DETERMINANTS OF TOTAL FACTOR PRODUCTIVITY GROWTH IN DIFFERENT POSTAL DESIGNATED OPERATORS

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MASTER OF ECONOMICS IN APPLIED ECONOMICS
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A THESIS SUBMITTED IN PARTIAL FULFILLMENT
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ชื่อเรื่อง ปัจจัยที่มีผลต่อการเติบโตของผลิตภาพการผลิตรวมของตัวแทนไปรษณีย์สากลในแต่ละประเทศ
ชื่อผู้เขียน นางสาวธัญวรัตม์ แก้วทอง
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บทคัดย่อ

การศึกษานี้วัดการเติบโตของผลิตภาพการผลิตรวม (TFP) ของตัวแทนไปรษณีย์สากลและปัจจัยที่กำหนดการเติบโตของผลิตภาพการผลิตรวมโดยการใช้ DEA-Malmquist Productivity Index และการวิเคราะห์การถดถอยด้วย EGLS ผลการศึกษาพบว่าการเติบโตของ TFP โดยเฉลี่ยในเอเชีย ยุโรป และ CIS รวมถึงละตินอเมริกาและแคริบเบียนเพิ่มขึ้นจากปี 2016 ถึง 2018 ในขณะที่แอฟริกาเป็นเพียงภูมิภาคเดียวที่มีการเติบโตของ TFP เป็นแนวโน้มที่ลดลง ผลการวิจัยยังแสดงให้เห็นว่าในบรรดาปัจจัยที่กำหนดการเติบโตของ TFP นั้น ปัจจัยระดับของรายได้, ปัจจัยคุณภาพของไปรษณีย์ (2IPD), และปัจจัยการเปิดเสรี มีความสัมพันธ์เชิงบวกกับการเติบโตของ TFP ในขณะที่ปัจจัยดัชนีนวัตกรรมโลก (GII) มีความสัมพันธ์เชิงลบกับการเติบโตของ TFP ผลลัพธ์เหล่านี้สามารถสนับสนุนให้ตัวแทนไปรษณีย์สากลพิจารณาการพัฒนาการดำเนินงานโดยมุ่งเน้นไปที่การเปิดเสรีในภาคไปรษณีย์และคุณภาพของตัวแทนไปรษณีย์สากล และรัฐบาลสามารถสนับสนุนภาคไปรษณีย์ได้ด้วยการออกนโยบายเพื่ออำนวยความสะดวกให้กับภาคไปรษณีย์โดยเร็วที่สุด ตัวอย่างเช่น การปรับปรุงโครงสร้างพื้นฐานของประเทศ เช่น การพัฒนาถนนเพื่อการคมนาคมที่ดียิ่งขึ้น

คำสำคัญ : ผลิตภาพการผลิตรวม, Malmquist Productivity Index, Data envelopment analysis, บริการไปรษณีย์

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ABSTRACT

This study measured total factor productivity (TFP) growth of Designated Operators (DOs) from Universal Postal Union and its determinants by using DEA-Malmquist Productivity Index and regression analysis with EGLS. The results reveal that the average TFP growth in Asia, Europe and CIS, and Latin America and Caribbean have increased from 2016 to 2018 while Africa is only region that has decreased trend of TFP growth. The findings also show that among the determinants of TFP growth, the level of income, 2IPD, and liberalization have positive relationship with TFP growth while GII has negative relationship with TFP growth. These results can give consideration for DOs to improve their performance by focusing on being total liberalized in postal sector, and quality of DOs. The government can support them by launch policies that facilitate postal industry such as improving country's infrastructure like road for transportation as soon as possible.

Keywords : Total Factor Productivity, Malmquist Productivity Index, Data Envelopment Analysis, Postal Service

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Tunwarat Kaewthong

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CHAPTER 1
INTRODUCTION

In the last 5 years, e-commerce has experienced continuous growth. From 2016 to 2018, online purchases have increased from 1.1 to 1.45 million people (UNCTAD, 2020a). Furthermore, the proportion of total revenue from parcels and logistics from Universal Postal Union (UPU) has grown continuously from 15% in 2007 to 27% in 2018 (UPU, 2020). In Belgium and Cyprus the volume of domestic parcel services has increased more than 25% from 2016 to 2018 (European Commission, 2020).

The growth in e-commerce lead to an increase in competition as can be seen from higher number of parcel delivery companies. For example, in Thailand, the number of parcel delivery companies increased in the last two years while Hong Kong in 2018, not only has value added of the logistics sector increased by 4.3% from 2017 but also have 14,400 establishments in logistics sector. In Belgium and Cyprus, from 2016 to 2018, total volumes of domestic parcel services have increasing trend from 63,275.3 to 79,593.8 thousand pieces for Belgium and also from 3,806.0 to 4,797.0 thousand pieces for Cyprus. Furthermore, from 2016 to 2018, the market share of parcels of DOs, the representative of the postal companies from UPU in every country, has decreased from 37.80% to be 35.50% (European Commission, 2020; Jaenglom and Tantipidok, 2020; Logistics and Producer Prices Statistics Section

Census and Statistics Department, 2018; UPU, 2020). Consequently, DOs are facing intense competition.

If DOs want to survive in this intense competition, in case there is liberalization in the market, they need to be more productive because more productive firms can increase their market share by grabbing it from lower productive firms and affect lower productive firms exit the market (Competition & Markets Authority, 2015; Holmes and Schmitz, 2010; Schembri and Choudhri, 2002). In some countries which the parcel delivery market is not liberalized, if suppliers are low productive, they need to increase productivity otherwise they will lose the benefit that they could get (OECD, 2002).

Thus, to know productivity growth become important for DOs because they can improve their performance to be more competitive in intense competition. To measure productivity, in transportation field, Malmquist Productivity Index (MPI) is popular for productivity measurement (Assaf, 2011; Cheon et al., 2010; Estache et al., 2004; Li and Hu, 2011; Murillo, 1999; Nicola et al., 2013; Petrović et al., 2012; Ralević et al., 2020). In addition, those studies have found determinants of TFP growth in logistics and transportation field such as Ralević et al. (2020) found that ownership is one of determinant of TFP growth. However, their study considered only DOs in Europe and focused on the year 2003 and 2017 which can be different with situation from 2016 to present. So, it makes we still don't know that how are TFP growth of

DOs and its determinants in each region since 2016 to present which important to DOs to understand overall of their structure and improve their competitiveness.

Thus, this led us to the question “with intense competition in parcel delivery market, how are the TFP growth of DOs in each country around the world and what are its determinants?”. Therefore, the aim of this study is to measure the total factor productivity (TFP) growth of DOs in each country and its determinants in four regions including Africa, Asia-Pacific, Europe and Commonwealth of Independent States (CIS), and Latin America and Caribbean from 2016 to present.

1.1 IMPORTANCE OF THE STUDY

In this study, we will know TFP growth for DOs and what affects to TFP growth. The results will help DOs know how performance they are and what are the determinants that can affect to their TFP growth which can lead them to understand their overall structure of organization and improve their performance follows the determinants to be more competitive in intense competition of parcel delivery market.

1.2 ADVANTAGE OF THE STUDY

The result will help to understand the level of TFP growth and the relationship between TFP growth and quality of DOs, level of liberalization, level of income and innovation. They relate to each other or not and if they relate, they relate to each other in what direction.

1.3 OBJECTIVES OF THE STUDY

The first objective of this study is to measure the total factor productivity (TFP) growth of DOs in each country in four regions including Africa, Asia-Pacific, Europe and Commonwealth of Independent States (CIS), and Latin America and Caribbean.

The second objective of this study is to measure the determinants of total factor productivity (TFP) growth of DOs in each country in four regions including Africa, Asia-Pacific, Europe and Commonwealth of Independent States (CIS), and Latin America and Caribbean.

CHAPTER 2

LITERATURE REVIEW

2.1 POSTAL SECTOR

2.1.1 Postal Structure

DOs in each countries have differences in their structure whether there are governmental authority and regulatory authority, restructuring/ postal reform, labors' status, designated operator.

1. Authorities, Postal Reform, and Labor Status

Some countries, they have both governmental authority and regulatory authority while some countries have only one authority and the restructuring are ongoing or finish in some countries. Moreover, the status of labor is also different, some have the same status as state employees but some are not which we can see the details as in Table 1.

Table 1 *Authorities, Postal Reform, and Labor Status of DOs in Africa.*

Region	Country	Government Authority	Regulatory Authority	Postal Reform	Status of personnel
Africa	Madagascar	Ministry of Telecommunications, Posts and Communications (MTCP)	Directorate for Postal Sector Monitoring (DSSP) of the MTPC	ongoing	same status as other state employees
	Mauritius	Ministry of Information and Communication Technology	The Information and Communication Technologies Authority (ICTA)	ongoing	same status as civil servants

Source: (UPU, 2022f)

Table 1 *(Continue) Authorities, Postal Reform, and Labor Status of DOs in Africa.*

Region	Country	Government Authority	Regulatory Authority	Postal Reform	Status of personnel
Africa	South Africa	Ministry for Communications	Independent Communications Authority of South Africa (ICASA)	ongoing	have their own status as SAPO employees
	Tanzania	Ministry of Communications, Science and Technology	The Tanzania Communications Regulatory Authority (TCRA)	ongoing	same status as other state employees

Source: (UPU, 2022f)

For Africa, all countries have both Government Authority and Regulatory Authority while the status of labor, South Africa is only one country that has their own status. In Table 2 to 4 we can see the different in Asia, Europe and CIS, and Latin America and Caribbean, respectively.

Table 2 *Authorities, Postal Reform, and Labor Status of DOs in Asia*

Region	Country	Government Authority	Regulatory Authority	Postal Reform	Status of personnel
Asia	India	Ministry of Communications and Information Technology	Department of Posts	ongoing	same status as other state employees
	Iran	Ministry of Information and Communication Technology	None	ever	same status as state employees
	Jordan	Ministry of Information and Communications Technology	Telecommunications Regulatory Commission	ever	salaries are based on the salary scales applicable to public employees

Source: (MDES, 2022; UPU, 2022f)

Table 2 *(Continue) Authorities, Postal Reform, and Labor Status of DOs in Asia*

Region	Country	Government Authority	Regulatory Authority	Postal Reform	Status of personnel
Asia	Mongolia	Ministry of Roads, Transport and Tourism	Communications Regulatory Commission	N/A	not clear mention
	Sri Lanka	Ministry of Postal Services	N/A	ongoing	same status as state employees
	Thailand	Ministry of Digital Economy and Society	None	ever	same status as other state employees

Source: (MDES, 2022; UPU, 2022f)

For Asia, only India, Jordan, and Mongolia have both Government Authority and Regulatory Authority which is different from Africa. And some countries have ever had the reform of their operation while some are ongoing. All countries, except Mongolia and Jordan, have the clear labor status that their labors are same status as the state employees.

Table 3 *Authorities, Postal Reform, and Labor Status of DOs in Europe and CIS*

Region	Country	Government Authority	Regulatory Authority	Postal Reform	Status of personnel
Europe and CIS	Armenia	1. Ministry of Transport and Communication 2. State Estate Managing Department	Public Services Regulatory Commission	ever	not clear mention
	Belarus	Ministry of Communications and Informatization	None	none	not have the same status as state employees
	Belgium	Ministry of Economy	Belgian Institute of Postal Services and Telecommunications (BIPT)	ever	not clear mention

Source: (UPU, 2022f)

Table 3 *(Continue) Authorities, Postal Reform, and Labor Status of DOs in Europe and CIS*

Region	Country	Government Authority	Regulatory Authority	Postal Reform	Status of personnel
Europe and CIS	Bosnia and Herzegovina	Bosnia and Herzegovina Ministry of Communications and Transport	Bosnia and Herzegovina Agency for Postal Traffic	none	not clear mention
	Bulgaria	Ministry of Transport, Information Technology and Communications	Communications Regulation Commission (CRC)	ever	not clear mention
	Croatia	Ministry of Maritime Affairs, Transport and Infrastructure	Croatian Regulatory Authority for Network Industries (HAKOM)	ever	not civil servants

Source: (UPU, 2022f)

Table 3 *(Continue) Authorities, Postal Reform, and Labor Status of DOs in Europe and CIS*

Region	Country	Government Authority	Regulatory Authority	Postal Reform	Status of personnel
Europe and CIS	Cyprus	Ministry of Transport, Communications and Works	Commissioner of Electronic Communications and Postal Regulation	ever	civil servants
	Estonia	Ministry of Economic Affairs and Communications	Estonian Competition Authority (ECA)	ever	not clear mention
	Hungary	The Ministry of National Development	National Media and Infocommunications Authority	ever	have their own status

Source: (UPU, 2022f)

Table 3 *(Continue) Authorities, Postal Reform, and Labor Status of DOs in Europe and CIS*

Region	Country	Government Authority	Regulatory Authority	Postal Reform	Status of personnel
Europe and CIS	Italy	Ministry of Economic Development (MISE) – Department of Postal Service	Italian Communications Authority (Agcom)	ever	not have the same status as state employees
	Kyrgyzstan	State Committee of Information Technologies and Communications of the Kyrgyz Republic	State Communication Agency	ever	not clear mention

Source: (UPU, 2022f)

Table 3 *(Continue) Authorities, Postal Reform, and Labor Status of DOs in Europe and CIS*

Region	Country	Government Authority	Regulatory Authority	Postal Reform	Status of personnel
Europe and CIS	Latvia	The Ministry of Transport	The Public Utilities Commission (PUC)	ever	not have the same status as state employees
	Lithuania	Ministry of Transport and Communications	Communications Regulatory Authority of the Republic of Lithuania	ever	not clear mention
	Moldova	Ministry of Information Technology and Communications	None	ever	not have the same status as state employees

Source: (UPU, 2022f)

Table 3 *(Continue) Authorities, Postal Reform, and Labor Status of DOs in Europe and CIS*

Region	Country	Government Authority	Regulatory Authority	Postal Reform	Status of personnel
Europe and CIS	Montenegro	N/A	N/A	N/A	N/A
	Romania	Ministry of Communications and Information Society	National Authority for Management and Regulation in Communications (ANCOM)	ever	not have the same status as state employee

Source: (UPU, 2022f)

Note: Although the data is not available for Montenegro but DOs in this country is under government operation (Vlada Crne Gore, 2021)

Table 3 *(Continue) Authorities, Postal Reform, and Labor Status of DOs in Europe and CIS*

Region	Country	Government Authority	Regulatory Authority	Postal Reform	Status of personnel
Europe and CIS	Serbia	Ministry of Foreign and Internal Trade and Telecommunications	Republic of Serbia Agency for Postal Services	ever	not clear mention
	Slovakia	Ministry of Transport and Construction of the Slovak Republic	Regulatory Authority for Electronic Communications and Postal Services	ever	not civil servants

Source: (UPU, 2022f)

Table 3 *(Continue) Authorities, Postal Reform, and Labor Status of DOs in Europe and CIS*

Region	Country	Government Authority	Regulatory Authority	Postal Reform	Status of personnel
Europe and CIS	Switzerland	Federal Department of the Environment, Transport, Energy and Communications (DETEC).	1. Postal Regulatory Authority (PostReg) 2. Monsieur Prix 3. The Post Office Commission	ever	sets its own policy

Source: (UPU, 2022f)

From Table 3 we can see the differences in postal reform and labor status of each country. Moreover, for Belarus and Moldova have only Regulatory Authority while others have both of Authority. The interesting is Armenia has 2 Government Authority. The reason is with resolution No. 1611–A of the Government of Armenia, of 9 November 2006, the authority to manage the shares of "Haypost" CJSC (national postal operator), owned by the Republic of Armenia, was assigned to the State Estate Managing Department, under the Government of Armenia. So, State Estate Managing

Department become as another one of Government Authority for Armenia (UPU, 2022a).

Moreover, Switzerland has 3 Regulatory Authority. For Monsieur Prix, it has the duty to gives its opinion on requests for price increases for services under the monopoly. And for The Post Office Commission, it's duty is to intervene in cases of disputes (involving the closing or transformation of a post office) between a municipality and Swiss Post (UPU, 2022g). The last region is Latin America and Caribbean which we can see in Table 4.

Table 4 *Authorities, Postal Reform, and Labor Status of DOs in Latin America and Caribbean*

Region	**Country**	**Government Authority**	**Regulatory Authority**	**Postal Reform**	**Status of personnel**
Latin America and Caribbean	Colombia	Ministry of Information Technology and Communications	None	ever	have both status of civil service and not civil service

Source: (UPU, 2022f)

Table 4 *(Continue) Authorities, Postal Reform, and Labor Status of DOs in Latin America and Caribbean*

Region	Country	Government Authority	Regulatory Authority	Postal Reform	Status of personnel
Latin America and Caribbean	Costa Rica	None	Autoridad Reguladora de los Servicios Públicos (ARESEP) (Public Services Regulatory Authority)	ever	not have the same status as state employees
	Mexico	State Secretariat for Communications and Transport	None	ever	same status as state employees

Source: (UPU, 2022f)

Table 4 *(Continue) Authorities, Postal Reform, and Labor Status of DOs in Latin America and Caribbean*

Region	Country	Government Authority	Regulatory Authority	Postal Reform	Status of personnel
Latin America and Caribbean	Panama (Rep.)	Ministry of Government	N/A	N/A	same status as state employees
	Uruguay	Ministerio de Industria, Energía y Minería (Ministry of Industry, Energy and Mining)	Unidad Reguladora de los Servicios de Comunicaciones (URSEC) (Regulatory body for communications services)	N/A	same status as state employees

Source: (UPU, 2022f)

All countries in this region have the labor status as the state employee but for Colombia, it also has the position that are not the same as the state employees. Another interesting country in this region is Costa Rica. As we can see that Costa Rica

doesn't have Government Authority while other 33 countries in this study have. From Table 1 to 4, we can see that each country has government organization as the supervisor. Some countries ever or ongoing to experience the postal reform for the main reason that to make more efficiently operation for the competition in postal market and for the labor status, we found that some countries the labor are state employees while some are not.

2. Designated Operator (DO)

In each country, they can have their own name of DOs and also can have 1 DO, 2 DOs or more, depend on their regulations. In this study we found that only 2 countries have DOs more than 1 operator, those are Bosnia and Herzegovina and Kyrgyzstan.

In Bosnia and Herzegovina, there are 3 DOs in this country, Republika Srpska Enterprise for Postal Operations, JSC Banja Luka, BH Post Public Enterprise, Sarajevo, and Croatian Post Ltd. Mostar. With the available data, we found that Republika Srpska Enterprise for Postal Operations, JSC Banja Luka is a joint stock company which have principal functions to provide domestic and international postal services, financial services, trade, telecommunications and IT services, construction, printing. While BH Post Public Enterprise, Sarajevo is a limited liability company separate from the telecommunications sector and has the principal functions similarly with Republika Srpska Enterprise for Postal Operations, JSC Banja Luka which are domestic

and international postal services. Construction, maintenance and use of postal installations and equipment (UPU, 2022b).

In addition, Kyrgyzstan, at first there is only State Enterprise Kyrgyz Post under the State Committee of Information Technologies and Communications is responsible for the provision of postal services. However, on 16 August 2016, there is unrestricted permanent operating license so the Ministry of Transport and Communications of the Kyrgyz Republic establish Kyrgyz Express Post as a limited liability company and be the second designated postal operator of the Kyrgyz Republic which was confirmed by UPU International Bureau circular 83 of 21 May 2013 (UPU, 2022d).

3. Monopoly in Postal Services

Some countries, DOs are monopoly in all services while some countries are totally liberalized, and also some are monopoly in some services. The countries that totally liberalized are Armenia, Belgium, Bulgaria (Rep.), Colombia, Croatia, Cyprus, Estonia, Montenegro, Romania, Slovakia, 10 countries from 34 countries while 4 countries that are monopoly in all services are Jordan, Sri Lanka, Belarus, and Kyrgyzstan (UPU, 2022f; Vlada Crne Gore, 2021). Other 20 countries also have differences in their regulations for postal services which we can group the reserved services as follows.

First, Letter-post items, many countries reserved letter-post items as a reserved service such as Mauritius, India, and Latvia but the regulations for reservation are different in each country. For example, reserved for weighing 2 kg. or less in Madagascar and Thailand, up to 1 kg. in Mexico and South Africa, delivery of letters 500 g. in Iran. Moreover, we found that letter services are services that most countries reserved for DOs (UPU, 2022f).

Next, Government or legal correspondence, some countries reserved for correspondence sent by the courts and correspondence concerning administrative and legal proceedings such as in Serbia, Panama (Rep.), and Bosnia and Herzegovina (UPU, 2022f). Some countries reserved almost all services but also has the exception such as Moldova that reserved all postal services except the express postal parcel service or Costa Rica that reserved for all items but with the weight less than 2 kilograms (UPU, 2022f).

2.1.2 Postal Services

Postal Services can be divided into 4 main services which are letter-post, parcels & logistics, financial services, and other products (UPU, 2019b). Each service can be divided into different types which we can see as follows.

1. Types of Postal Services

1.1 Letter-post

Letter-post items can be divided into 4 services; small letters, large letters, bulky letters, and small packets. The size for small letters needs to be minimum

dimensions at 90 x 140 mm. while maximum dimensions is 165 x 245 mm. and the maximum thickness is 5 mm. While large letters have minimum dimensions same as small letters but allow for maximum dimensions until 305 x 381 mm. with the thickness maximum at 20 mm. The weights of small letters are allowed until 100 g while large letters can reach until 500 g (UPU, 2017d).

The conditions for bulky letters and small packets are the same but things inside bulky letters need to be only documents while small packets containing goods, with physical specifications. The weights of both services are allowed until 5 kg. with the maximum length, width and depth combined: 900 mm., but the greatest dimension may not exceed 600 mm., with a tolerance of 2 mm. In roll form, length plus twice the diameter is 1,040 mm., but the greatest dimension may not exceed 900 mm, with a tolerance of 2 mm. The minimum, to have a surface measuring not less than 90 x 140 mm., with a tolerance of 2 mm. In roll form, length plus twice the diameter is 170 mm. but the greatest dimension may not be less than 100 mm. (UPU, 2017d).

1.2 Parcels & logistics

For parcel, the regulations have indicated that the size of parcel must not exceed two meters for any one dimension or three meters for the sum of the length and the biggest circumference which measured in a direction other than of the length. While the weight of parcels has the maximum at 20 kilograms, some countries can reach 50 kilograms depend on their regulations (UPU, 2017d). For

logistics, the convention from UPU has indicated that the DOs involving the transported path can base on bilateral agreements which appropriate provisions (UPU, 2017d).

To illustrate, in Thailand, there is a service called Logispost provided through Thailand Post network. Logispost is a service for big, bulky or special shape items which can be sent and pick up at the post office that convenient for customers, and also can be track with Track & Trace system (Thailand Post, 2022). While in Switzerland, there is services called bulky goods which is the shipping option for all parcels that exceed the dimensions of a standard parcel and not heavier than 30 kg. Bulky goods can be sent at different delivery speeds; SameDay consignment, Bulky goods “Moon”, Bulky goods Priority, and Bulky goods Economy (Swiss Post, 2022). Moreover, in Cyprus, Cyprus Post can accept the parcel with the maximum length at 1500 mm both cylindrical shape and other shapes (Cyprus Post, 2018).

1.3 Financial Services

Many financial services are provided in DOs in each country. Basically, there is Postal Payment Services which is the service for transfer money through worldwide network of DOs (UPU, 2022e). However, DOs also offer related services and products such as Savings/postal accounts, Pension payments, Payment of social aid and scholarships, Payment of e-commerce products, Bill payments, Mobile payments (UPU, 2022c).

For example, in South Africa, South African Post Office (SAPO) has services provided as Pay a bill (payments to Corporates), Payment of Social Grants, Motor Vehicle Licence Renewals, Prepaid airtime, Lottery, Money transfers, Government bonds, and Corporate share issues (SAPO, 2022). Similarly in Bosnia and Herzegovina, BH Post Public Enterprise, Sarajevo provided some financial services which divided to be Postal Money Order Transactions, Domestic Payment Transactions, and Banking Transactions (BH Pošta, 2022). In addition, in Italy, Poste Italiane also provided Payments and Mobile service which included the e-money and electronic payments sector, Poste Mobile mobile telephone operations, all new initiatives tied to the digital world and Financial Services which included current accounts, promotion and distribution to the public of loans provided by banks and financial intermediaries, collection of postal savings (Poste Italiane, 2020a).

1.4 Other products

Apart from Letter-post services, Parcels & logistics services, and Financial Services. Some DOs also provide other products such as Electronic postal certification mark, Text-based services, and Postal electronic mailbox (UPU, 2017d).

For example, in South Africa, SAPO provided a product line called Business solutions which includes Mobile Based Solutions – Bulk & Premium Rated SMS Notifications & USSD, Applications, Internet Based Solutions – Electronic Bill Presentment & Payments Solution, Web Based Online Payments Solutions, Personal Certificate Class 1, 2,3 and 4, SSL Certificate, Certificate Authorities, Registration

Authorities, Software Customisation, PKI Training, Secure Fax, and Fax and Photocopier (SAPO, 2022). In Mauritius, Mauritius Post also has PO Box Rental service, service for customers who want to receives all items at post office (Mauritius Post, 2022). Moreover, Poste Italiane in Italy provided Insurance Services which operate through PosteVita, a life insurance company in Italy, and now Poste Italiane are active in the casualty insurance segment (Poste Italiane, 2020b).

2. Proportion of Postal Revenue

We can see the proportion of revenue by services as shown in Figure 1

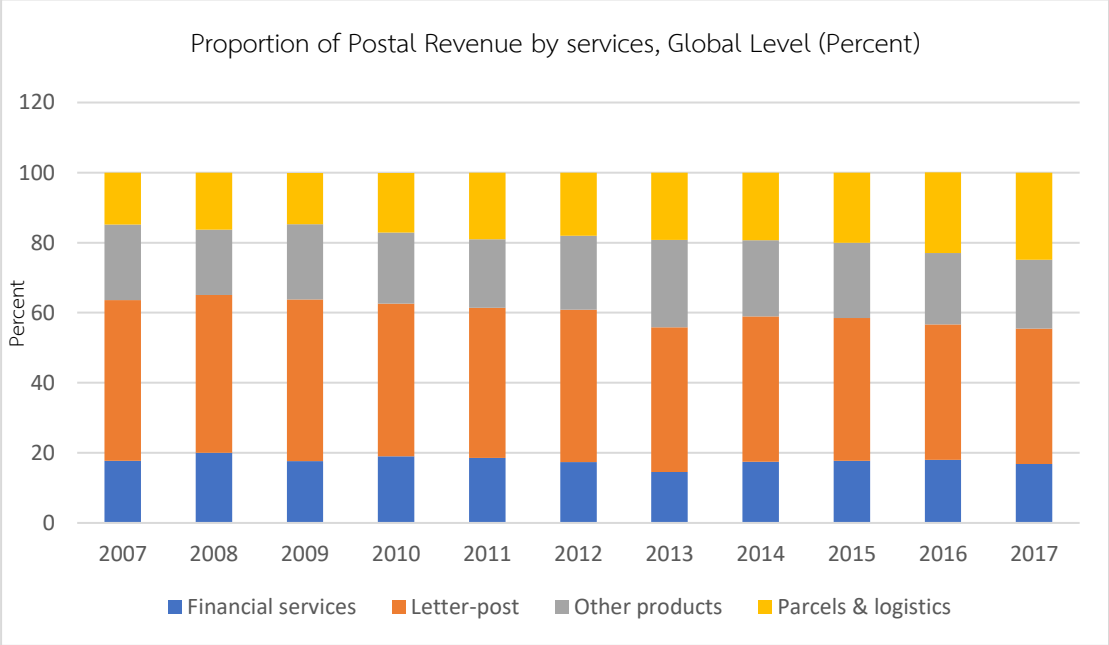

Figure 1 *Proportion of Postal Revenue by services (Global Level) from 2007 to 2017*
Source: (UPU, 2019b)

We can see that the biggest proportion of postal revenue come from letter service which accord with Monopoly in Postal Services section that most countries reserved letter services for DOs (UPU, 2022f). So, it means that in those countries, if people

need to send letter, they need to send through DOs so this can be the cause of big proportion for postal revenue.

In addition, we found the interesting thing that revenue from parcel & logistics services has increasing trend, accord with UNCTAD (2020a) which shown that E-commerce sales reached $25.6 trillion globally in 2018, up 8% from 2017. However, if we look into region level, we found that not all regions have parcels & logistics as the biggest proportion and the proportions of revenue stream from each service have changed differently in each region between 2007 and 2017 as we can see in Figure 2.

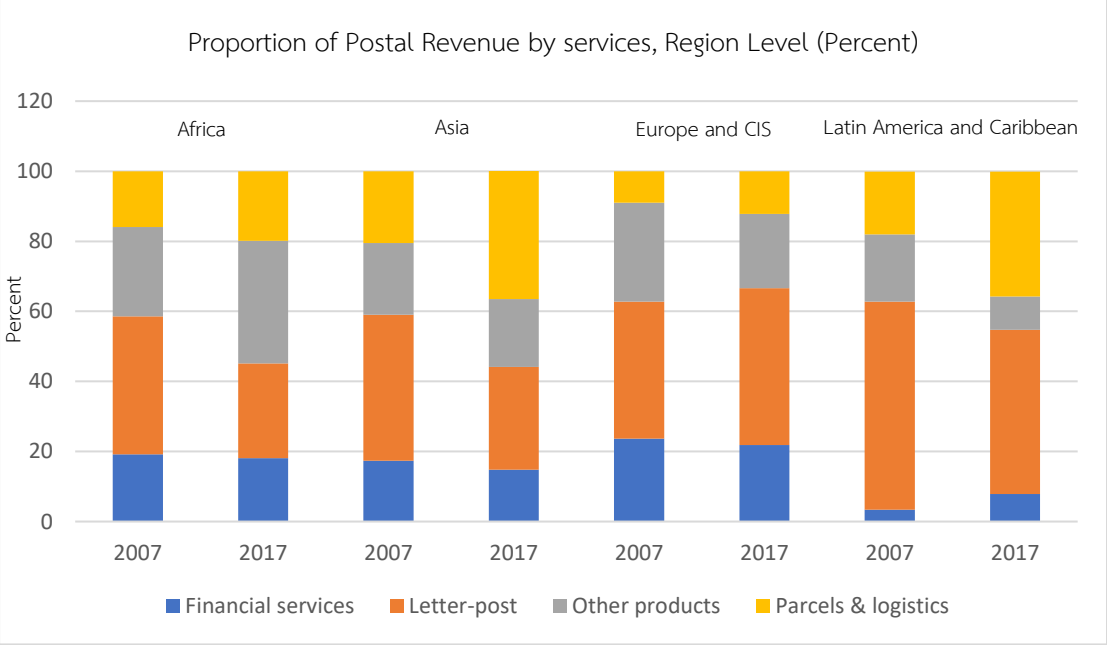

Figure 2 *Proportion of Postal Revenue by services (Region Level) in 2007 and 2017*
Source: (UPU, 2019b)

From Figure 2, we can see that the revenue from parcel & logistics services still have increased in all regions. While financial services, only Latin America and

Caribbean has increasing proportion. For letter services, only Europe and CIS has increasing proportion, and for other products, only Africa has increasing proportion.

Moreover, the biggest proportion in each region is different. In 2017, the biggest proportion is other products for Africa, parcel & logistics services for Asia, letter services for Europe and CIS and Latin America and Caribbean. We can look into the situations in each region as follows.

First, Africa in 2017, with the available data, we can find the example only in South Africa. However, the situation of SAPO is different from overall of Africa region because the main proportion of SAPO is letter-post items which is accounted around 60% of revenue stream for SAPO (SAPO, 2022) which accord with the reserved area of SAPO that letters up to 1 kilogram need to be sent at SAPO only (UPU, 2022f). This evidence shows that other countries in Africa can have higher proportion of other services but with the limitation of data, we cannot look deeper into this situation.

Second, Asia got the biggest proportion in parcels &logistics which can be explained this situation by a report from UNESCAP (2018). In this report, it showed that Asia is the fastest-growing region in the global e-commerce marketplace as can be accounted for the largest share of the world's business-to-consumer e-commerce market. Moreover, many Asia countries such as Iran, Thailand, Mongolia, Sri Lanka also have B2C E-commerce Index, show the processes involved in an online

shopping B2C transaction such as internet users or B2C web presence until payment method, exceed 50 points (UNCTAD, 2017). These evidences showed that the demand for parcels and logistics services are high in this region which can result in high proportion of parcels & logistics services, the main revenue stream, in this region.

Third, the situations in Europe and CIS and Latin America and Caribbean. The reason for these 2 regions that have high proportion in letters-post items can be because most of countries in these regions have reserved the letters-post items services only for DOs (UPU, 2022f). So, it means that if customers need to send all items which related as the letters, they need to send through DOs so DOs can be only one player who can get this market share in postal market.

2.1.3 Postal Processing

Each countries have the similarities in their process, however, they also have some differences in details of their operations which we can see the examples from United States of America, Thailand, and Switzerland as follows.

1. United States of America

United States Postal Service (USPS), DO in United States of America, has divided services into 3 types; letters, flats, and packages (USPS TV, 2014). For each type, they also have differences in processing as follows.

Letters (a written, typed, or printed communication, especially one sent in an envelope by mail, messenger, or carrier) are started with the culling mail that cannot be handled by machines because of size, shape, or weight. Then, the letters enter to Advanced Facer-Canceller System (AFCS), the machine with specialized cameras and computer, to find the addresses on envelopes, match with the database, and then faces the letter with the right direction to sprays it with a unique ID tag an cancel the stamp with a postmark (USPS TV, 2014). Next, letters are transferred to Delivery Barcode Sorter to be sorted by machine to delivery point sequence, in other words, to the postal carriers for delivery along their routes (USPS TV, 2014).

Flats (an oversize piece of first, standard, or periodicals class mail that exceeds at least one of the dimensions for letter-size mail) will be weighed and verified before processed. The large bundle of flats will be moved to preparation area and separated. Then, the bins of flats will go to Flats Sequencing System, a machine with the length of a football field, and will be sorted by scanning system. Sorted flats will be transferred to trays and loaded onto carts, finally, they are moved to the loading dock (USPS TV, 2014).

Packages (parcels that do not meet the mail processing categories of letters or flats) will be sorted by the Automated Package Processing System. The packages will be moved along of belts and rollers to enter the scanning and imaging tunnel, by this, the machine will read the address, determine the package dimensions and

weight, check the postage, scan barcode for updating the package's tracking information. Packages will go along the conveyer and sorted to bins by destination then move to the loading dock (USPS TV, 2014).

After all items are sent to the post offices, in the morning, carriers will gather the sorted items to take out on their routes (USPS TV, 2014).

2. Thailand

Thailand Post, DO in Thailand, has given the examples for the process of normal parcel and EMS service.

For parcel, after the accepting from post office, it will be sent to Lak Si Mail Center which is responsible for all countries in Thailand. At Lak Si Mail Center, there are 6 main steps for operation that are accepting, opening mail bag, sorting, closing mail bag, exchanging mail bag and transporting for distribution to the minor hubs (Thailandpostchannel, 2014).

For EMS or Express Mail Service, after the accepting from post office, it will be sent to Bangkok EMS Centre with 5 steps. There are accepting and scan barcode of mail bag into Track and Trace system, opening the mail bag and scan barcode of all items, sorting with Tilt Tray which is similar to the machine of USPS, closing mail bag and roll pallet, and transferring to transport truck to the minor hubs (Thailandpostchannel, 2014).

For both parcel and EMS service, after they reach the destination post office, they will be delivered by 2 ways. First, the carriers deliver to the receivers' home and second, deliver at post office for COD service (cash on delivery), Logispost, or in case that cannot deliver at home.

3. Switzerland

Swiss Post, DO in Switzerland, has given the example of process for customers who want to have their incoming documents processed by Swiss Post. This service has 4 steps, first, the mail input delivers the mail to the on-site location after that, the mail will be pre-sorted and can split into 2 paths, the physical and digital mailroom. For physical mailroom, it is for the mail that need to be delivered to receivers physically and cannot transform to digital information, includes 3 steps; Fine sorting, Security Scan, and Leave the premise through dispatch (SwissPostSolutions, 2018).

Second, digital mailroom, it is for physical documents that can be scanned and digitized. These processes are automated with OCR and AI technology to the greatest possible extent such as e-mails or online forms. Then they will be filtered and sorted, properly archived, then delivered or further processed. The physical and digital mail will be sent directly to customers employees at the destination or can be sent for continued processing (SwissPostSolutions, 2018).

2.2 RELATIONSHIP BETWEEN PRODUCTIVITY AND COMPETITIVENESS

Many studies found that productivity and competition have effects to each other. As the situation that has higher competitors, to be more productive can increase the competitiveness of firms and also for competition, it leads firms to be more productive to survive in the market (Ferreira and Rossi Junior, 2003). For example, Castellacci (2011) and Backus (2020) found that increase in market competition, can lead to the better productivity in both manufacturing and service sector. On the other hand, Laureti and Viviani (2011) found that productivity has effect on firm competitiveness.

In the aspect that competition affect to productivity, with the higher competition, firms need to increase their productivity by this mechanism (Holmes and Schmitz, 2010). When number of firms increased, lead to competitive pressure arising from pulling out market share by competitors which make the firms need to operate their business more efficiently to exist in the market (Fernandes, 2007). With higher competition, firm can use new technology to increase their efficiency for production and reallocate their resources more efficiently which leads to improve their productivity (Nickell, 1996).

While the aspect of higher productivity affects to the competitiveness, to be competitive, firms must provide products or services for customers at the level that they are willing to pay which can come from the higher productivity (Laureti and Viviani, 2011). In accordance, productivity levels are important determinants for

explaining competitive performance (Anastassopoulos and Patsouratis, 2004; Laima et al., 2020).

So, these studies point out the important of measuring productivity growth of DOs which can be one of mechanisms to see the competitiveness of firms in the intense competition in parcel delivery market and can give them consideration for improving their performance.

2.3 STUDIES MEASURING TFP AND ITS DETERMINANTS IN TRANSPORTATION AND LOGISTICS SECTOR

Approaches to measure total factor productivity (TFP) include Laspeyres, Fisher, Törnqvist, Bennet, and Malmquist TFP indexes (O'Donnell, 2012). In transportation and logistics sector, the most commonly used approach is Malmquist TFP index (MPI) as we can see from using this approach in many studies in this field.

In the aviation industry, Assaf (2011) has used MPI to measure the productivity by using three outputs and three inputs from 13 major Australian airports and found that most airports have improved in TFP which caused by changes in pure and scale efficiencies. Similarly Perelman and Serebrisky (2012) who used in sample Latin American airports and the results show that privately operated airports can make the higher productivity growth. Murillo (1999) use MPI to study about 33 Spanish civil airports from 1992 to 1994 and he reveal that technology and diversity of structures of the airport have caused the performance of the airport. While Nicola et al. (2013) which use MPI to analyzed productivity of 20 Italian airports found that the

decreased in productivity come from insufficient technological improvement and low level of quality of services delivered.

For railways, (Petrović et al., 2012) used MPI to measure productivity of rail across 14 European countries and found that the decrease in productivity come from the economic crisis. Li and Hu (2011) also use this approach to measure productivity in Chinese railway system and they stated that the reform of railway operation had positive effect on Chinese railway system.

In ports and terminals sector, Cheon et al. (2010) evaluated the effect of port reforms on productivity by MPI and found that the ownership restructuring affect to productivity gains which accord with Estache et al. (2004), who applied MPI to study about Mexico's port system and they found that the liberalized and decentralized in port system can increase the total factor productivity.

Ralević et al. (2020) use this to study in postal sector in Europe countries from 2003 to 2017 and they reveal that the increased in TFP can come from the ownership and rising services of DOs related to marketing and e-commerce. However, the results from Ralević et al. (2020) can be different in the present period due to the increasing in e-commerce.

The reasons for using MPI consist of TFP changes can be decomposed into transferring the efficiency boundaries and reaching the efficiency boundary which can reveal the use of new technologies and optimal use of new technologies of firms,

MPI can easily assessed and compared performance of firms from specified period to other periods, and MPI in Data Envelopment Analysis (DEA) can make more efficient and facilitate the calculation of inefficiency values for firms (Amani et al., 2018). So, with previous studies and those reasons, in our study Malmquist TFP index will be used to measure the TFP growth.

2.4 CONCEPTUAL FRAMEWORK

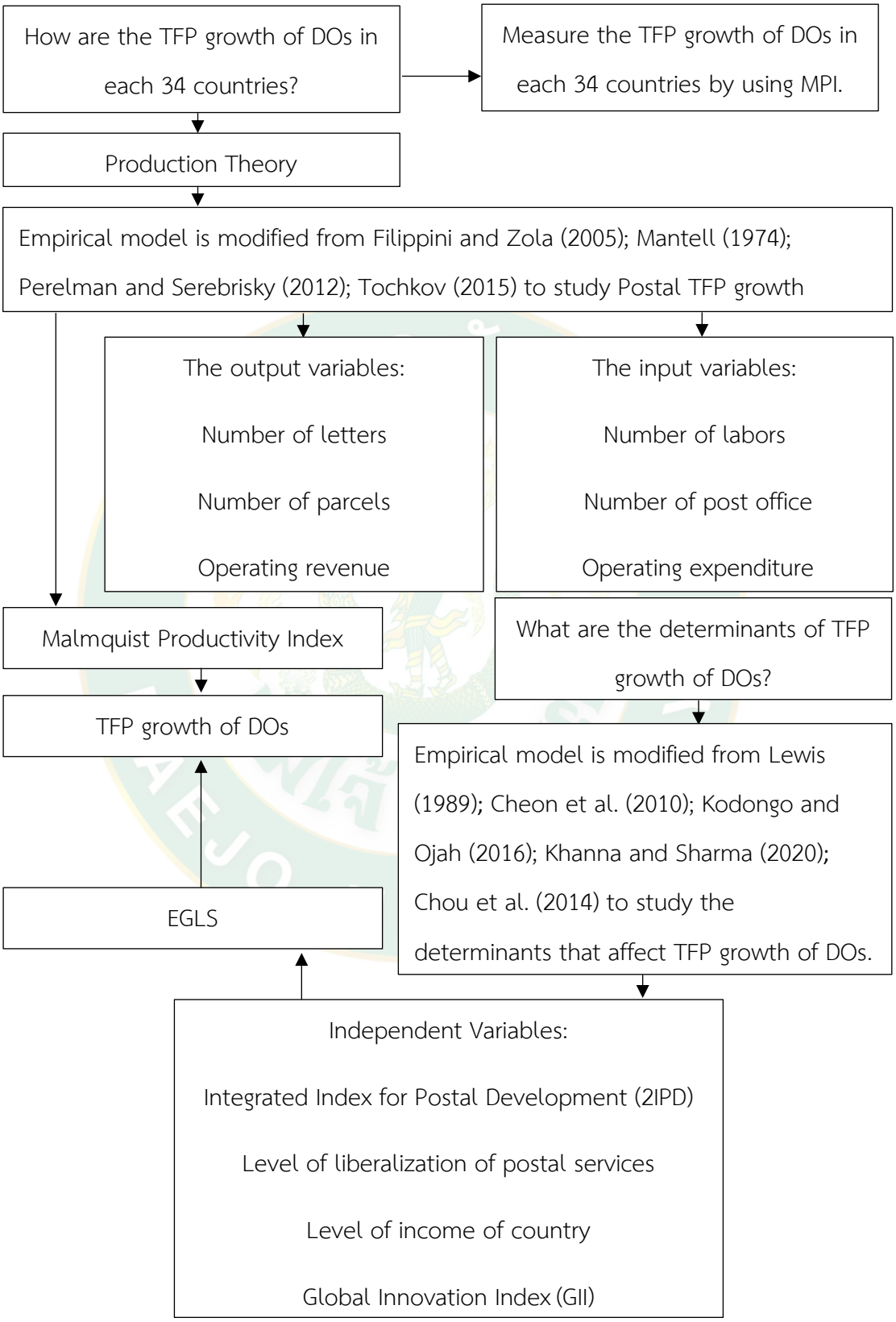

Figure 3 *Conceptual framework*

In this study, we start the first step with the question ‘How are the TFP growth of DOs in each 34 countries?’, so we will measure the TFP growth of DOs in each 34 countries by using Malmquist Productivity Index (MPI). The theory that we use is production theory with the empirical model modified from Filippini and Zola (2005); Mantell (1974); Perelman and Serebrisky (2012); Tochkov (2015) to study Postal TFP growth. The inputs consist of total number of staff, total number of permanent post offices due to they are mentioned in postal sector, and operating expenditure is considered to be an input to cover the other sources of production. While the outputs are number of letter-post items, domestic service, number of parcels, domestic service because they are mentioned as the outputs in postal sectors, and operating revenue is considered to be an output to show the other outcomes from postal production. Then, we use the MPI to measure the TFP growth because in transportation field, MPI is popular for productivity measurement. So, with the inputs and outputs mentioned and MPI, we get the results for TFP growth of DOs.

Moreover, to find ‘What are the determinants of TFP growth of DOs?’, we have the empirical model which is modified from Cheon et al. (2010); Chou et al. (2014); Khanna and Sharma (2020); Kodongo and Ojah (2016); Lewis (1989) to study the determinants of TFP growth. The determinants that we focus on are Integrated Index for Postal Development (2IPD) which shown quality of DOs, Level of

liberalization of postal services, Level of income of country, represented the infrastructure in country, Global Innovation Index (GII) as the representative for innovation in postal sector. These 4 determinants come from the review of previous study in transportation field, quality can affect to TFP growth in terms of increasing in quality can increase the productivity while liberalization leads to higher competition and then to increasing in productivity. For infrastructure and innovation, they can help the operation of postal company work more efficiently which can lead to higher productivity. For the dependent variable, it is TFP growth that we receive from step one. To measure this, we use EGLS for estimation.

CHAPTER 3
METHODOLOGY

3.1 DATA SET

This study used panel data which gather 34 countries[1] from 2016 to 2018. All the secondary data are accessed from database of UPU and considered total number of staff, total number of permanent post offices, and operating expenditure as inputs while number of letter-post items, domestic service, number of parcels, domestic service, and operating revenue as outputs. For finding determinants of TFP growth, we also used panel data and gathered secondary data of 34 countries from 2017 to 2018. Data for 2IPD and liberalization is gathered from UPU. While GII is accessed from the reports of Cornell University, INSEAD, and the World Intellectual Property Organization (WIPO). Data for income is gathered from UNCTAD, UN, and World Bank.

3.2 THEORETICAL MODEL

3.2.1 Modeling Production in the postal sector

The general form of production function, which is a technical relation between inputs and outputs (Koutsoyiannis, 1979), can be mentioned as

$$Y = F(A, K, L) \tag{1}$$

[1] There are Armenia, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria (Rep.), Colombia, Costa Rica, Croatia, Cyprus, Estonia, Hungary, India, Iran (Islamic Rep.), Italy, Jordan, Kyrgyzstan, Latvia, Lithuania, Madagascar, Mauritius, Mexico, Moldova, Mongolia, Montenegro, Panama (Rep.), Romania, Serbia, Slovakia, South Africa, Sri Lanka, Switzerland, Tanzania (United Rep.), Thailand, and Uruguay.

Where Y are the outputs, A, K, and L are the level of technology, capital, and labor for producing outputs, respectively (Ferrari et al., 2019). We can see the adaptation of this function in different ways in transportation sector. For example, Estache et al. (2004) has considered the length of docks concessioned by the government and the number of workers as inputs and the volume of merchandise handled as output for the study in sources of efficiency since it has liberalized and decentralized in Mexico port system. Gulati (2021) measured the total factor productivity growth in 8 state-owned passenger bus companies in India by using fleet size, staff strength, fuel and lubricants as inputs while revenue bus per day and passenger-kilometers performed as outputs.

In postal sector, numbers of labor and post offices are mentioned for production as we can see from Filippini and Zola (2005); Perelman and Serebrisky (2012); Tochkov (2015). However, there are many sources of production due to the various service in postal sector. So, in our study we will include the operating cost to cover the other sources of production apart from numbers of labor and post offices. For outputs, the number of letter post mail and parcels are mentioned in many studies (Filippini and Zola, 2005; Mantell, 1974; Perelman and Serebrisky, 2012; Tochkov, 2015). Because we use operating cost to cover the other sources of production. So, we will use operating revenue to show the other outcomes that come from postal production. Thus, production function in postal sector can be modelled the following way:

$$Q = f(emp, pstof, cost) \quad (2)$$

Where Q represents the different output generated in rendering postal services including the number of letters, parcels, and operating revenue. In turn, emp, $pstof$, and $cost$ are number of labors, number of post office, and cost for producing letters, parcels, and revenue, respectively.

3.2.2 Total Factor Productivity Growth and Malmquist Productivity Index in postal sector

TFP is the portion of output which is not explained by the number of inputs used in production which means its level will be determined by how efficiently and intensely that inputs are utilized in production (Comin, 2006). As shown in *Equation 3*, TFP is the ratio of the aggregate output to the aggregate input.

$$TFP = \frac{Aggregate\ Output}{Aggregate\ Input} \quad (3)$$

Where $Aggregate\ Input$ and $Aggregate\ Output$ means index of inputs and outputs used in production, respectively (Fuglie, 2020).

For MPI, TFP growth can be measured from the radial distance of the observed output and input vectors in period *s* and *t* which is relative to a referred technology (Coelli et al., 2005). This index can be divided into output-oriented and input-oriented but in our study, we focus on output-oriented due to it focuses on the maximum level of outputs that can be produced by the given input vector and given technology which relative to the observed level of outputs (Ji and Lee, 2010),

which is appropriate for our study because we try to find the TFP growth from the existed inputs of DOs in each country.

Measurement of the MPI starts with the following decomposition proposed by Coelli et al. (2005)

$$m_0(q_s, q_t, x_s, x_t) = [m_0^s\ (q_s, q_t, x_s, x_t) \cdot m_0^t\ (q_s, q_t, x_s, x_t)]^{0.5} \quad (4)$$

Where $m_0(q_s, q_t, x_s, x_t)$ means the geometric average of the two indexes based on period *t* and period *s* technologies while $m_0^s\ (q_s, q_t, x_s, x_t)$ and $m_0^t\ (q_s, q_t, x_s, x_t)$ show the MPI in period *s* and *t*, respectively (Coelli et al., 2005).

Each component of the TFP can be measured using distance functions (Cheon et al., 2010) including distance functions into *Equation 4* we get

$$m_0(q_s, q_t, x_s, x_t) = \frac{d_0^t(x_t, q_t)}{d_0^s(x_s, q_s)}\left[\frac{d_0^s(x_t, q_t)}{d_0^t(x_t, q_t)} \times \frac{d_0^s(x_s, q_s)}{d_0^t(x_s, q_s)}\right]^{0.5} \quad (5)$$

Where the ratio outside square brackets shows the change in the output-oriented measure of technical efficiency between period *s* and *t* which called efficiency change while the inside brackets show the change in technology between period *s* and *t* which call technical change (Cheon et al., 2010; Coelli et al., 2005; Estache et al., 2004).

So, the two terms from *Equation 5* are

$$Efficiency\ change = \frac{d_0^t(x_t, q_t)}{d_0^s(x_s, q_s)} \quad (6)$$

$$Technical\ change = [\frac{d_0^s(x_t, q_t)}{d_0^t(x_t, q_t)} \times \frac{d_0^s(x_s, q_s)}{d_0^t(x_s, q_s)}]^{0.5} \quad (7)$$

For *Equation 6 and Equation 7* we can depicted in case of a single input and single output as

$$Efficiency\ change = \frac{q_t/q_c}{q_s/q_a} \quad (8)$$

$$Technical\ change = [\frac{q_t/q_b}{q_t/q_c} \times \frac{q_s/q_a}{q_s/q_b}]^{0.5} \quad (9)$$

Where q_t/q_c is the proportion of output in period *t* that firm actual produced divided by the output that firm can produce on the frontier in period *t*. While q_s/q_a means the proportion of output in period *s* that firm actual produced divided by the output that firm can produce on the frontier in period *s*. For q_t/q_b, it is the proportion of output in period *t* that firm actual produced divided by the output that firm can produce on the frontier in period *s* with the same amount of input. And q_s/q_b is the proportion of output in period *s* that firm actual produced divided by the output that firm can produce on the frontier in period *t* with the same amount of input (Coelli et al., 2005).

3.2.3 Determinants of TFP growth in transportation and logistics sector

As the study from Johnson (2016), we can model determinations of TFP growth as

$$TFP_{it} = \alpha + X_{it}\beta + \mu_{it} \quad (10)$$

Which means TFP growth is affected by a vector of X_{it} determinants and μ_{it} is error term (Khan, 2005).

Several determinants of TFP in the transportation and logistics sector have been proposed in the literature. In our study, we have considered the first two variables that are quality and liberalization. For quality, due to Lewis (1989); Shetty (1986) showed that increasing in quality can increase the productivity in both service and manufacturing sector (if a company uses low-quality parts, it can cause mechanical breakdowns, as well as work slowdowns or even stop). While liberalization, Cheon et al. (2010); Competition & Markets Authority (2015); Estache et al. (2004); Holmes and Schmitz (2010); Schembri and Choudhri (2002), found that liberalization lead to competition among firms to make customers satisfied, so firms need to increase their TFP which accord with Quirós (2011) who found that in postal sector, liberalization or higher competition can lead to the increased in productivity.

Another determinant proposed in the literature is infrastructure. Several studies found that better in infrastructure will affect to better TFP (Deng, 2013; Khanna and Sharma, 2020; OECD, 2018). Because good infrastructure can facilitate the operation more efficiency which lead to higher productivity. Moreover, Chou et al. (2014) found that innovations have positive effects on TFP because innovation can help them operate their business more efficiently which lead to get more

outputs. Their results also accord with (Guckin et al., 1998); Hall (2011). So, with those studies, innovation become one determinant of TFP growth which we expect the positive affect on TFP growth in our study. So, with those studies, we can form the equation as

$$TFP_t = \alpha + \beta_1 QL_{it} + \beta_2 LB_{it} + \beta_3 INF_{it} + \beta_4 INV_{it} + \mu_t \quad (11)$$

Where QL means quality, LB is liberalization, INF refers to infrastructure, and INV is innovation. Which means TFP growth is affected by quality, liberalization, infrastructure, and innovation. And we expect that quality, liberalization, infrastructure, and innovation will have positive effect on TFP growth.

3.3 ECONOMETRIC MODEL

3.3.1 DEA Measurement for Malmquist Productivity Index (MPI)

The estimation of TFP is based on a DEA framework. DEA can be used because of these reasons. The nature of DEA is, the greater number of units, the closer results are to the truth which increase the reliability for the study (Amani et al., 2018). Furthermore, it sets target for inefficient firms to make them efficient and identifies the slacks in inputs and outputs (Glenn, 2017). So, in our study, DEA is used for measure MPI. The 4 distance functions are calculated to measure the TFP growth between period *s* and *t* which can be mentioned from Coelli and Rao (2005) as

$$\begin{aligned} [d_0^t(y_t, x_t)]^{-1} &= max_{\phi,\lambda}, \phi, \\ subject\ to\ -\phi y_{it} + Y_t\lambda &\geq 0, \\ x_{it} - X_t\lambda &\geq 0, \end{aligned} \quad (12)$$

$$\lambda \geq 0,$$

$$\begin{gathered} [d_0^s(y_s, x_s)]^{-1} = max_{\phi,\lambda}, \phi, \\ subject\ to - \phi y_{is} + Y_s\lambda \geq 0, \\ x_{is} - X_s\lambda \geq 0, \\ \lambda \geq 0, \end{gathered} \tag{13}$$

$$\begin{gathered} [d_0^t(y_s, x_s)]^{-1} = max_{\phi,\lambda}, \phi, \\ subject\ to - \phi y_{is} + Y_t\lambda \geq 0, \\ x_{is} - X_t\lambda \geq 0, \\ \lambda \geq 0, \end{gathered} \tag{14}$$

$$\begin{gathered} [d_0^s(y_t, x_t)]^{-1} = max_{\phi,\lambda}, \phi, \\ subject\ to - \phi y_{it} + Y_s\lambda \geq 0, \\ x_{it} - X_s\lambda \geq 0, \\ \lambda \geq 0, \end{gathered} \tag{15}$$

The notation $d_0^s(y_t, x_t)$ means the distance from period *t* to the period *s* technology. For y_i, it is a M×1 vector of output quantities for the *i*th country while x_i is a K×1 vector of input quantities for the *i*th country. ϕ is scalar and $\boldsymbol{\lambda}$ is a N×1 vector of weights. Finally, Y is a N×M matrix of output quantities for all N countries; X is a N×K matrix of input quantities for all N countries.

In *Equation 14* and *Equation 15*, the production points are compared to technologies from different time periods, the ϕ parameter must not be greater than or equal 1. Because the data point will lie above the production frontier which most

likely occur in *Equation 15* where the production point from period *t* is compared to technology in period *s* (earlier period). When the technical progress has occurred, the ϕ value can be less than one.

3.3.2 Determinants of TFP growth in postal industry

From *Equation 11*, we can estimate the determinants of TFP growth as

$$TFP_{it} = \alpha + \beta_1 IPD_{it} + \beta_2 LIB_{it} + \beta_3 IN_{it} + \beta_4 GII_{it} + \mu_t \quad (16)$$

Which TFP_{it} means TFP growth of country i from time t (i = 1, 2, ..., 34 and t = 1,2,3) in the transportation industry is affected by 2IPD, the index represents quality of DOs (IPD); level of liberalization in postal services (LIB); level of income of country (IN); and Global Innovation Index, the index represents innovation of country (GII) which can be described as follows.

IPD is variable that represents the QL of each DOs which was shorten from Integrated Index for Postal Development (2IPD), the index that evaluated by UPU (UPU, 2017a). For quality, every country's DOs will have the quality. The value of 2IPD can be decomposed in reliability, postal reach, postal relevance, and postal resilience score which weighted equally and the maximum score is 100, it means the better quality be, the higher score of country is (UPU, 2017a). As the studies from Lewis (1989) and Shetty (1986) showed that increasing in quality can increase the productivity, the 2IPD is considered to represent DOs' quality in this study. And we

expect that the coefficient for 2IPD will be positive which is our alternative hypothesis while null hypothesis is coefficient of 2IPD be zero.

LIB, represents LB, in our study we considered it as the dummy variable that reflects the level of liberalization of postal services. If the country has liberalization in all postal services, the value will be 0, while if it is not liberalized in all services, the value will be 1. Which the studies from Cheon et al. (2010); Estache et al. (2004); Holmes and Schmitz (2010); Schembri and Choudhri (2002), found that liberalization lead to increase in TFP which accord with Quirós (2011) who found that in postal sector, liberalization or higher competition can lead to the increased in productivity. Therefore, the alternative hypothesis that we expect is the coefficient for LIB will be less than 0. While the null hypothesis is coefficient of LIB is equal to 0.

While infrastructure, from the studies of De and Ghosh (2005) and Kodongo and Ojah (2016) found that level of income of country has positive relationship with level of infrastructure of country. It means in the country with high income level, it will have better infrastructure compared to lower income level countries. So, in our study, we proxy level of income as a representative of level of infrastructure in country and represents INF. And considered level of income (IN) as a dummy variable which represent infrastructure for postal services. IN will equal to 0 when it is low or lower middle-income country and equal to 1 when it is high or upper middle-income country. From the study of Deng (2013); Khanna and Sharma (2020);

OECD (2018), it found that better in infrastructure will affect to higher TFP. Thus, we expect that the coefficient for IN will be more than 0 which is our alternative hypothesis while the coefficient of IN equal 0 will be our null hypothesis.

Finally, we use the GII (Global Innovation Index) represents INV and to be representative of the innovation of DOs (WIPO et al., 2016). Because data on innovation of the DOs is not available. Therefore, national level innovator indicator like the GII was used as a proxy due to studies from OECD and Eurostat (2018) and Van et al. (2014) supported that innovation at firm level tend to have the same direction as country level. Moreover, from Chou et al. (2014); Guckin et al. (1998); Hall (2011) found that better in innovation will improve TFP. Therefore, we expect that the coefficient for GII will be more than 0 which is our alternative hypothesis and the null hypothesis is GII has coefficient equal 0.

We use panel EGLS which is a generalization of OLS regression (Kaufman, 2013) with cross section weights. The EGLS is better than OLS in the aspect of unbiased estimator of coefficient with the minimum sampling variance among the group of linear unbiased estimators (Kaufman, 2013). And Mance et al. (2020) found that panel data can have heteroscedasticity and autocorrelation between errors, and to solve this problem, panel EGLS method can be used. Which accord with the study from Sarpong and Ntiamoah (2011) that used panel EGLS with cross section weights to solve the problem of multicollinearity and autocorrelation. Furthermore, White

cross-section coefficient covariance method can solve the heteroskedasticity problem (Belke and Volz, 2020). So, with all these reasons make us use the EGLS with cross section weights and White cross-section coefficient covariance in this study.

CHAPTER 4

RESULT AND DISCUSSION

4.1 TFP GROWTH MEASUREMENT

The findings of the DEA analysis are shown from Table 5 to Table 8, each table included region, country, TFP growth, Efficiency Change (EC), and Technical Change (TC).

Table 5 *TFP growth and its EC and TC in Africa from 2016 to 2018*

Region	Country	TFP growth		EC		TC	
		2017	2018	2017	2018	2017	2018
Africa	Madagascar	1.081	0.939	1.282	0.969	0.843	0.969
	Mauritius	0.964	0.868	0.886	0.764	1.088	1.136
	South Africa	0.793	0.730	2.231	0.647	0.356	1.130
	Tanzania	0.903	0.711	0.906	0.758	0.996	0.938
	Average	0.930	0.806	1.231	0.776	0.755	1.039

Note: average is the geometric mean of all countries in each region

From Table 5, We can see that Africa experienced a fall in TFP change from 2017 to 2018 as a result in depressed EC. Färe et al. (1994) have stated that EC come from the improvement in efficiency which accord with Worthington (2000). So, we can interpret that DOs in Africa have less efficiency improvement from 2017 to 2018 compare to 2016 to 2017 especially DOs in South Africa.

For South Africa, the high EC in 2016 to 2017 can come from South African Post Office (SAPO) make improvement in efficiency by changing the way it conducted the line haul of mail and parcels which can reduce costs of moving mail and parcels on the road by at least 90 million South African rand (ZAR) per annual (SAPO, 2017) which means that SAPO had more efficient operation. However, in 2018, they experienced the large drop of EC because loss of customer volumes which means decreased in outputs (SAPO, 2018).

On the other hand, TC in 2016 to 2017 of South Africa was decreased due to the machine issue that 29 machines from 38 machines are fully functional at the main mechanized hubs. However, in 2017 to 2018, TC increased due to the Operations Document and Management System (ODMS) which covers all aspects of control and synchronizes with the operations manuals on branch, area and regional level which can help each post office work more efficiently (SAPO, 2018).

Table 6 *TFP growth and its EC and TC in Asia from 2016 to 2018*

Region	Country	TFP growth		EC		TC	
		2017	2018	2017	2018	2017	2018
Asia	India	0.657	0.751	0.727	0.659	0.904	1.140
	Iran	0.920	0.978	0.947	1.009	0.972	0.969
	Jordan	0.860	1.018	0.819	1.084	1.049	0.940
	Mongolia	0.395	0.867	0.433	0.848	0.912	1.022

Table 6 *(Continue) TFP growth and its EC and TC in Asia from 2016 to 2018*

Region	Country	TFP growth		EC		TC	
		2017	2018	2017	2018	2017	2018
Asia	Sri Lanka	1.036	1.030	1.239	1.068	0.836	0.965
	Thailand	0.353	0.911	0.992	0.792	0.356	1.150
	Average	0.650	0.920	0.818	0.896	0.794	1.028

Note: average is the geometric mean of all countries in each region

From Table 6, in Asia, there are increased trend of average TFP growth, EC, and TC and Thailand is country that has the most improvement in TFP growth. In Thailand from 2017 to 2018, the reason of increased in TC can come from Thailand post (THP) has new innovation that are data management system which can support electronic transactions more efficiently, buying technology system to provide in each post office for customers' convenience, and new Helpdesk system for update in hardware and software (Thailand Post, 2017). Furthermore, continue with the results in Europe and CIS as shown in Table 7.

Table 7 *TFP growth and its EC and TC in Europe and CIS from 2016 to 2018*

Region	Country	TFP growth		EC		TC	
		2017	2018	2017	2018	2017	2018
Europe and CIS	Armenia	1.032	0.939	1.084	0.970	0.952	0.969
	Belarus	1.018	1.011	1.047	1.057	0.972	0.956
	Belgium	0.671	0.729	0.615	0.639	1.091	1.140
	Bosnia and Herzegovina	0.993	1.003	1.043	1.039	0.952	0.965
	Bulgaria	1.020	1.111	1.049	1.147	0.972	0.969
	Croatia	1.018	0.971	1.074	1.037	0.948	0.936
	Cyprus	0.886	0.931	0.817	0.817	1.085	1.140
	Estonia	0.895	0.912	0.763	0.930	1.173	0.980
	Hungary	0.966	0.864	0.916	0.925	1.054	0.934
	Italy	0.866	0.973	1.091	0.977	0.793	0.996
	Kyrgyzstan	0.751	0.929	0.828	0.908	0.907	1.022
	Latvia	0.998	0.989	1.048	1.021	0.952	0.969
	Lithuania	1.022	1.034	1.074	1.081	0.952	0.956
	Moldova	0.918	0.971	1.014	1.011	0.905	0.961
	Montenegro	0.827	0.959	1.002	0.965	0.826	0.994
	Romania	1.006	1.031	1.035	1.038	0.972	0.993
	Serbia	0.975	0.981	1.025	1.016	0.952	0.965

Table 7 *(Continue) TFP growth and its EC and TC in Europe and CIS from 2016 to 2018*

Region	Country	TFP growth		EC		TC	
		2017	2018	2017	2018	2017	2018
Europe and CIS	Slovakia	0.995	0.975	1.050	1.042	0.948	0.936
	Switzerland	0.963	0.954	1.000	0.837	0.963	1.140
	Average	0.932	0.958	0.968	0.964	0.963	0.994

Note: average is the geometric mean of all countries in each region

In Europe and CIS, there are quite stable trend of average TFP growth, EC, and TC. Most countries' DOs in this region have increased trend of TFP growth because of increased in EC or TC or both. However, only seven countries' DOs that have decreased trend in TFP growth which are Armenia, Belarus, Croatia, Hungary, Latvia, Slovakia, and Switzerland. These seven countries have different trend of EC and TC.

For example, in Hungary, from 2016 to 2017, the increase in TC can come from expanding the installation area of the parcel terminals. Parcel terminal is terminal that provided many lockers to facilitate customers to pick up the parcel anytime. In 2017, 10 parcel terminals were developed which caused to have higher number of lockers from 760 to 1,200 lockers. This technology makes more opportunity to get more parcels with the existing employees, which can be seen in

upward trend in the number of parcels delivered at parcel terminals, due to it is convenience for customers to pick up parcels anytime at parcel terminals (Magyar Posta Zrt., 2017).

Moreover, in Latvia, we can see that from 2016 to 2017 EC is higher than from 2017 to 2018 because in 2016, Latvijas Pasts (post office in Latvia) start cooperation with e-commerce sector leaders. And in the second half of 2016, Latvijas Pasts got the new board which lead to higher investment in Latvijas Pasts and improvement of customer care and postal services (Vārpa, 2017). All of this led to increase in EC of Latvia's DOs from 2016 to 2017.

Latin America and Caribbean in Table 8, we can see that all countries' DOs, except Panama, have decreased trend of EC but increased in TC. For Panama's DOs, both EC and TC have increased gradually.

Table 8 *TFP growth and its EC and TC in Latin America and Caribbean from 2016 to 2018*

Region	Country	TFP growth		EC		TC	
		2017	2018	2017	2018	2017	2018
Latin America and Caribbean	Colombia	1.029	0.961	1.081	0.998	0.952	0.963
	Costa Rica	0.926	0.940	1.212	0.967	0.764	0.973
	Mexico	1.042	1.037	1.152	1.070	0.905	0.969
	Panama (Rep.)	0.565	0.821	0.715	0.865	0.791	0.949

Table 8 *(Continue) TFP growth and its EC and TC in Latin America and Caribbean from 2016 to 2018*

Region	Country	TFP growth		EC		TC	
		2017	2018	2017	2018	2017	2018
Latin America and Caribbean	Uruguay	1.071	0.977	1.291	1.007	0.830	0.971
	Average	0.903	0.944	1.069	0.979	0.846	0.965

Note: average is the geometric mean of all countries in each region

The increased EC from 2016 to 2018 can come from the reform and modernization of the postal sector in Latin America from 2013-2016 such as training, and technical and technological investment by governments to modernize the postal services and operations of DOs (UPU, 2017b). This can lead to higher EC. Furthermore, from 2017 to 2018, increased in TC can come from the intervention strategy in Latin America, which is the project to develop the IT technologies and digitalize postal services. For example, there are tracking tools which can follow the shipments in real time, EDI message exchanges, digitalization in financial services such as bill payments, insurance, government payments (UPU, 2017b).

Overall, the findings show that Africa is the only regions who has exhibited depressed TFP change while Sri Lanka, Belarus, Bulgaria, Lithuania, Romania, and Mexico are the leader countries that has increasing continuously of TFP growth due to they have the value of TFP growth more than 1 in all years.

Moreover, we found the interesting things that all of these 6 countries have increasing of EC as they have the value of EC more than 1 in all years, so, the possibility can be that EC has an important role for increasing in TFP growth. And from 4 of 6 countries are DOs in Europe and CIS region, the reasons can be because the promotion in the region to provide logistics services, which can generate more income with existed employees and also start to install automatic lockers for the self-distribution of parcels, and also other modern technological solutions (UPU, 2017c) which can lead them to get higher efficiency.

The results showed that each country has different trend of TFP growth, EC, and TC, however, decrease trend doesn't mean they must have worse operation but it can come from the quantity for improvement from 2016 to 2017 is more than 2017 to 2018 (Cheon et al., 2010; Chung et al., 1997). However, the TFP growth measurement results accord with the trend of postal output gap from UPU (2019b) only for Asia and Africa countries. In this report, it showed that only Asia DOs have good performance due to positive postal output gap. The causes can be from the behavior of people in Asia and Pacific countries that have higher demand for e-commerce which lead to higher number of parcels (UNESCAP, 2018) and then results in higher TFP. Another possibility is with the growth in TFP of DOs in those countries, they are more competitiveness which make them can grab market share of parcel

delivery market from other competitors (Competition & Markets Authority, 2015; Holmes and Schmitz, 2010; Schembri and Choudhri, 2002).

For the Africa, Europe and CIS, and Latin America and Caribbean, we found the different in TFP growth in each country. By this result, since the behavior of people in these countries they demand more e-commerce (UNCTAD, 2020b), we can think about the competitiveness that, although some countries' DOs in these regions have TFP growth which lead to higher competitiveness (Laureti and Viviani, 2011), but it is not enough for overcoming competition in parcel delivery market in their regions. As a result, their postal output gaps have negative value because they can't compete with the competitors well (Anastassopoulos and Patsouratis, 2004).

4.2 DETERMINANTS OF TFP GROWTH

The results of the panel EGLS regression are shown in Table 9. Findings show evidence of a positive relationship between quality of countries' DOs, and TFP growth, the coefficient for 2IPD is positive and statistically significant ($p<0.01$). With the coefficient, it means if countries' DOs have increased in value of 2IPD 1 unit, it will increase TFP growth 0.002 unit. These findings follow Lewis (1989) and Shetty (1986). who said that higher quality can gain trust from customers which can lead DOs get more postal items and higher TFP growth. And also accord with the results of best performers; Belarus, Bulgaria, and Lithuania, who have TFP growth more than 1 in all years. Because these 3 countries have the value of 2IPD in the ranking that quite high that are 21st for Belarus, 30th for Lithuania, and 34th for Bulgaria from 172

countries in 2018 (UPU, 2019a). Moreover, another evidence is there are 7 countries which are Belgium, Italy, Moldova, India, Thailand, Cyprus, and Iran, also have increasing in TFP growth and all these 8 countries also have 2IPD value at 72.06, 71.35, 62.55, 60.82, 59.73, 57.95, and 54.70, from total of 100 score respectively (UPU, 2019a).

The coefficient for liberalization is negative and statistically significant ($p<0.01$). In average DOs whose services are completely liberalized outperform their counterparts who hold monopolies in all services by 0.035 unit. These findings follow those of Castellacci (2011); Holmes and Schmitz (2010); Laureti and Viviani (2011); Schembri and Choudhri (2002) who said that liberalization push DOs to be more productive to survive in postal market. This finding is accord with the results of TFP growth in Bulgaria and Romania because these countries are the countries that total liberalized in all postal services (UPU, 2022f) and have TFP growth more than 1 in all years.

Table 9 *Regression analysis results of determinants of TFP growth*

Variable	Coefficient	Std.Error	t-stat	Prob.
C	1.049	0.014	73.014	0.000
IPD_{it}	0.002	0.000	5.430	0.000
LIB_{it}	-0.035	0.010	-3.422	0.001
IN_{it}	0.038	0.000	86.517	0.000
GII_{it}	-0.006	0.001	-6.909	0.000
R-squared			0.290	
Adjusted R-squared			0.245	
Durbin-Watson stat			1.478	
F-statistic			6.443	

Notes: GII refers to Global Innovation Index, IN means level of income, IPD is Integrated Index for Postal Development, and LIB is level of liberalization. Level of significance at 1%, 5%,10%.

While income which is the representative of infrastructure in our study, has positive coefficient and statistically significant ($p<0.01$). In average countries whose income level is high or upper middle-income, outperform their counterparts who is low or lower middle-income by 0.038 unit. These findings also accord with Deng

(2013) and Khanna and Sharma (2020) who found that that better in infrastructure will affect to better TFP. Because good infrastructure can facilitate the operation more efficiency which lead to higher productivity. For example, to deliver parcels or letters, in the same time period, countries which have better infrastructure can manage their time more efficiently because of better in traffic management while worse infrastructure countries have to lose their time for traffic jam (Bull and Cepal, 2003; Jain et al., 2012). This finding also accords with our results in first step because the best performers, who have TFP growth more than 1 in all years, are in high or upper middle-income countries. There is Lithuania for high-income country and Belarus, Bulgaria, Romania and Mexico for upper middle-income countries (United Nations, 2018).

Finally, innovation, the coefficient is negative and statistically significant ($p<0.01$). It means if the country has GII value increased by 1 unit, it will decrease TFP growth 0.006 unit. These results do not accord with Chou et al. (2014); Guckin et al. (1998); Hall (2011) who stated that innovations have positive effects on TFP. The possible reasons can be, first, GII which is country's innovation level does not represent the innovation of DOs in country. Second, the study from Ghak et al. (2020) said that, in some countries, there are the difficulties for transfer knowledge about innovation to business due to some regulations in countries. This reason can be reasonable to postal sector that if there are new innovations but cannot apply to

use it in postal sector with any reasons, it means the investment in innovation is useless, which means waste of money on investment without receiving the benefits and finally, it can lead to lose in TFP growth (Ghak et al., 2020).

CHAPTER 5
CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

This study measured the TFP growth and its determinants of DOs by using DEA-Malmquist and regression analysis by EGLS. The study studied 34 DOs in four regions from 2016 to 2018. The results reveal that in each country has different trend of MPI due to its EC and TC trends which come from changes in efficiency or technology. The results also accord with the report from UPU that Arab and Asia and Pacific DOs have the increasing trend of postal output gap (deviation of operating revenues' growth with respect to GDP in PPP (base 100 = 1996)) which can be received from TFP growth in those countries' DOs.

For determinations of TFP growth, in this study used IPD_{it} (2IPD), LIB_{it} (liberalization in postal sector), IN_{it} (level of income in those countries), and GII_{it} to represent the quality, level of liberalization of DOs, infrastructure, and innovation. The results illustrate that, quality, level of liberalization of DOs, and infrastructure have positive relationship on TFP growth while GII, countries' innovation index, has negative relationship with TFP growth. The reason can come from investment in innovation with cannot utilize from them.

These results can give consideration for DOs to improve their performance by focusing on being total liberalized in postal sector and improving quality of DOs.

5.2 POLICY RECOMMENDATIONS

According to the results of this study, the government can support DOs by launch policies that facilitate postal industry. For example, as the infrastructure has positive effect on TFP growth, government can consider infrastructure improvement such as road, as soon as possible to support DOs work more efficiently. In another perspective, the better road can lead to higher quality of DOs due to it can help DOs to deliver the items on time which is increase reliability, a composition of 2IPD which is a determinant with positive relationship to TFP growth.

In addition, the results show that being total liberalized can lead to better TFP growth compared to give the rights to DOs being monopoly in all or some services. So, in country that DOs are monopoly in all or some services, government can consider to reform their postal delivery market to be total liberalized for higher competition which leads to higher TFP growth compared to giving the rights for DOs in all or some postal services.

5.3 LITMITATION

The limitation in this study include as follows. First, with the estimation of TFP growth is based on a DEA framework. The nature of DEA is the greater number of units, the closer results are to the truth, so in this study, we try to gather the data from each country as much as possible. However, with the accessible of data, we can gather only 34 countries from 2016 to 2018.

Second, in this study we focus on DOs which are the representative of UPU, it is interesting to include the private parcel delivery companies as other units to compare with DOs but with the accessible of data, we can compare the TFP growth of DOs only.

5.4 RECOMMENDATIONS FOR FURTHER STUDIES

In this study we found that 2IPD, which represent the quality of DOs, have positive effect on TFP growth and 2IPD can be divided to reach score, reliability score, relevance score, and resilience score. So, future study can find that in these 4 compositions of 2IPD, which composition has the most effect on TFP growth and the result can be helpful for DOs to consider improving the most affected composition of 2IPD.

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