



Corresponding Banking Relationships & EU-African Services Trade Flows

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Abstract

The cross-border exchange of goods and services has come under threat in the recent time due to de-risking (declining corresponding banking relationships, CBRs) in the global financial market. It is not difficult to think of the consequences of this development on trade relationship between a more financial inclusive European Union (EU) and African economy. Therefore, this study investigated the impact of CBRs on EU-African services trade between 2011 and 2018. Utilizing trade gravity model estimated with Hausman and Taylor Random Effect regression technique, the key result is that the effects of CBRs on services trade between EU and Africa vary with directions of correspondence, currencies, forms and directions of services trade. While CBRs received in EU generally reduced services trade (-2.2%) between EU and Africa, positive impact was noticed with CBRs sent in Euro (3.1%) and US dollars (1.9%) from EU and Africa, respectively. Hence, de-risking in US dollars and Euro in Africa and Europe, respectively will have a significant undesired impact on services trade between Africa and EU. To minimise the undesired impact of de-risking on services trade between these regions, there is a need to safeguard the integrity of payment system in US dollars in Africa and Euro in EU in a manner that will preserve access to CBRs to facilitate services trade, while technical capacity building of corresponding banks, information sharing among them will also help. More importantly, there is a need to improve financial inclusion in Africa to measure up to what is obtainable in EU, otherwise huge gaps in financial inclusion will not be beneficial to services trade between EU and Africa.

Key words: De-risking, Corresponding banking relationships, Services trade, Africa, European Union

JEL Codes: F02, F14, F36, P45

1. Introduction

The service sector, in terms of its contribution to total Gross Domestic Product (GDP) and trade, is increasingly occupying a growing place in Africa and the European Union (EU). For instance, data from the World Bank shows that the share of services value added and trade in services in GDP in Africa has improved considerably averaging 46.8% and 18.3%, respectively, between 2010 and 2018. In the EU, services sector takes higher pre-eminence than that of Africa by accounting for an average of 59.7% and 31.8% of GDP within the same period. While services sector continues to

play an important role in diversification of production and trade base, especially in Africa, data from the Organisation for Economic Co-operation and Development (OECD) indicates that the share of Africa in EU's total services trade is not only marginal but has equally declined from 3.1% in 2010 to 2.1% in 2018. Merchandise trade is equally not exempted. The share of EU in Africa's total merchandise trade declined consistently from 53.4% in 2001 to 32.8% and 32.3% in 2010 and 2018, respectively. This is a clear case of a strain in trade relationship between Africa and EU, traceable to several potential factors.

Recently, the cross-border exchange of goods and services has come under threat due to de-risking in the global financial market- a complex and multidimensional problem affecting the global financial network. That is, the global financial institutions are increasingly restricting business relationships with local banks in certain countries and regions due to increasing compliance costs and regulatory risks (World Bank, 2016; Langthaler and Niño, 2017). It is not difficult to think of the consequences of this development for African economies in a highly financially integrated global market. Already, countries in Africa, Eastern Europe, and Arab countries have lost some corresponding bank relationships (CBRs) (World Bank, 2015; Adriano, 2017). In the study of the World Bank (2015), over half of the banks surveyed reported a moderate or significant decline in their CBRs in Africa. This implies that banks in Africa and emerging economies are having increasing difficulties connecting to the trade finance world. This is traceable to a rise in illicit activities such as terrorist financing, money laundering, tax evasion, fraud and corruption practices which require higher Customer Due Diligence (CDD) in the area of Know-Your-Customer (KYC), Anti-Money-Laundering (AML), and Combating-the-Financing-of-Terrorism (CFT). The policing and monitoring role entrusted on financial institutions create additional compliance burden for the local banks. This development has unintended consequences for cross-border trade where services such as international wire transfers, cash management services and trade finance has been difficult to access.

While services trade has the potential of making development more inclusive, given the huge proportion of services in gross national outputs, Africa's services trade with the EU is not only narrow (unlike merchandise trade) but it has also declined considerably. This limits potential gains that comes with trade in services. However, the extent to which de-risking in the financial sector accounts for this undesired development remains a research issue. Hence, this study investigated the impact of CBRs on bilateral Africa-EU trade in services. It disentangles services trade into travel, transport, other businesses, as well as telecommunications, computer and information (TCI) services. Eleven (11) African countries¹ and 22 EU economies² (excluding UK following Brexit) are sampled for aggregate services trade, while Morocco, Egypt, South Africa and Nigeria were selected in the analysis involving forms of services trade between the EU and Africa. The last focus takes Africa as a whole against the sampled EU countries. The 11 sampled African countries account for about 73.9% of EU aggregate services trade with Africa between 2010 and 2018, while the four subsampled African countries account for approximately 60.0% of EU services trade with Africa (OECD data). The sampling is primarily based on consistency of bilateral services trade between Africa and EU. Besides, the sampled African economies truly reflect African regional representative from the Northern Africa (Morocco, Egypt, Algeria and Tunisia), West Africa (Nigeria and Ghana), Central Africa (Congo), Eastern Africa (Kenya), Southern Africa (South Africa, and Angola) and Oceania Africa (Mauritius).

Related studies such as Moshirian (1993), Kimura and Lee (2006), Walsh (2008), Kaur (2011), Karam and Zaki (2013), Cole and Guillin (2015) and Nordås (2018) did not have Africa and EU bilateral services trade as their focus while CBRs were not considered as an important potential

¹ Morocco, Egypt, South Africa, Nigeria, Angola, Congo, Algeria, Ghana, Kenya, Mauritius and Tunisia

² Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Hungary, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Slovak Republic, Slovenia, Spain, and Sweden

driver of bilateral services trade. Hence, this study is empirically novel and relevant in terms of the policy to revive services trade ties between Africa and the EU.

The rest of the paper is organised as follows: besides the introductory section where the motivation for the study was discussed, section two focused on facts related to trends in services trade between the EU and Africa as well as trend in key indicators of de-risking such as CBRs and corruption perception of the sampled economies. Section three presented the literature review focusing on relevant theories and previous studies. Section four is on methodology where the framework of analysis, estimation techniques and data were discussed. Section five presented the results, while section six focused on summary, conclusion and policy lessons.

2. Some Stylize Facts on EU-Africa Trade in Services and Drivers of De-risking

2.1. EU-Africa Services Trade Trends

Overall, EU demonstrate services trade surplus globally and also with Africa between 2010 and 2018 (Table 1). However, Africa's total services trade deficit reduced between 2014 (when it was -\$80.5 billion) and 2018 (when it recorded -\$43.2 billion). This implies that Africa's services exports have increased considerably relative to its imports. Also, the total services trade of EU increased significantly from \$3238.0 billion in 2010 to \$4872.6 billion in 2018. This represents about 50.5% increase within these periods. Meanwhile, the share of Africa in total EU's services trade declined consistently from 3.1% in 2010 to 2.1% in 2018. That is, there is a 1% services trade loss between Africa and the EU within a decade.

Further, the EU accounts for about 39.3% of total Africa's trade in services between 2010 and 2018 (Table 1). Comparing the share of Africa's services trade in EU market and the share of EU's services trade in African market (Table 1) clearly indicates huge disparities in market penetrations. While the EU is having huge penetration in African markets, the same is not the case with Africa in EU markets. This is not surprising since many African markets are small open economies. Nevertheless, the size of EU in African services markets has equally declined from 41.6% in 2010 to about 38.4% in 2018. This implies that other emerging markets are displacing the EU in African services market.

Further, the EU demonstrates services trade surplus with African countries but a significant heterogeneity is noticed also in volume. EU's services trade with Egypt, Morocco, Mauritius, and Tunisia, on the average between 2010 and 2018, is deficit (Figure 1) while it is surplus for the remaining sampled African countries within the same period. South Africa recorded the highest services trade volume with the EU averaging \$15614.4 million between 2010 and 2018 (Figure 1). This is followed by Egypt, Morocco and Nigeria which recorded \$11608.02 million, \$10864.74 million and \$7425.2 million, respectively while Ghana recorded the least services trade of \$2687.38 million with EU within the same period (Figure 1).

Table 1. Trends in EU-Africa Trade in Services

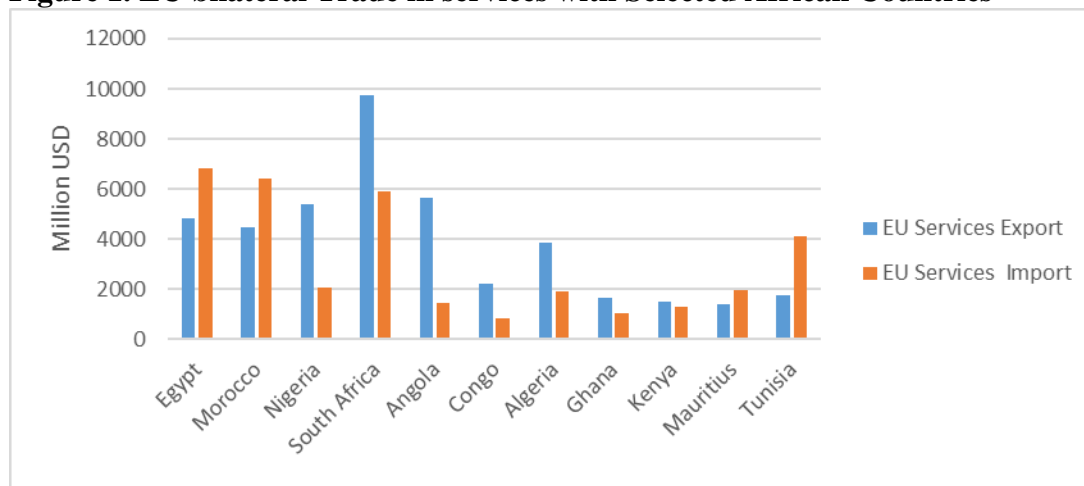
	EU export to the World	EU export to Africa	EU import from the World	EU imports from Africa	EU total trade	EU total trade with Africa	Africa Total trade	African total trade Balance	EU total trade with the 11 sampled African economies	Share of Africa in EU total trade	Share of 11 sampled African countries in EU total trade with Africa	Share of 11 Sampled African countries in EU total trade	Share of EU in to total African Trade
Unit of Measurement	(Billion USD)	(Billion USD)	(Billion USD)	(Billion USD)	(Billion USD)	(Billion USD)	(Billion USD)	(Billion USD)	(Billion USD)	%	%	%	%
Column Label	(A)	(B)	(C)	(D)	(A+C)	(B+D)	(E)+	(F)+	(G)	$\frac{(B+D)}{(A+C)}*100$	$\frac{(G)}{(B+D)}*100$	$\frac{(G)}{(A+C)}*100$	$\frac{(B+D)}{(E)}*100$
Year													
2010	1725.4	55.0	1512.6	46.8	3238.0	101.7	244.5	-55.4	75.0	3.1	73.7	2.3	41.6
2011	1951.8	60.8	1662.7	46.1	3614.6	106.9	263.7	-69.8	79.9	3.0	74.8	2.2	40.5
2012	1945.9	58.7	1647.8	44.5	3593.7	103.3	273.4	-67.9	76.5	2.9	74.1	2.1	37.8
2013	2109.8	57.4	1777.8	44.1	3887.6	101.5	274.0	-77.1	74.9	2.6	73.8	1.9	37.0
2014	2286.3	62.7	1941.1	47.8	4227.4	110.5	290.0	-80.5	83.0	2.6	75.1	2.0	38.1
2015	2139.6	61.6	1879.0	45.7	4018.6	107.3	261.8	-61.8	80.5	2.7	75.0	2.0	41.0
2016	2183.3	55.3	1918.2	42.5	4101.6	97.8	231.2	-44.6	73.1	2.4	74.7	1.8	42.3
2017	2386.1	52.1	2077.0	43.3	4463.2	95.4	258.7	-46.1	68.8	2.1	72.1	1.5	36.9
2018	2620.0	53.3	2252.5	49.0	4872.6	102.3	266.6	-43.2	73.2	2.1	71.5	1.5	38.4

Source: OEDC statistics and ITC trade map based on UNCTAD, WTO trade in services database based on Eurostat, International Monetary Fund, Organisation for Economic Co-operation and Development (OECD) and relevant national statistical authorities' statistics.

Note: + indicates data from the later source

The 11 sampled African economies account for over 70% of EU's services trade with Africa (Table 1). It is noticed that the share of these economies in EU's services trade declined marginally between 2014 and 2018. This implies that EU's services are equally gaining increasing prominence in other African countries. However, the share of 11 sampled African economies in EU's services trade with Africa has also declined from 2.3% in 2010 to 1.5% in 2018. While there was a 1% loss in EU services trade with Africa, 0.8% was lost with the 11 sampled African economies within a decade.

Figure 1. EU bilateral Trade in services with Selected African Countries



Source: OECD statistics

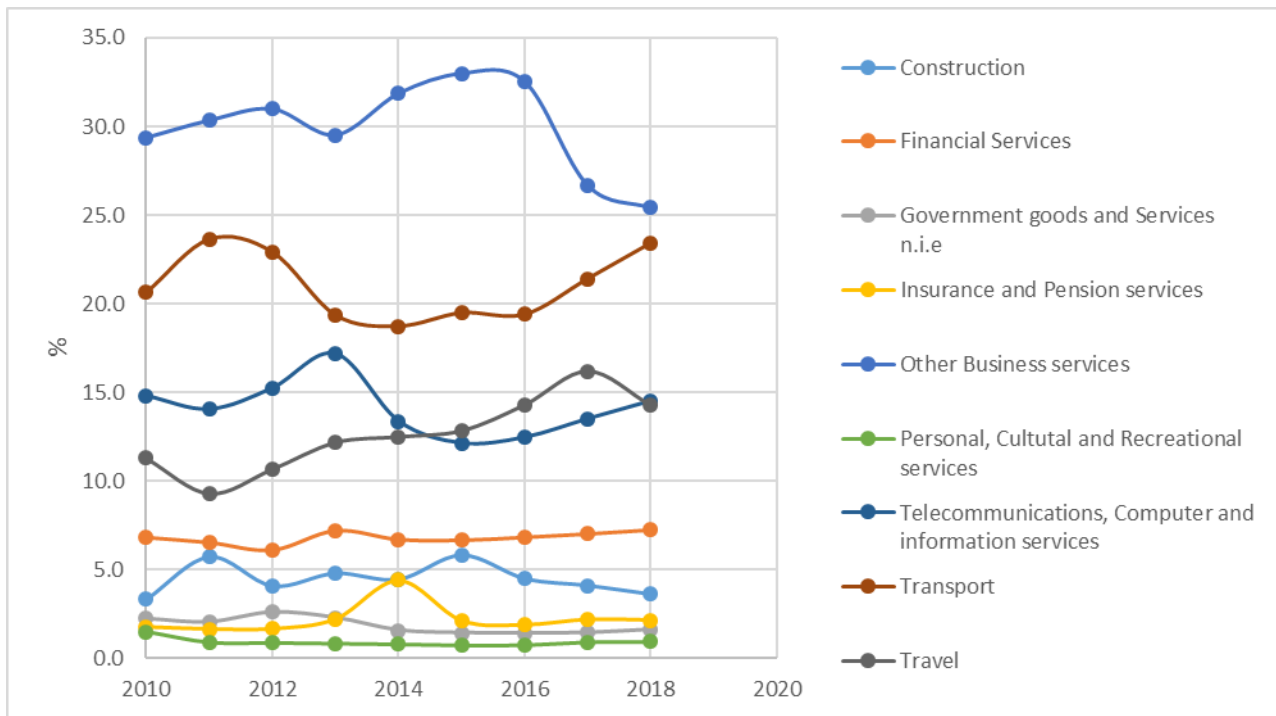
2.2. EU-Africa Services Trade Components

Generally, transport, travel and other business services (including research and development; professional and management consulting, technical, trade-related and other business services) form a significant proportion of services trade conducted by African countries. These three forms of services trade jointly account for over 70% of trade in services across the sampled economies in 2018 (Figure A1-A4). For instance, it is 83.3% and 79.0% for Egypt and South Africa, respectively. Meanwhile, there are some heterogeneity in other forms of services trade. Financial services are more relevant in Nigeria's services trade, it is government goods and services for Morocco, and TCI services for South Africa.

This trend is not different from what is obtainable in the global trade in services where travel, other business services and transport accounts for about 24.4%, 22.2% and 19.4% of global trade in services, respectively in 2018 (Figure A5), making 66% overall. This is followed by TCI and financial services accounting for 8.3% and 6.5% of global trade in services, respectively.

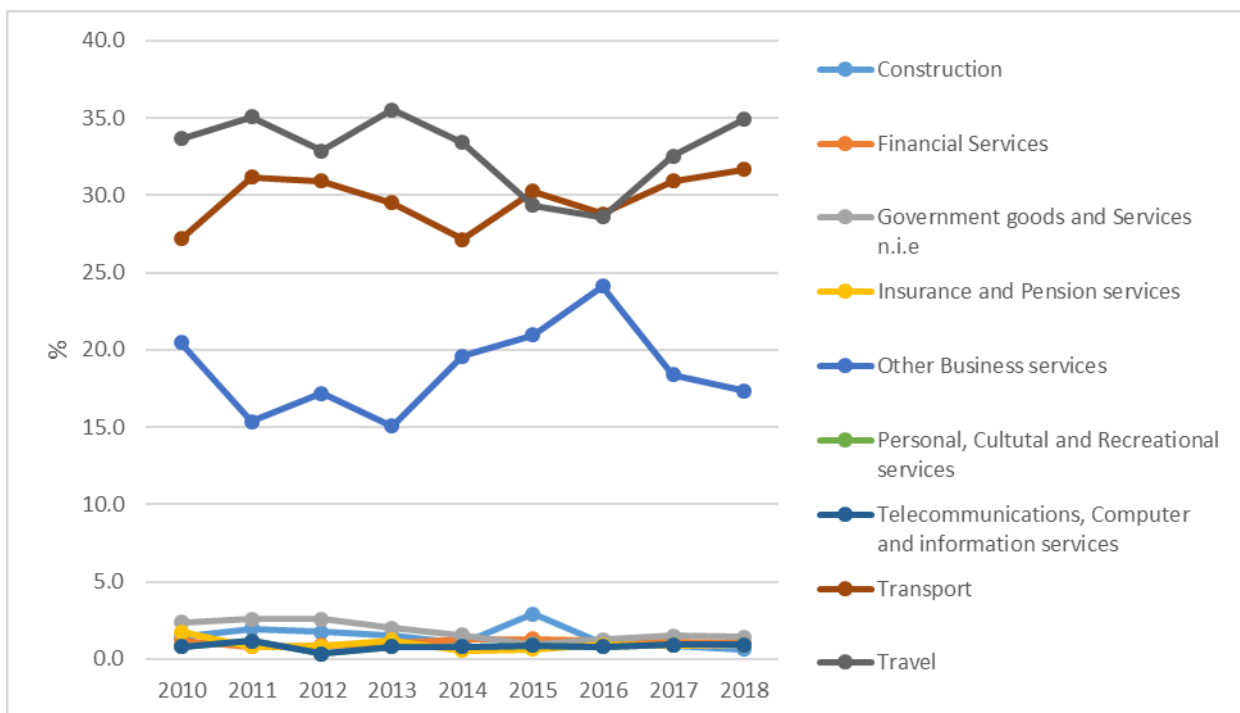
Relating to forms of EU services export to Africa, other business services tops the list by accounting for an average of 30% between 2008 and 2018 (Figure 2). This is followed by transport, TCI as well as travel and financial services. These five services account for 84.5% of EU total services export to Africa. However, there are variations in terms of services the EU imports from Africa whereby travel tops the list with 32.9% of total services imported between 2008 and 2018 (Figure 3). Other important services import of EU from Africa are transport and other business services with 29.7% and 18.7% share in EU total services trade with Africa, respectively. Overall, the three leading services account for 81.3% of total EU services import from Africa between 2008 and 2018. Hence, EU services export to Africa is more diversified than its import from Africa. In other word, Africa is less diversified in services trade export, concentrated mainly in three services.

Figure 2. Share of Services Trade Components in EU Services Export to Africa



Source: OECD statistics

Figure 3. Share of Services Trade Components in EU Services Import from Africa



Source: OECD statistics

Moreover, there have been significant drop in the share of other business services trade between EU and Africa (Figure 2 and 3). Hence, general decline in services trade between EU and Africa (Table 1) is traceable to this development. However, transport and travel has improved considerably, especially between 2016 and 2018.

Focusing on the four major African economies, which account for approximately 60.0% of EU-Africa services, there are notable variations in services trade with the EU. For instance, while exports of EU's other business services trade have declined considerably in Nigeria, it increased marginally in South Africa, Morocco and Egypt, especially between 2015 and 2018 (Figure A6). However, EU's imports from these African economies have significantly increased within the same period, especially from Egypt. In the case of transport services, South Africa is the leading importer of EU services while Egypt is the leading exporter of EU's transport services imports (Figure A7). Since 2014, there have been decline in EU's travel services export to Nigeria and Egypt but this was compensated for by increase in EU's travel services exports to South Africa and Morocco (Figure A8). Nigeria has been the least exporter of EU's import of travel and transport services in Africa between 2010 and 2018 (Figure A7 and A8). Given the nature of services trade between some African countries and EU which is dominated by travel and transport services, services trade between EU and Africa will further deep in the Covid-19 and post-Covid-19 eras given its impact on travel and transport businesses globally. However, the negative impact of Covid-19 on services trade between Africa and EU may be least on Nigeria because it is the least exporter of travel and transport services imported by the EU (see Figure A7 and A8).

In terms of trade in financial between Africa and EU, South Africa is the leading net importer in Africa with an average of \$161 million exports to EU and \$864 million imports from EU between 2010 and 2018 (Figure A9). While South Africa is also the leading importer of EU's exports of TCI services in Africa, Morocco is the leading exporter of it to the EU between 2010 and 2018 (Figure A10).

In sum, within the period under coverage, the following is observed: (i) Africa demonstrated deficit in services trade with EU (ii) African penetration in EU services market is weak, and (iii) African services export to EU is concentrated in travel, transport and other business services while its services import from EU is more diversified to include financial as well as TCI services. Opposite is the case with EU. Also, the decline in services trade is driven by other business services while its improvement is driven by transport and travel services trade. Also, EU- Africa services trade relationship has demonstrated significant dynamics in the last one decade. One of the drivers of this dynamics is one of the objectives of this study.

The next sub-section focuses on the phenomenon of de-risking among the sampled economies and why it constitutes a potential threat to trade in services between EU and Africa.

2.3. Indicators of De-risking

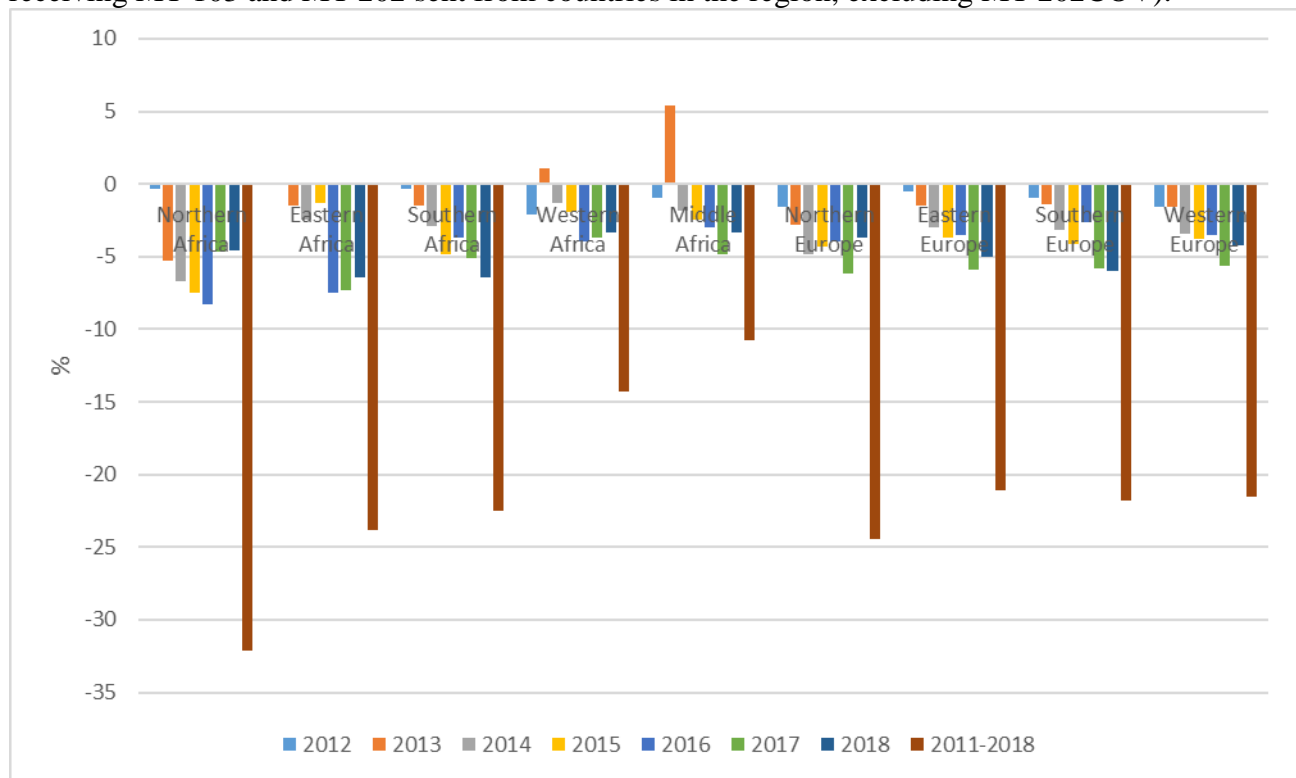
"De-risking" is a risk management control on international transactions in which international financial institutions exit or reduce relationships with clients considered "high risk". It is achieved by introducing more stringent measures in the area of reporting requirements, large fines on non-compliance, and increased capital and liquidity requirements, following the 2007/2008 global financial crisis (Haley, 2017; Langthaler and Niño, 2017). These factors constitute a compliance challenge and additional costs for financial institutions to facilitate full range of international financial transactions, especially for the corresponding banks which act as intermediaries between banks in different countries or as an agent to process local transactions for clients involved in international transactions. Since international transactions do not require an established financial relationship between banks, most international wire transfers are executed through the Society for Worldwide Interbank Financial Telecommunication (SWIFT) network³. This arrangement, through the correspondent bank having arrangements with home and foreign bank, alleviates the need for the domestic bank to establish a physical presence abroad before international transactions can be

³ <https://www.investopedia.com/terms/c/correspondent-bank.asp>

facilitated. This type of arrangement between foreign financial institutions and local financial institutions is regarded as CBRs.

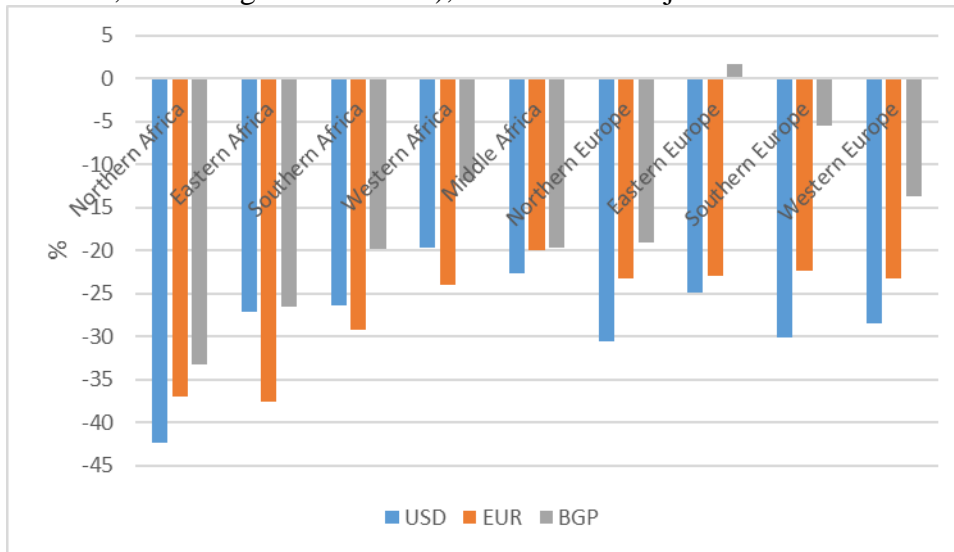
Globally, there have been a decline in CBRs and situation in EU and Africa is not different. Figure 4 and 6 shows that CBRs have dropped significantly in Africa and Europe between 2011 and 2018. In terms of MT 103 and MT 202 sent by African countries, North Africa shows the highest decline in the CBRs by 32.1% between 2011 and 2018 while Central Africa is the least with -10.8% decline within the same periods. The decline in North African economies' CBRs is highest in United State Dollars (USD) (Figure 5). Overall, the CBRs in USD decline of 28.0% is the highest among the three major international currencies across all regions between 2011 and 2018. This makes it the currency most affected by the withdrawal of CBRs. This is not surprising since USD is the major tradable currency. Among European economies, Northern European countries shows the highest decline of -24.4% in CBRs while Eastern Europe has the least decline with -21.1% (Figure 4). The reason for the least decline in Eastern Europe is that the number of active GBP counterpartents (count of counterparties abroad), unlike other currencies in the region, actually increased between 2011 and 2018 (Figure A11).

Figure 4. Changes in the number of active counterpartents by regions (counterparties abroad receiving MT 103 and MT 202 sent from countries in the region, excluding MT 202COV).



Source: BIS (2019). (https://www.bis.org/cpmi/paysysinfo/corr_bank_data.htm and https://www.bis.org/cpmi/paysysinfo/corr_bank_data/chartpack_1905.pdf)

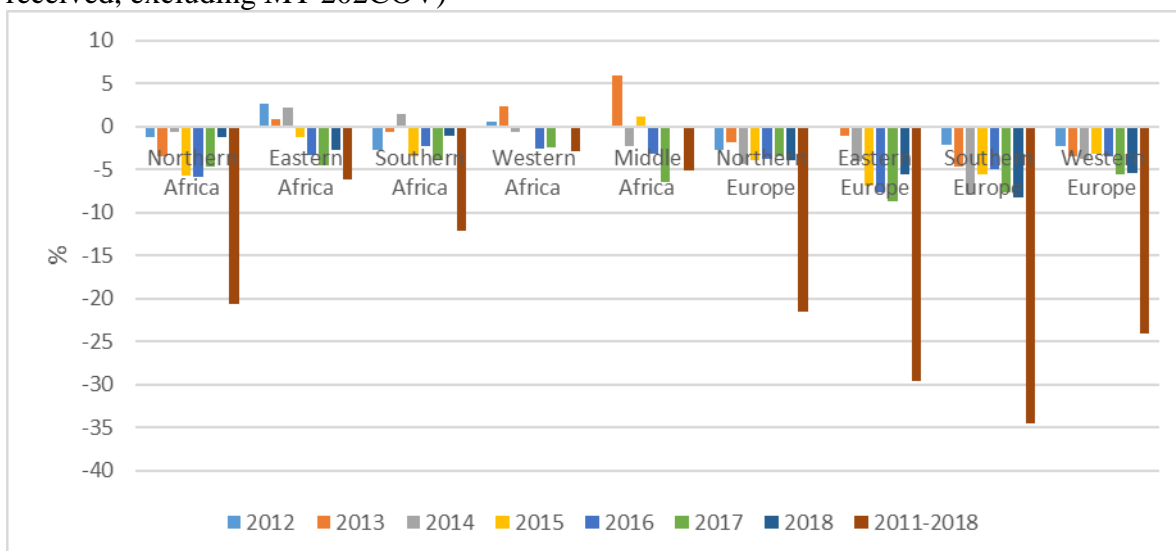
Figure 5. Changes in the number of active correspondents by regions (MT 103 and MT 202 sent, excluding MT 202COV), for the three major international currencies, 2011-2018



Source: BIS (2019).

In the case of MT 103 and MT 202 received across sampled regions, the decline in CBRs by African countries is lesser compared to what is obtained with MT 103 and MT 202 sent (see Figures 4 and 6). This implies that CBRs in Africa are more active in international transactions involving receipt than payment. This is not the case with EU. In all, CBRs withdrawals is highest in EU than in Africa. On the average, Africa recorded a CBRs withdrawal of -20.7% in terms of MT 103 and MT 202 sent and -9.4% in terms of receipt between 2010 and 2018. In the EU, it is -22.8% and -27.5%, respectively within the same period (Figure 4 and 6). This implies that correspondent banks' risks and profitability assessment of the relationships are higher in EU than they are in Africa.

Figure 6. Changes in the number of active correspondents by regions (MT 103 and MT 202 received, excluding MT 202COV)

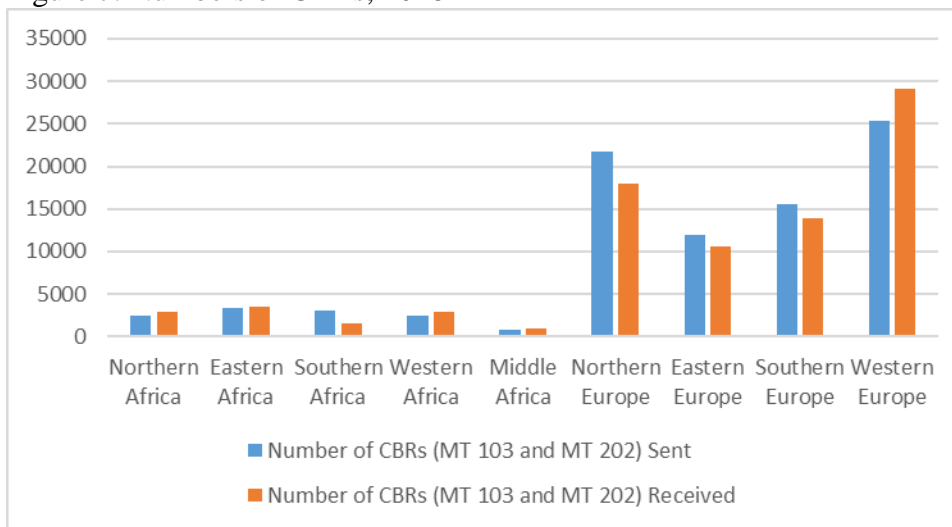


Source: BIS (2019)

The negative change in EU's CBRs is higher than that of Africa, but EU's CBRs is significantly more than Africa's. For the CBRs sent, Africa has average of 2,422 while EU has average of 12,110 in 2018. In the case of CBRs received, Africa has 2,371 and EU has 17,918 in the same year (Figure 7).

This shows that financial inclusion in cross-border trade finance is narrow in African unlike in EU. Hence, further de-risking constitutes additional burden that limits cross-border trade between Africa and EU.

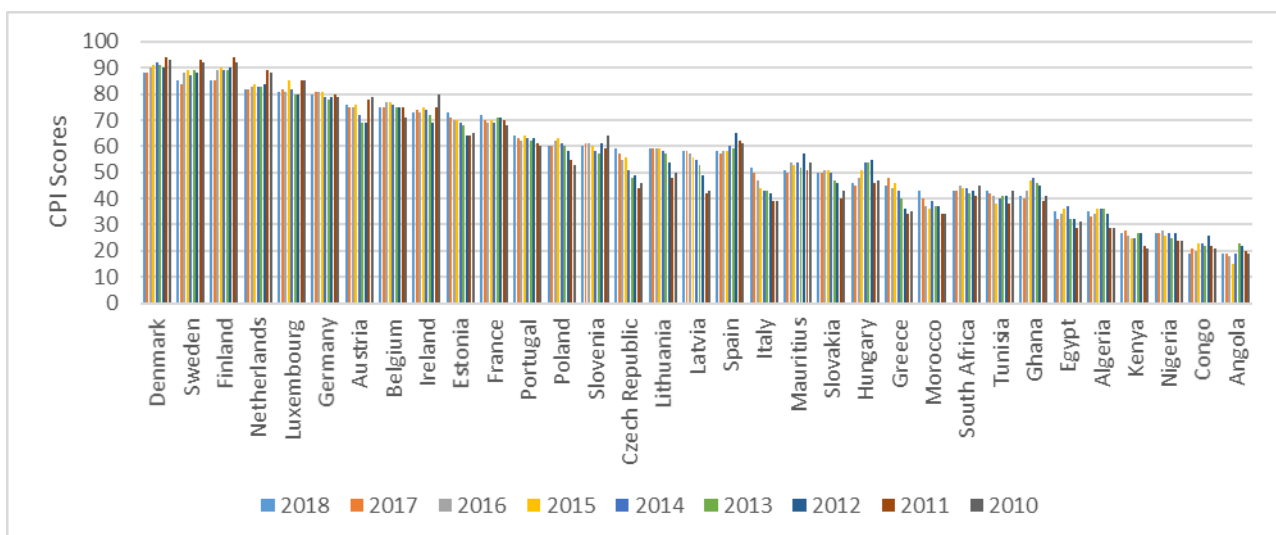
Figure 7. Numbers of CBRs, 2018



Source: BIS (2019)

The Corruption Perception Index (CPI) scores⁴ of the sampled EU and African economies shows that most African countries perform less than 50, on the average, between 2010 and 2018 in the index with the exception of Mauritius which performed better than some European economies (Figure 8). This is an indication that many African countries are perceived as more corrupt and this makes them risky thus raising compliance risk/costs concerns among the corresponding banks.

Figure 8. Corruption Perception Index of the Sampled Countries



Source: Transparency International, Corruption Perception Index (2018).

2.4. Relevance of the Services Sector in the Sampled Economies

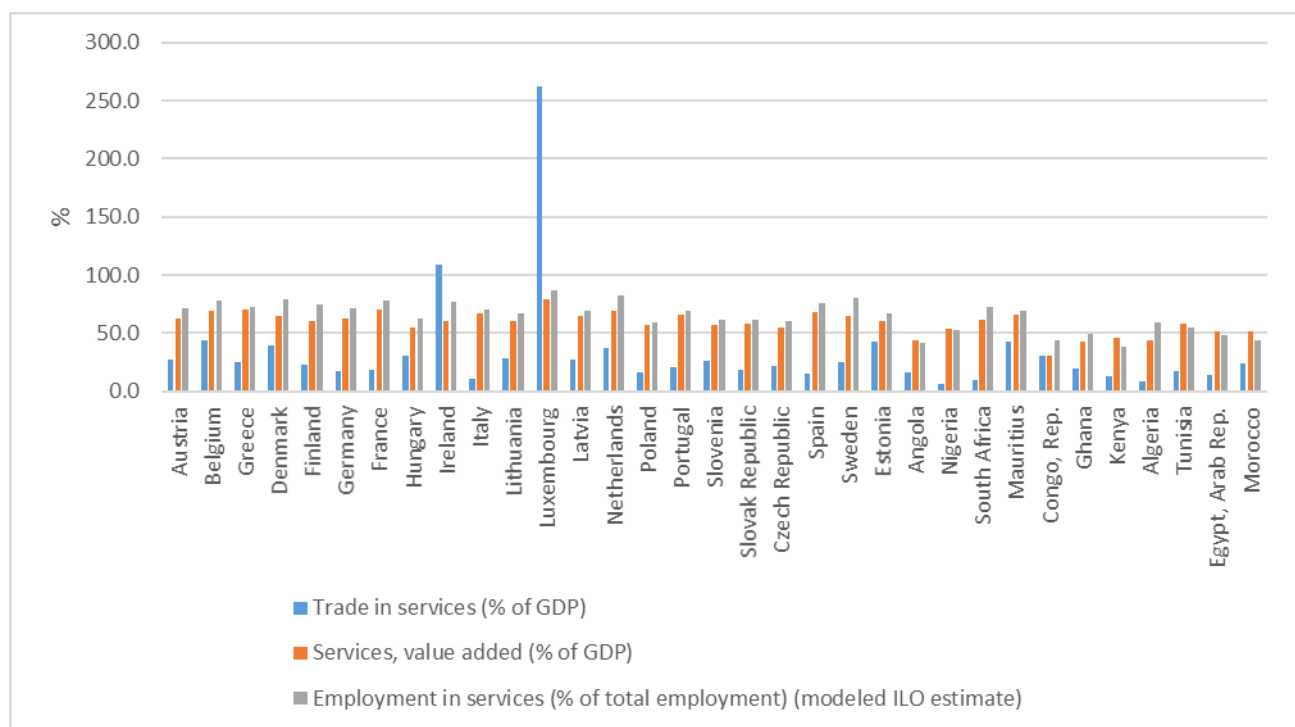
The increasing importance of services sector cannot be overemphasised. The proportion of services sector in the gross outputs of the sampled economies is above 50%, except for few African countries such as Angola, Congo, Ghana, Kenya and Algeria (Figure 9). However, trade in services

⁴ On the scale of 100 (very clean) to 0 (highly corrupt)

averages 18.2% and 40.2%, respectively among the sampled African and EU economies. Luxemburg and Ireland are outliers because trade in services is greater than their GDPs. This implies a high level of specialization in certain highly-profitable services industries making them to generate more income from services trade than the entire domestic economy. In the case of Luxemburg, it trades significantly in financial, other businesses, travel as well as insurance and pension services, while it is telecommunications, computer, and information; transport, financial, and insurance and pension services for Ireland.

In terms of employment generation and inclusive growth, services sector is equally important. On the average, 52% of all employment is generated by services sector in Africa while it is 71.6% in EU. Between 2010 and 2018, South Africa, Mauritius and Algeria services sector are the leading employment generating among the sampled Africa economies accounting for 72%, 68.6% and 59.4% of all employment, respectively (Figure 9). In the EU, Luxemburg, Netherlands and Sweden have leading services sector with average of 87.3%, 82% and 80.4% of all employment, respectively (Figure 9). Given this trend, the reason why services trade balance is characterised with surplus in the EU is more obvious.

Figure 9. Share of Services Sector Macroeconomic Fundamentals



Source: World Bank’s World Development Indicators (Online database)

3. Literature Review

3.1. Theoretical Literature

There are debates on whether standard international trade theory and its different models such as Ricardian, Heckscher-Ohlin-Samuelson, New trade model of Krugman, and “New” new trade model of Melitz and Antràs can equally explain trade in services (Hindley and Smith, 1984; van Welsum, 2003). Wherever the pendulum of debate swings, international trade theory has largely failed to zero-in on explaining drivers of trade in services. Whether these models explain drivers of services trade or not, certain inferences could be drawn for services trade from their conclusions: (i) the neoclassical trade models conclude that relative labour efficiency and specialization in activities that uses abundant resources intensively motivates cross-border trade, (ii) the new trade model was

based on the idea that increasing returns and networking would simply alter the pattern of comparative advantage, and (iii) the “New” new trade theory stressed the importance of firms specializing in a particular stage of production process (intermediate inputs), rather than in a sector, in understanding cross-border trade. This is referred to as intra-industry trade in intermediate inputs.

Given the conclusions of trade theories, trade in services fits into the neoclassical trade assumptions. That is, trade in services can be motivated by relative labour efficiency in one area of services than the other and across countries as well as abundance of certain type of services in one country than the other. The latter is particularly relevant to tourism services trade. This variation in relative abundance of a factor that is used in producing a particular service across countries determine the pattern of trade, specialization and comparative advantage. That is, as long as production of services varies across countries, depending on a host of factors, and the assumption that the consumers love varieties holds, international exchange of services becomes inevitable. However, applicability of new and “new” new trade theory to trade in services seems complicated due to its non-storability and ‘invisible’ nature, although some (Hindley and Smith, 1984; Deardorff, 1985) have argued that services also play an important role as intermediate inputs, especially when trade in goods is linked to trade in services. A good example is transport services.

Neoclassical trade theory emphasised the importance of relative productivity and prices in determining cross-border trade patterns. In autarky, abundant resources (by virtue of location or labour efficiency) attracts cheaper prices and vice versa. For instance, an Egyptian will be willing to pay less to see Egyptian pyramids while a European will be willing to pay more. Since utility determines willingness to pay, Germans will be willing to pay more to see pyramids because his or her utility is high for it. Hence, price of abundant service is cheaper in home in autarky. When services trade is liberalised and the services providers noticed increased demand for their services, there is incentive to raise prices thus making hitherto cheaper services more expensive. Hence, the validity of factor price equalisation (which determines welfare implications) in services trade can be argued. The liberalization of services sector takes the form of removing barriers to international transactions, services trade, the movement of consumers of services, the movement of the producers of services, and barriers to services FDI (Sampson and Snape, 1985; Sapir and Winter, 1994). Meanwhile, some services do not require the movement of consumers or producers (e.g. financial, digitized radio, television broadcasts services), while some services may be embodied in a good, which can make it difficult to distinguish between goods and services (Bhagwati, 1987). Factor price equalization in this later characterisation of services trade is ambiguous depending on trade option selected.

In line with the above, Jones and Ruane (1990) built a model of trade in services, there can either be trade in the service factor or trade in the service product itself. While the former combines with local factors to produce a non-traded service product (a situation in which management skills relocates to combine with local factors to produce a non-traded ‘service product’), the latter involve no further production in the foreign country and can be produced anywhere. These two level of services trade have different welfare and income distribution effects. Some of the conclusions are that opening up trade in either the service factor or the service product will unambiguously improve economic welfare that are not distributed equally across factors. Like the previous trade models, trade in services also has unequally distributed welfare effect.

Beside the above models of trade and discussions on their applicability to trade in services, gravity model of trade has equally been used to predict trade patterns based on the economic sizes and distance between two units. While the gravity has its root in physics, geography and spatiality, making some to argue it has no economic theoretical underpinning, it has been used to test hypotheses of trade theories with a lot of successes in accurately predicting trade in goods and services between countries (Carrère, Mrázová and Neary, 2020; Havranek and Irsova, 2016; Baier and Bergstrand, 2009; Baldwin and Taglioni 2007; Santos Silva and Tenreyro, 2006; Anderson, and van Wincoop, 2003; Feenstra, Markusen and Rose, 2001). Against the argument of weak theoretical underpinning of gravity model in explaining trade pattern, Deardorff (1998) demonstrated that gravity model is linked to and can be derived from neoclassical trade models such as the Heckscher-Ohlin and the “new” trade theories. Empirical applications of gravity model have been significant in bilateral merchandise trade flows between countries, and has equally be utilised to assess bilateral trade in services (Kimura and Lee, 2006; Ceglowski, 2006; Walsh, 2008; Nordås, 2018; Alhassan and Payaslioglu, 2019).

3.2. Empirical Literature

Empirical studies on the impact of de-risking on bilateral services trade between Africa and EU is rare. However, related studies have investigated the factors affecting trade in services (Ahmad, Kaliappan and Ismail, 2017; Yujiang Bi, Alexander, and Pei, 2019; Maune, 2019). The key factors identified as determinants of services trade are institutions quality, trade in goods (a compliment of services trade), real exchange rate, foreign income, foreign direct investment, the value added by services, and communication facilities. Others such as Moshirian (1993), Kimura and Lee (2006), Walsh (2008), Kaur (2011), Karam and Zaki (2013), Cole and Guillin (2015), Nordås (2018) have investigated bilateral trade in services using gravity model.

Specifically, on gravity model, Walsh (2008) assessed the determinants of trade in services and at disaggregated levels, with particular attention given to the role of barriers to services trade utilising the Hausman-Taylor estimator for services imports between pairs of 27 OECD countries during 1999-2001. The study found that wealth of countries and a common language are the most important determinants of services trade, while distance and adjacency are generally found to be insignificant. A variable measuring barriers to services trade was weakly significant. Also, Kaur (2011) examined the export potential in service sector of USA with its Asian trade partners (Japan, China, India, Singapore, South Korea and Hong Kong) by taking into account geographic, economic and other features. The study employed panel data methodology of data between 2000 and 2008. The study revealed that USA has export potential in services for India and Japan. Regarding the convergent and divergent economies, USA had convergence in exports with three Asian countries (Hong Kong, India and Korea) and divergence with three Asian countries (Japan, China and Singapore).

In a related study, Kimura and Lee (2006) assessed the impact of various factors on bilateral services trade relative to that on bilateral goods trade with standard gravity model for 10 OECD member countries and other economies for the years 1999 and 2000. Utilizing panel data estimated with time fixed effect, the key result was that services trade is better predicted by gravity equations than goods trade, while complementary relationship between goods exports and services imports was also established. Karam and Zaki (2013) examined the determinants of aggregate flows of service trade in MENA countries using an adapted version of the gravity model and a panel data set covering the 2000 to 2009 period for 21 countries and 10 sectors. The study introduced the number of bound commitments undertaken by a sector in the WTO and the availability of those commitments by mode of supply as additional determinant of services trade performance. The results, controlling for the selection bias related to the WTO membership and the endogeneity of

commitments, showed that being a WTO member boosts trade in services while being the number of bound commitments increases exports, imports and trade in services.

Besides, Cole and Guillin (2015) investigated differences in the determinants of signing an agreement on goods trade and services trade. The study employed gravity model which was estimated with bi-variate probit regression technique. In addition to the standard economic variables, the study included variables for skilled/unskilled labour, and political stability. The key result was that common languages affect the signature of agreements in goods differently than that of services. Nordås (2018), assessed the relative importance of non-actionable institutional and cultural factors and actionable policy measures for services market integration, using the Nordic countries as a case study. Employing Poisson pseudo maximum likelihood, the study found that policy-determined free trade agreements (FTAs) boost services trade by 75% and a single market by an additional 45%, while the accumulated effect of all standard non-actionable shared geographical, institutional and cultural features (sharing a land border, language, colonial past and legal origin) almost triples services trade. The study concluded that full integration of services markets may rely on deeper institutional and cultural factors.

This study, by examining the drivers of bilateral services trade between Africa and EU, and introducing CBRs as a new determinant of services trade between them, is not only empirically novel but is also of huge policy relevance.

4. Methodology and Data

4.1. The gravity model

The methodology used in this study will be based on gravity model applied on bilateral services trade following studies such as Walsh (2008), Karam and Zaki (2013), Cole and Guillin (2015) and Nordås (2018). The customary econometric gravity specification is stated as:

$$T_{ij} = G \frac{M_i^{\alpha_1} M_j^{\alpha_2}}{D_{ij}} n_{ij} \quad (1)$$

where T_{ij} represents volume of trade between country i and j , $M_i^{\alpha_1}$ and $M_j^{\alpha_2}$ typically represent the GDPs for countries i and j , D_{ij} denotes the distance between the two countries, and n_{ij} represents an error term. Linearising equation (1) and setting G as a constant give:

$$\ln T_{ij} = \alpha_0 + \alpha_1 \ln M_i + \alpha_2 \ln M_j - \alpha_3 \ln D_{ij} + \mu_{ij} \quad (2)$$

Equation (2) is expanded to capture some other variables of interest. Hence, the estimable gravity equation for total services trade in the context of this study is given as:

$$\begin{aligned} \ln ST_{ijt} = & \alpha_0 + \alpha_1 \ln RGDP_{it} + \alpha_2 \ln RGDP_{jt} + \alpha_3 \ln RGDP_{PC_{it}} + \alpha_4 \ln RGDP_{PC_{jt}} + \\ & \alpha_5 \ln Popu_{it} + \alpha_6 \ln Popu_{jt} + \sum_{k=7}^{10} \alpha_k \ln CBR_{it} + \sum_{l=11}^{14} \alpha_l \ln CBR_{jt} + \alpha_{15} \ln Corrupt_{it} + \\ & \alpha_{16} \ln Corrupt_{jt} + \alpha_{17} \ln lang_{ijt} + \alpha_{18} \ln Dis_{ij} + \alpha_{19} \ln Col_{ij} + \alpha_{20} \ln WTO_{ij} + \varepsilon_{ijt} \end{aligned} \quad (3)$$

Where $\ln ST_{ijt}$ is the log-transformed total services trade between country i (reporting EU economy) and country j (an African economy) at time t , $\ln RGDP_{it}$ and $\ln RGDP_{jt}$ is log-transformed RGDP of services exporting and importing nation, respectively. Besides that GDP is a force of attraction in traditional gravity model, cross-border exchange is not possible without

productivity. Also, GDP is relevant in the estimation because it includes other sectors of the economy thus capturing the possible complementarity between goods sector and services trade (see Kimura and Lee, 2006). $LnRGDPPC_{it}$ and $LnRGDPPC_{jt}$ is the log-transformed RGDP per capita of a two trading partners representing their purchasing ability, wealth and taste for different forms of services. For instance, income per head determines the demand for certain services trade than others. $LnPopu_{it}$ and $LnPopu_{jt}$ is the log of population of the two countries pair. This represents the market for the services trade. $\sum_{k=7}^{10} \alpha_k LnCBR_{it}$ and $\sum_{l=11}^{14} \alpha_l LnCBR_{jt}$ is the vector of log of different measures of CBRs in the two paired countries⁵/region, respectively. Increase in CBRs is expected to facilitate services trade and implies low de-risking. $Corrupt_{it}$ and $Corrupt_{jt}$ is corruption scores of paired countries, respectively. The level of corruption constitutes a down risk side to services trade (Nordås, 2018; Yujiang Bi, Alexander, and Pei, 2019) and a major factor in de-risking (Grolleman and Jutra, 2017). $lang_{ijt}$ is a dummy variable having the value of 1 if a pair of country speaks same official language and zero otherwise. Dis_{ij} is the physical distance between two capital cities of a pair of services trading partners. WTO_{ij} is a dummy representing a pair of trading partners that are members of World Trade Organization (taking value of 1) or not (taking the value of zero) (see Karam and Zaki, 2013). Out of these 33 economies, only Algeria is not a WTO member. ε_{ijt} is an independent and identically distributed (i.i.d) error term.

Equation (3) is further estimated between EU and four sub-sampled African economies in four major forms of services trade as indicated.

Trade theory recognises the need to produce before trade can occur. However, it argues that the key drivers of trade between two countries are relative prices and productivity and not really absolute productivity. While the estimable equation above depicts the drivers of total services trade and its different forms between EU and Africa, it did not fully capture services trade pattern in terms of the drivers of such services exports and imports. Hence, this study examines EU-African-wide services trade and its different forms. Hence, the estimable equations are specified as follows:

$$LnSX_{jit} = \gamma_0 + \gamma_1 LnRGDPR_{ijt} + \gamma_2 LnRGDPPCR_{ijt} + \gamma_3 LnCBRXX_{ijt} + \gamma_4 Col_{ij} + \varepsilon_{ijt} \quad (5)$$

$$LnSM_{jit} = \gamma_0 + \gamma_1 LnRGDPR_{ijt} + \gamma_2 LnRGDPPCR_{ijt} + \sum_{k=3}^5 \gamma_k LnCBRMR_{jt} + \gamma_6 Col_{ij} + \varepsilon_{ijt} \quad (6)$$

Where i is the reporting EU economy and j is Africa as a continent. $LnSX_{ijt}$ and $LnSM_{ijt}$ is log-transformed services export and import of EU with Africa, respectively, $LnRGDPR_{ijt}$ is log-transformation of ratio of an EU economy's RGDP to total African RGDP, $LnRGDPPCR_{ijt}$ is the log-transformation of ratio of an EU economy's RGDP per capita to average of African RGDP per capita, $LnCBRXX$ is the log-transformation of the ratio of CBRs received by EU and Africa, $\sum_{k=3}^6 \gamma_k LnCBRMR_{jt}$ is the log-transformation of the ratio of vector of CBRs sent by EU and Africa. While colonization dummy serve as gravity variable, corruption, population, distance, language and WTO membership are excluded. The colonization dummy takes the value of 1 if any of the sampled EU country has colonised any African country in time past and zero otherwise. In all, an African country had been colonized by six out of the 22 sampled European powers— France, Germany, Belgium, Spain, Portugal, and Italy.

⁵ Data on CBRs was not available at country level but at regional level. Hence, CBRs in a region was used as CBRs for the sampled country from that region. For instance, CBRs for West Africa is used as the CBRs for Nigeria.

4.2. Estimations Technique

There are evidence and arguments that Ordinary Least Squares (OLS) suffers from heterogeneity bias while estimating a log-linearized model in the gravity model context (Cheng and Wall, 2005; Santos Silva and Tenreyro (2006). OLS does not also capture the possible correlation between the covariates and unobserved individual-level random effects, otherwise known as endogeneity problem. Hence, studies such as Walsh (2008) used Hausman and Taylor model (HTM) while Santos Silva and Tenreyro (2006) and Nordås (2018) utilised Poisson pseudo maximum likelihood (PPML). PPML has features that allow the inclusion of zero trade flows which makes it more appropriate in cases of missing services trade flows and appropriate to avoid OLS biases. However, PPML does not capture potential endogeneity, especially between services trade and some of the explanatory variables such as GDP and heterogeneity across the cross-sectional observations. For instance, while services trade flows can be explained by GDP, services trade is also a component of GDP for an open economy. Additional advantageous feature of HTM is that it is suitable for unbalanced panel data characterising our dataset. Hence, the study employs HTM.

4.3. Data and sources

The data for this study covers the period between 2010 and 2018 and comprise of bilateral services trade between sampled EU and African economies, measured in million USD. This is sourced from the OECD statistics. The EU is taken as reporting economies for the bilateral services trade. Other variables such as RGDP, RGDP per capita, services value added and population are sourced from the World Bank's *World Development Indicators* (online data base). Also, CBRs data was sourced from the Committee on Payments and Market Infrastructures (CPMI) quantitative review of correspondent banking data, while corruption perception scores and distance including language (in kilometres) were sourced from Transparency International database and CEPII data set (at www.cepii.fr), respectively.

5. Results and Discussions

The estimations of total services trade, with Hausman-Taylor Random Effects, is presented in Table 2. Among the time variant exogenous variables, EU per capita real GDP is a positive driver of trade between Africa and EU. However, its impact is elastic. Also, 1% increase in CBRs received in EU reduces services trade between EU and Africa by 2.2%. This implies that rise in CBRs (i.e. reduced de-risking) in EU is likely to divert services trade between EU and Africa. It is important to note that rise in CBRs makes cross-border trade more efficient. Hence, services trade between high comparative advantage EU nations with more CBRs and lower comparative advantage African countries with lower CBRs works against creating a very efficient trade finance system leading to overall lower services trade. That is, Africa may not be an efficient importing partner of services exported by EU. This is harmful to consumers and producers of services in EU and Africa, with more harmful impact likely on net-services-trade-importing Africa.

However, the impact of de-risking varies in different currencies with CBRs sent from EU. Active CBRs sent from EU in Euro elastically improved services trade between Africa and EU such that 1% increase in CBRs sent from EU increases services trade between Africa and EU by 3.1%. Hence, EU is relatively an efficient importing partner of services exported by Africa. In Africa, CBRs sent in US dollars also improves services trade flows between EU and Africa.

Further, while an increase in corruption perception score in EU (that is, the less corruption in EU) significantly increases services trade with Africa, the corruption score of Africa was not significant

in driving services trade. Besides, real GDP of Africa and EU are important positive drivers of services trade between them. Among the time invariant exogenous variables, distance was found to weakly influence services trade between Africa and EU negatively.

Table 2. Trade in Services Gravity Regression Model between EU and Africa (11 sampled economies)

logtst	Coef.	z-score	P>z
TVexogenous			
loggdppce	0.619	2.570**	0.010
loggdppca	0.025	0.180	0.859
logpope	-0.424	-0.810	0.419
logpopa	-0.604	-1.550	0.120
logcbrxe	-2.169	-4.490***	0.000
logcbrusde	-0.436	-0.47	0.635
logcbreure	3.115	3.010***	0.003
logcbrgbpe	-0.097	-0.260	0.795
logcbrxa	-0.045	-0.060	0.949
logcbrusda	1.894	3.750***	0.000
logcbreura	-1.01	-1.860*	0.062
logcbrgbpa	-0.656	-1.600	0.110
logcore	0.726	2.610***	0.009
logcora	-0.222	-1.090	0.278
TVendogenous			
logrgdpe	1.067	2.370**	0.018
logrgdpa	1.136	3.200***	0.001
TExogenous			
logdis	-1.154	-1.710*	0.087
lang	0.674	0.610	0.545
wto	2.005	1.470	0.141
col	2.192	1.010	0.312
_cons	-29.589	-2.290**	0.022
Rho	0.99		
Wald Chi-2 (20)	144.18***		
CD statistics	1.899*		
Observations	1522		

Source: Authors' Computation

Note: The variables ending with 'e' and 'a' in the Table 2 corresponds to sampled EU and African economies, respectively. tst= total services trade between sampled Africa and EU economies, rgdp= real GDP of the sampled economies (million USD), gdppc= real GDP per capita, pop= population (million), cbrm= corresponding banking relationships abroad receiving MT 103 and MT 202, excluding MT 202COV sent from countries in the region, cbrx= corresponding banking relationship received MT 103 and MT 202, excluding MT 202COV sent from counterparties abroad, cbrusd= active corresponding banking relationship abroad receiving MT 103 and MT 202, excluding MT 202COV sent from home country in USD, cbreur= active corresponding banking relationship abroad receiving MT 103 and MT 202, excluding MT 202COV sent from home country in Euro, cbrgbp= active corresponding banking relationship abroad receiving MT 103 and MT 202, excluding MT 202COV sent from home country in Great Britain Pounds. Also, cor= corruption scores and dis= physical distance (km) between two paired countries' capital cities, lang= language dummy, wto= dummy of World Trade Organization membership, and col= is dummy of colonisation

logdis	-2.786	-0.91	0.521	0.08	-0.339	-0.27	-2.603	-1.26
lang	-2.814	-0.47	-4.530	-0.39	0.943	0.78	0.262	0.09
col	9.592	0.85	15.269	0.65	0.383	0.14	2.164	0.36
_cons	179.834	3.84**	343.855	4.04***	-22.257	-1.16	33.439	1.01
Rho	1.0		1.0		0.98		1.0	
Wald chi2(19)	145.92***		52.58***		111.32***		35.74**	
CD test	0.108		1.830		0.560		0.984	
Obs	398		380		470		477	

Source: Authors' computation

In terms of trade pattern, relative real GDP per capita is a positive determinant of other business services and telecommunication, computer and information services export of EU to Africa, but it reduces export of transport services (Table 4). The outcome of transport services is similar to other business services which is negatively influenced by relative real GDP. The outcome of transport and other business services export related to relative real per capital income and relative real GDP support the Linder hypothesis which posits that countries with similar income consume similar quality products, and trade with each other. The result of transport and other business services export implies that de-similarity in income of EU and Africa will make EU export less of its travel and other business services to Africa. Moreover, relative CBRs received is found to significantly influence other business services export of EU to Africa. Colonial ties are important in explaining EU's exports of other business services to Africa.

Table 4. EU services Export to Africa

logsx	Total Export	Other services	Telecom	Transport	Travel
TVexogenous					
logrgdppcr	-0.225 (-0.61)	2.191 (3.4)**	1.672 (3.07)**	-1.622 (-3.14)**	1.297 (1.79)*
logcbrxr	-0.463 (-0.77)	2.371 (2.22)**	-0.585 (-0.6)	-1.135 (-1.22)	-0.941 (-0.74)
TVendogenous					
logrgdpr	0.246 (0.32)	-3.118 (-2.26)**	0.130 (0.08)	1.632 (1.19)	-0.126 (-0.07)
Tlexogenous					
col	2.143 (1.12)	9.286 (2.52)**	2.246 (0.66)	-0.285 (-0.09)	4.745 (1.13)
_cons	20.957 (6.57)***	2.176 (0.38)	13.281** (2.22)	27.020 (5.15)***	12.526 (1.66)*
Rho	0.98	0.99	0.91	0.98	0.93
Wald Chi-2 (20)	6.29	13.82**	37.84***	17.27***	33.15***
Observations	166	159	148	152	140

Source: Authors' computation

EU import of services estimations are presented in Table 5. Total services import is driven by relative CBRs sent. That is, if relative CBRs sent by the EU increases by 1% total import from Africa will rise by 2.6%. While EU's relative income per capita positively influence import of other business services, it has a negative effect on transport services import. Hence, EU is likely to import

less of transport services and more of other business services from Africa as income per head increases.

Table 5. EU services import from Africa

logsm	Total import	Other services	Telecom	Transport	Travel
TVexogenous					
logrgdppcr	-0.163 (-0.29)	3.161 (3.69)***	0.701 (0.71)	-1.396 (-1.99)**	1.413 (1.14)
logcbrusdr	-1.938 (-1.19)	0.032 (0.01)	-5.249 (-1.9)*	-1.554 (-0.72)	-4.900 (-1.3)
logcbreurr	2.690 (1.99)**	-3.133 (-1.52)	-1.904 (-0.84)	3.279 (1.91)*	2.566 (0.79)
logcbrbgpr	-0.767 (-1.1)	0.094 (0.09)	1.537 (1.26)	0.464 (0.46)	-5.212 (-3.31)**
TVendogenous					
logrgdpr	0.069 (0.08)	-2.057 (-1.57)	2.498 (1.65)*	0.933 (0.91)	-0.673 (-0.31)
Tlexogenous					
col	2.227 (0.9)	7.724 (1.94)*	-1.358 (-0.33)	0.596 (0.22)	4.921 (0.71)
_cons					
_cons	19.108 (6.09)***	5.331 (1.13)	22.894 (4.17)***	21.690 (5.87)***	15.976 (2.13)**
Rho	0.99	0.99	0.98	0.97	0.99
Wald Chi-2 (20)	11.66*	31.63***	19.66***	9.70	32.07
Observations	164	158	144	151	142

Source: Authors' computation

6. Conclusion and Policy Implications

Services trade has the potential of making development more inclusive. However, EU's services trade with Africa is narrowing and declining in the recent time. In this study, we focus on the role of CBRs and a number of conventional determinants of services trade in explaining services trade between the EU and Africa. Using the standard trade gravity model, we estimated regressions on bilateral services trade between 22 EU member countries and African countries (with two sub-samples of 11 and 4 countries) covering between 2011 and 2018. We employed more detailed data set subcategories of services trade including travel, transport, other business services and telecommunication, computer and information services trade as well as breakdown of services trade into exports and imports. This is necessary to explain the possible heterogeneous nature of the service trade.

We find that CBRs are very important in explaining services trade between the EU and Africa. Of course, other macroeconomic variables such as real GDP per capita, real GDP, and level of corruption equally have mixed significant effects on services trade and its various forms. We find inconsistencies in the pattern of effects of CBRs on services trade and its various forms. Indeed, there are results running counter to expectations that higher CBRs should promote services trade. The same is also applicable to other macroeconomic and gravity variables. The lack of strong and consistent findings with respect to CBRs and other macroeconomic variables is traceable to the fact that the two regions (EU and Africa) we are investigating vary significantly in economic fundamentals which may be causing less services trade between them. This is established by the

Linder hypothesis which posits that similarities in economic fundamentals such as income level may be important in explaining trade ties between countries.

However, colonial affiliation, distance, being a member of WTO and speaking same official language do not significantly influence trade between Africa and EU, except for EU's other business services export to Africa which is positively influenced by colonial affiliation and distance with weak negative effect on total services trade in Table 2. Some of our results in this regards agreed with other studies such as Walsh (2008) and Cole and Guillin (2015). However, the study did not find a significant relationship between two countries pair (involving EU and Africa) being members of WTO and services trade between them. This is contrary to Karam and Zaki (2013). The reason for the difference in outcomes raises the possibility of measurement problems. In the case of Karam and Zaki (2013), WTO is a dummy variable taking the value of 1 if the country is a WTO member and 0 otherwise. This is slightly different from our approach.

We found that institutional quality of EU economies measured by corruption scores positively drives services trade between EU and Africa, while less corruption in Africa shows opposite effect. These outcomes are in line with Yujiang, Alexander and Pei (2019) and Gil-Pareja, Llorca-Vivero and Martínez-Serrano (2019) who found ambiguous pattern of institutional quality and corruption on services trade.

In terms of policy that can enhance services trade between EU and Africa, de-risking in US dollars in Africa and Euro in EU due to lack of respondent bank's capacity to effectively manage risks relating to anti-money laundering, combating the financing of terrorism and tax transparency standards will have a significant undesired effect on services trade between Africa and EU. Hence, there is a need to safeguard the integrity of payment system in US dollars and Euro in a manner that will preserve access to CBRs to further facilitate services trade between Africa and EU. Given the weak financial inclusion in Africa compared to EU, there may be need for Africa to build the technical capacity to effectively monitor and enforce anti-money laundering, combating the financing of terrorism standards. Of course, information sharing among the corresponding banks in EU and Africa will also help in a significant way. There is a need to improve financial inclusion in Africa to measure up to what is obtainable in EU, otherwise huge gaps in financial inclusion will not be beneficial to services trade between the EU and Africa. This is one of the implications of the results of this study. In all these, IMF, World Bank and other regional financial institutions have important role to play given that one of their responsibilities is to provide practical guidance and training on how countries can develop their financial institutions for better economic outcomes.

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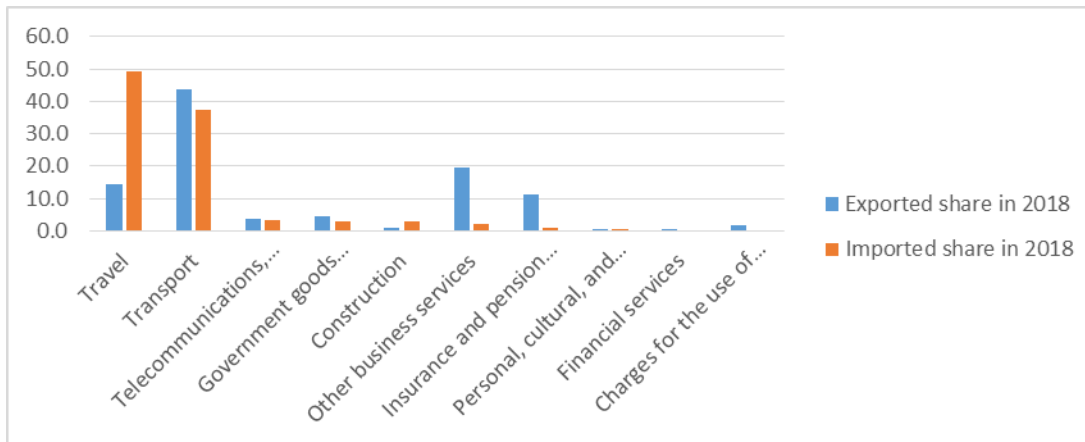
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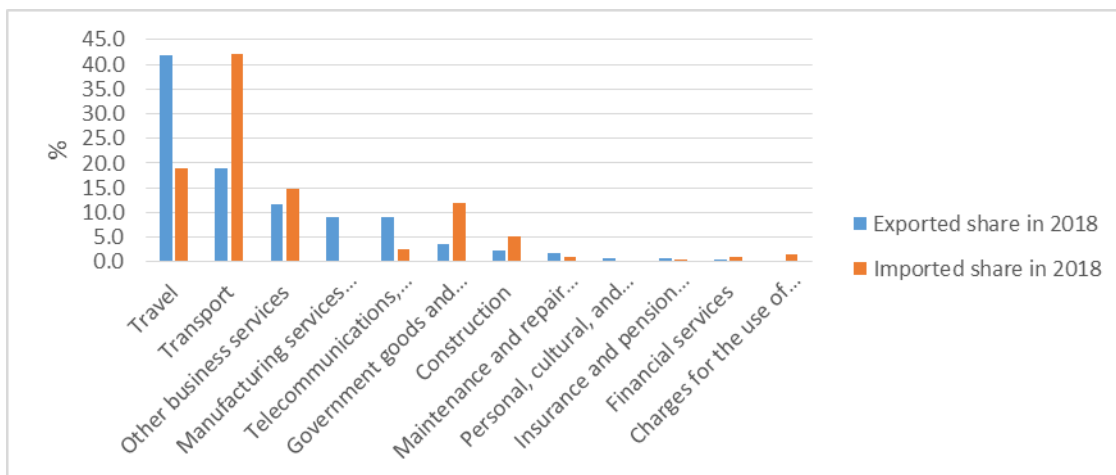
Appendix

Figure A1. Egypt services trade components



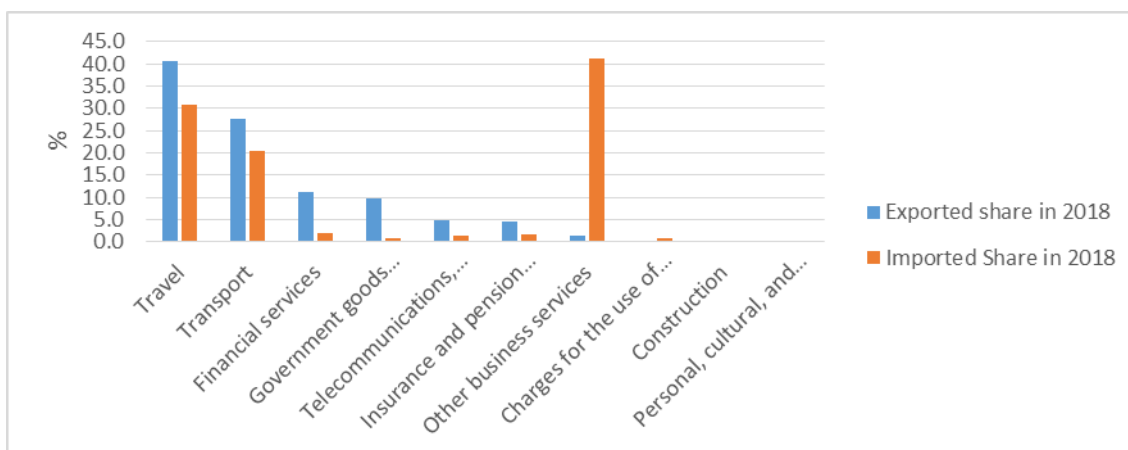
Source: ITC trade map

Figure 2. Morocco services trade components



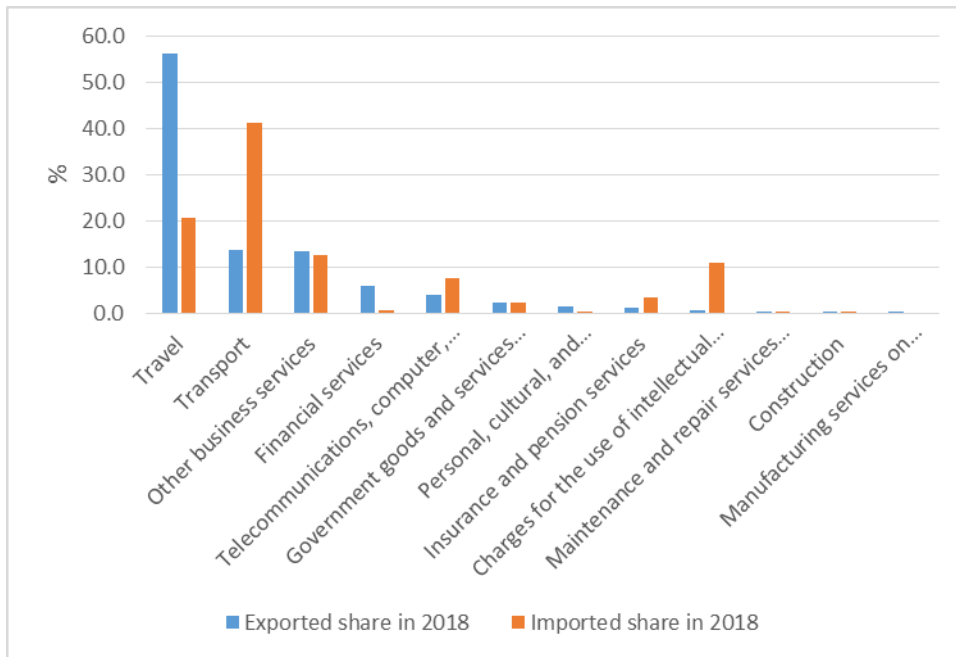
Source: BIS (2019)

Figure A3. Nigeria services trade components



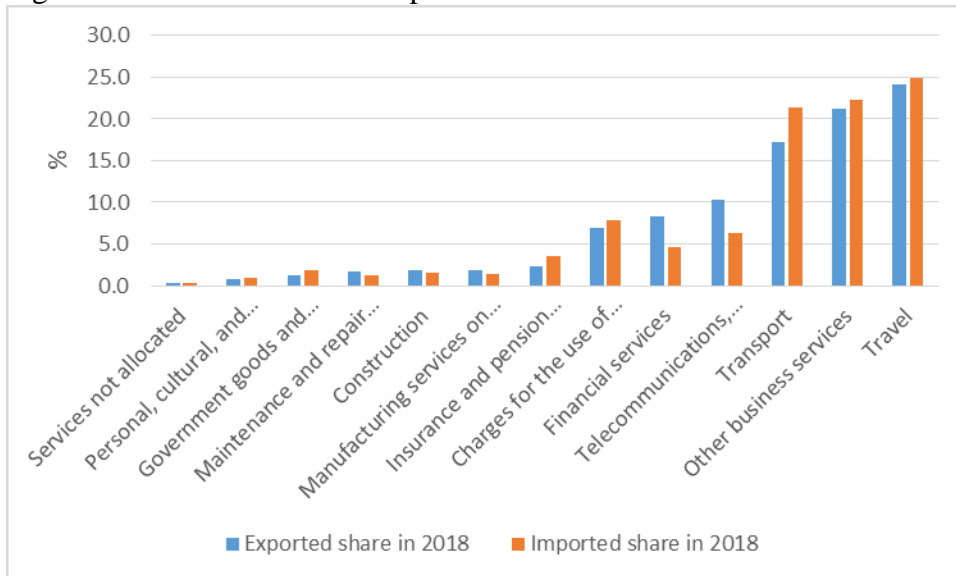
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Figure A4. South Africa services trade components



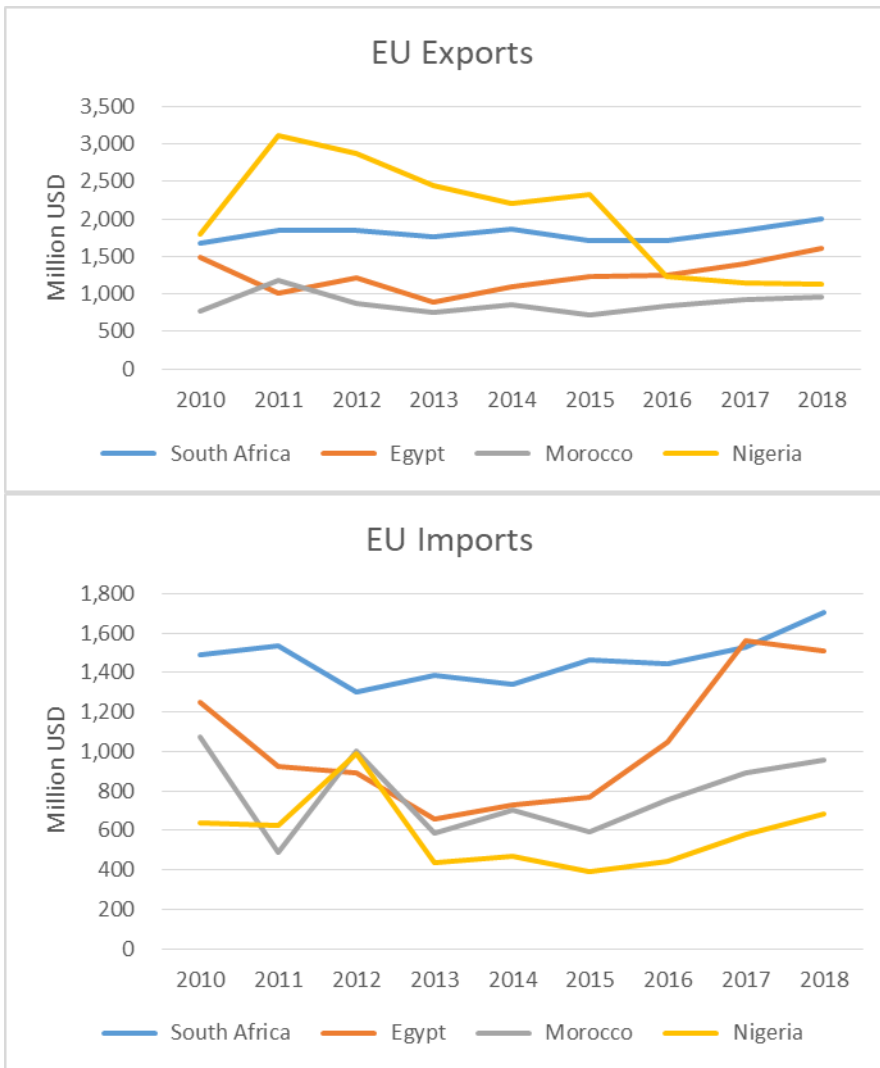
Source: BIS (2019)

Figure A5. Global trend in components of services trade



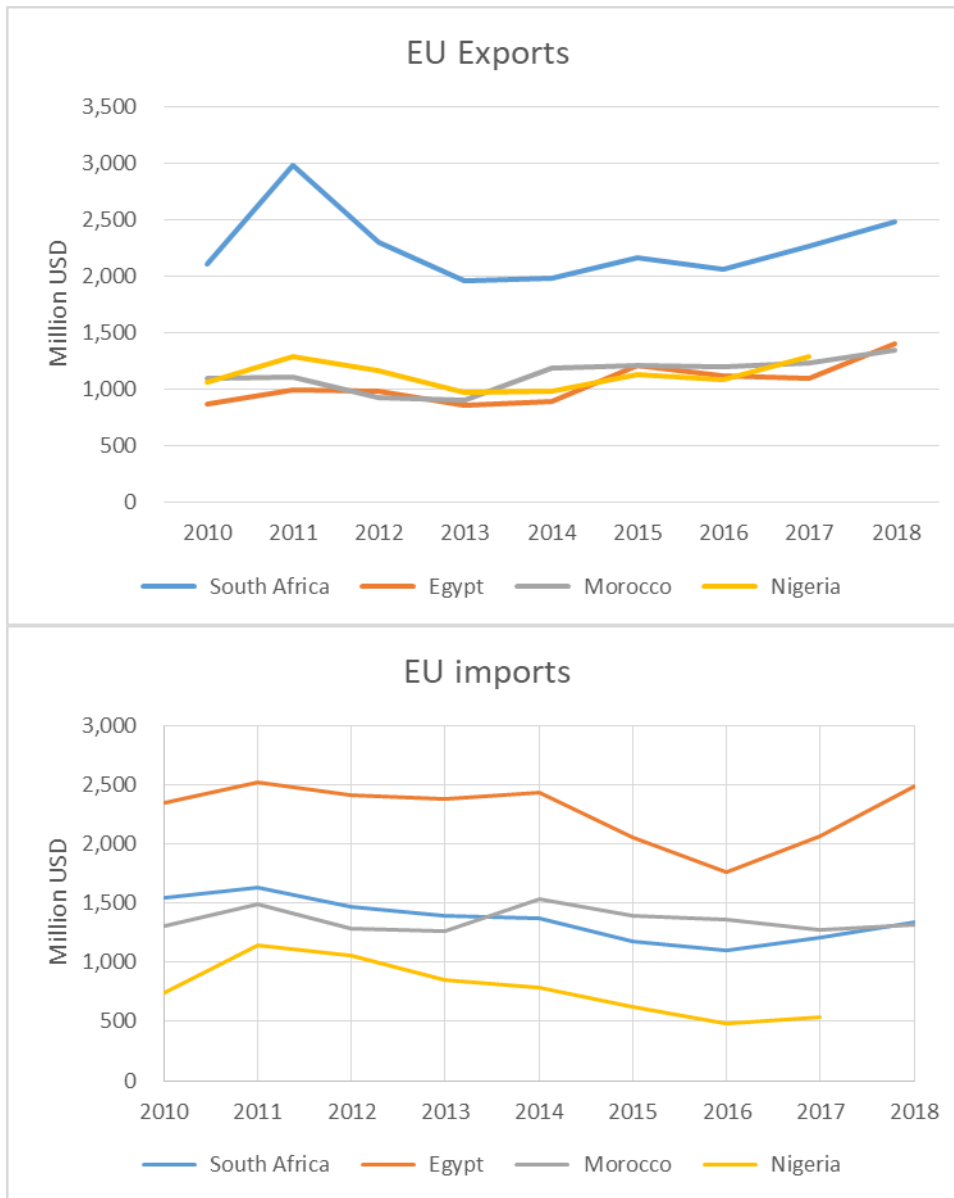
Source: BIS (2019)

Figure A6. EU-Africa Trade in Other Business Services



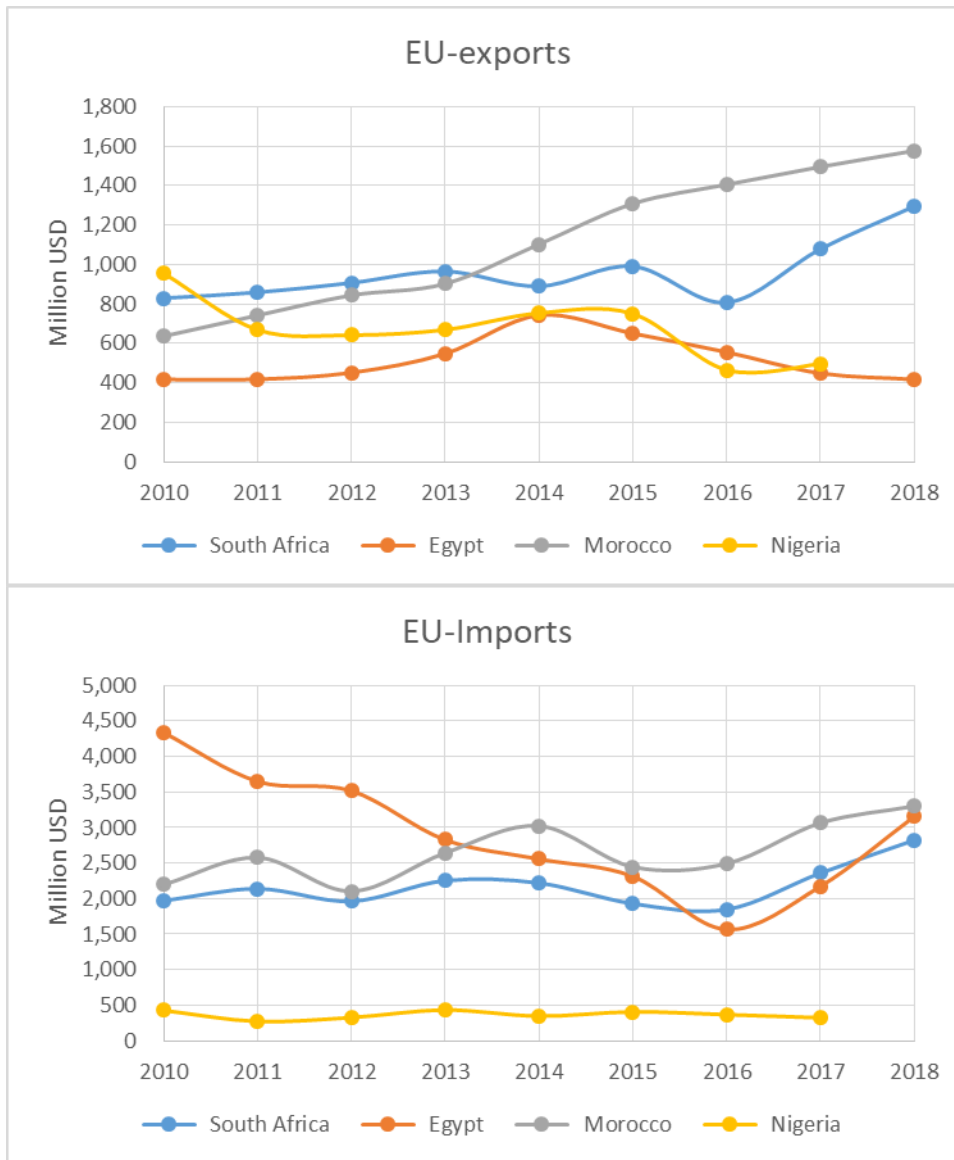
Source: OECD statistics

Figure A7. EU-Africa trade in Transport services



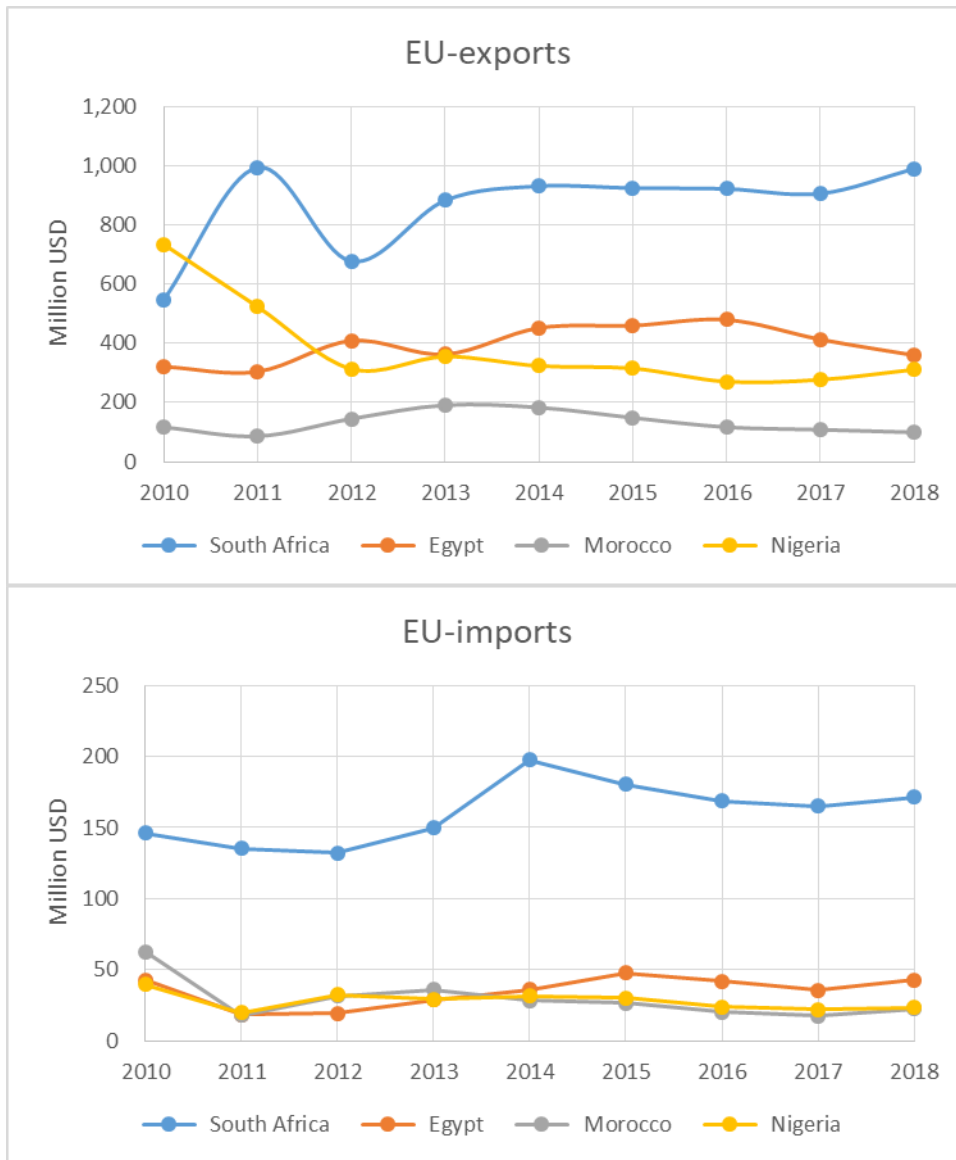
Source: OECD statistics

Figure A8. EU-Africa trade in Travel services



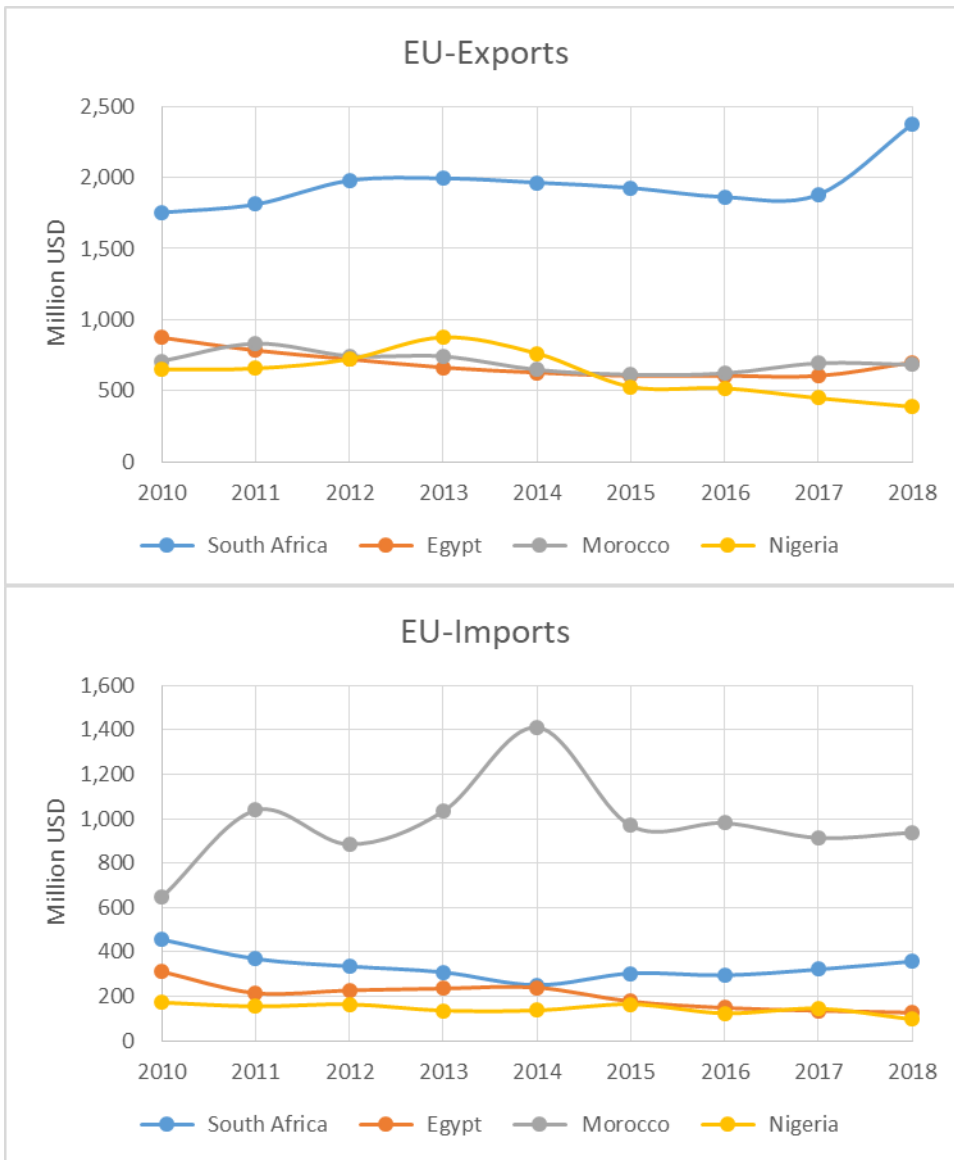
Source: OECD statistics

Figure A9. EU-Africa trade in financial services



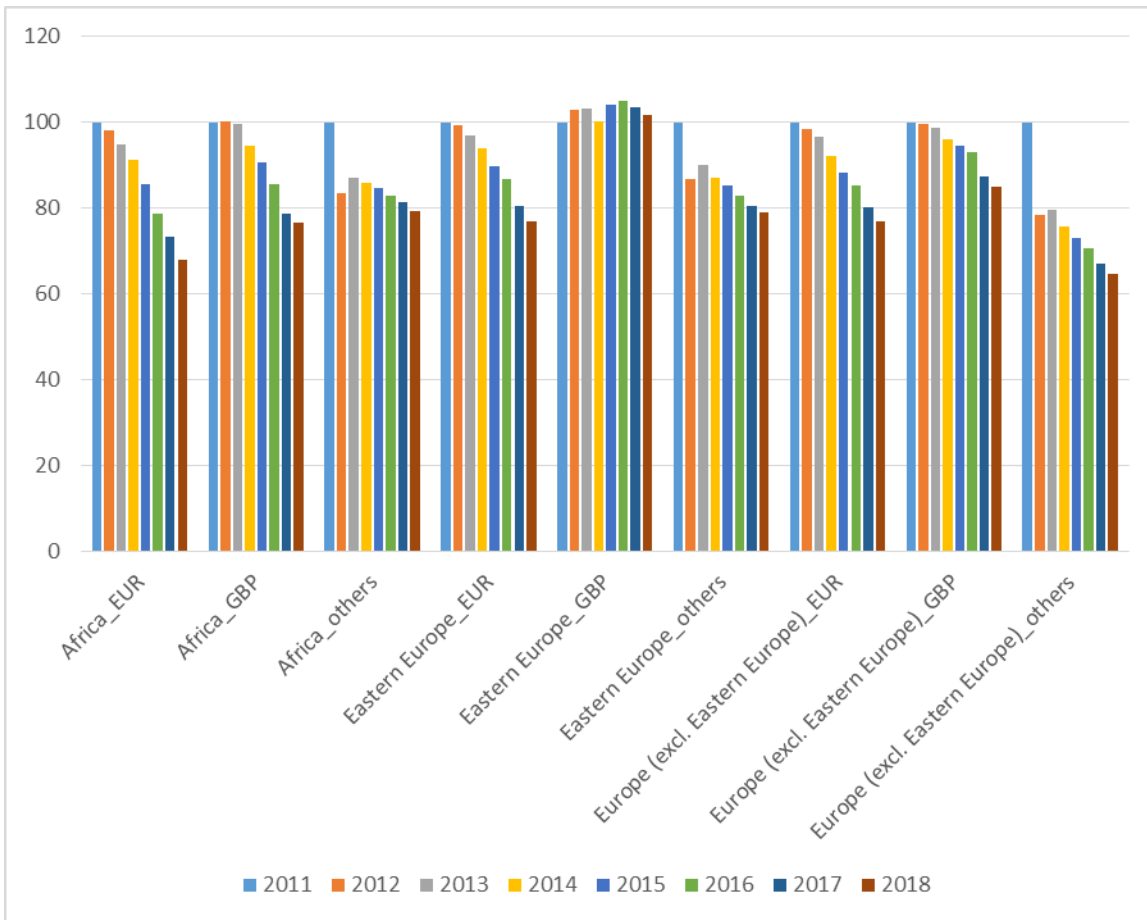
Source: OECD statistics

Figure A10. EU-Africa trade in TCI services



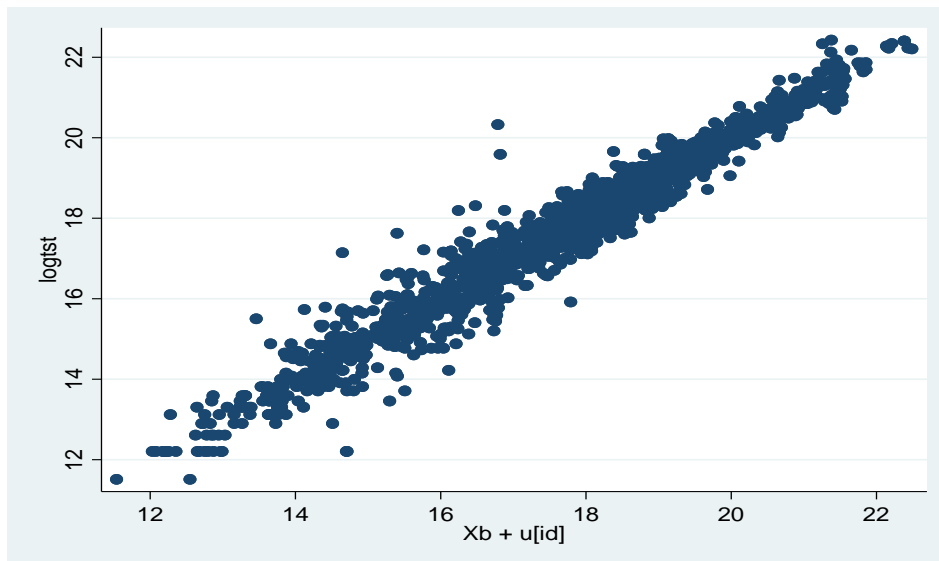
Source: OECD statistics

Figure A11. Index of number of active major currencies correspondents by region (count of counterparties abroad)



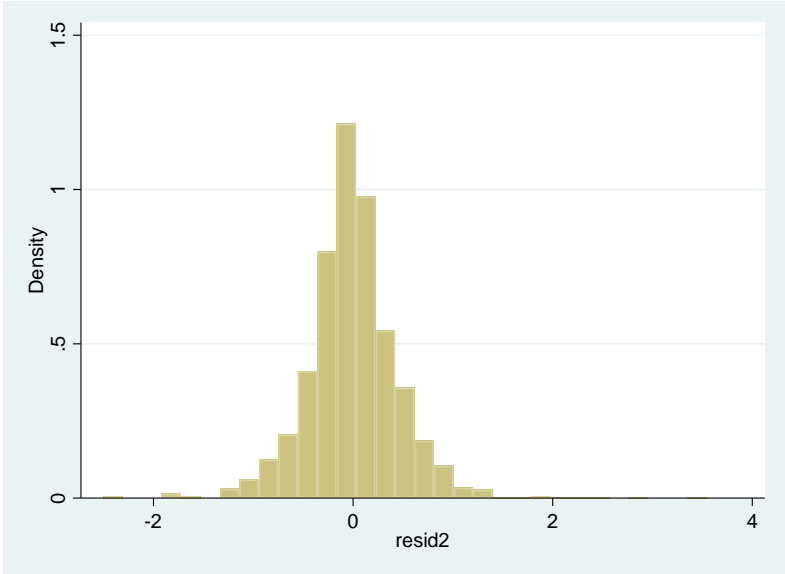
Source: BIS (2019). (https://www.bis.org/cpmi/paysysinfo/corr_bank_data.htm and

Figure A12. Linear prediction including random effect



Source: Authors' computation

Figure A13. Residual distribution



Source: Authors' computation