pandemic and global productivity. Ultimately, the study shows the impacts, trends, and characteristics of global productivity during the Covid-19 pandemic and recommends measures to enhance global productivity during the Covid-19 pandemic.

Recommendations for further studies

It is inevitable for future studies to evaluate the relationship between the cases of the Covid-19 global pandemic and the industrial global productivity in figure paradigm during the entire period of the Covid-19 global pandemic across global regions, countries, and sectors.

Recommendations for addressing the global productivity and revenue contraction from the Covid-19 pandemic impacts

1. introduction of a global unified, integrated, and coordinated resilience plan across all global states via the United Nations, focusing on responding to, recovering from, and thriving from an emergence such as the COVID-19 global pandemic.In a pragmatic example, the research study (FAO 2014) titled "Strengthening Resilience during the Time of Threats and Crisis", one of the study findings and recommendations strongly emphasised the establishment of the sustainable resilience plan as the proper measure in response to the emergence of such an event as the COVID-19 global pandemic, for quick recovery and thrive of global productivity.

2. Global states and United Nations policies' intervention (measures) and policies' review for proper response to the emergence of pandemics such as the COVID-19 global pandemic are such policies such as industrial policy review, fiscal and monetary review, and investment policies. The study (Mary Ahearn, Yee, and Huffman 2002) was undertaken to analyse the impact of government policies on enhancing agricultural productivity. The findings of this study revealed that there was a strong positive impact of government policies in promoting and enhancing productivity.

3. Global states must focus and direct more funds to invest in advanced technology and innovations to replace human beings who are being replaced by robots in the production process. Tremendous studies supported this notion. Among these studies is the study by Wisskirchen et al. (2017), which studied the artificial intelligence of robots and their impact on production. The study findings revealed that robots have a significant impact

on the production process, and further, the study recommends the application of robots for the quick production process and enhanced efficiency in production.

4. Education and scientific knowledge should be given to people in proper response to the COVID-19 global pandemic. The research study (Reiss 2020) strongly recommends education and scientific knowledge to be given to the global community as a means of proper response to the COVID-19 global pandemic and to further enhance global productivity.

Substantial investments in research to address global emergencies such as the COVID-19 global pandemic. The potential study (EuropeanCommission 2020) reveals that it is not possible for the global community to address the proliferating number of global emergencies without strong emphasis on research and innovation to come up with reliable answers for defeating global emergencies such as the COVID-19 global pandemic and global warming, and furthermore, to restore and enhance global productivity and revenues.

Acknowledgement

Non

Statement of Declaration of Research Interest

No – Research Interest

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