

**Sectoral Linkages of Financial Services as Channels of Economic Development –  
an Input-Output Analysis of the Nigerian and Kenyan economies**

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## **Abstract**

Sectoral linkages of the financial sector act as channels of economic development. This paper evaluates sectoral linkages of the Nigerian and Kenyan financial sectors, respectively. By means of an Input-Output Analysis for 2007, 2009 and 2011 both backward linkages and forward linkages, multiplier effects and variation indices for the financial services sectors are determined. We additionally investigate these linkages for the communication sector due to the increasing importance of mobile money. We find considerably high forward and backward linkages only for the Nigerian financial sector. Here, changes in final demand for or primary input into the financial sector have a wide and evenly spread impact on the rest of the economy. The financial sector can be classified as key sector of the Nigerian economy. For Kenya however, this can only be confirmed in part. Sectoral linkages are considerably lower than in the case of Nigeria, which may be due to a well-developed mobile financial market in Kenya. Results for the communication sector however yield rather low linkage values and multiplier effects for both economies and do not map the expected role within the countries. All results are confirmed by a robustness test. A lack of data coverage especially with regard to mobile money and a high degree of informal transactions in the financial sector could influence these results. Still, our findings confirm the economic significance of the financial sector for both the economies also when this finding is more evident for the Nigerian economy.

**JEL Codes:** D57, G20

# **Sectoral Linkages of Financial Services as Channels of Economic Development – an Input-Output Analysis of the Nigerian and Kenyan economies**

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## **1. Introduction: aim and scope of the study**

The financial system is the nerve center of a country's development (Financial Stability Report, 2011). An efficient provision of financial services is determining a country's economic growth and prosperity. First, the financial sector provides many employment opportunities and generates high income. Second, financial services, comprising banking, savings and investments as well as insurance services enable people to save money, to guard against uncertainty. Thereby they build wealth and have the chance to receive loans. Third, an efficient provision of and access to financial services is crucial for a country's business environment. Next to enabling business start-ups, these services enforce and increase the efficiency of existing companies. Finally, and of specific importance for Africa, an efficient provision of financial services fosters the expansion and the competitiveness of local companies aiming at participating in regional and international markets (Sutton and Jenkins, 2007).

The latter fact is all the more important in light of recent developments of an ongoing fragmentation of production processes and an expansion of Global Value Chains (GVCs). These GVCs are of special interest for emerging and developing economies since they are a first step into world markets providing an enormous potential for development and growth. For African countries, the participation within these chains is worth striving for but also very difficult. Only very few sub-Saharan African nations are well-integrated into GVCs, among them Nigeria and – slightly less so – Kenya (Draper, Freytag and Fricke, 2014). Especially these two economies play a significant regional role in West and Eastern Africa. As Ogunleye (2011) suggests, Kenya and Nigeria can be considered growth poles in Africa (together with South Africa, Botswana and Angola) and hence have the potential to drive regional development. The state of development of their financial sector plays an important role for both the domestic economies and the neighboring countries since positive spillovers can arise to other countries in the region. An efficient provision of financial services is crucial to improve the chances to join GVCs, (Miroudot et al., 2009). They are key in an economy and determine other sectors' competitiveness significantly.

However, there is a gap in the respective literature (see section 4 below), as the inter-sectoral connectedness of financial services in emerging and developing countries has not been in the focus. This study therefore aims at analyzing the specific role of the financial sector in two African economies, namely Nigeria and Kenya. We assess the overall economic effects coming from the sectoral linkages of the financial services sectors in Nigeria and Kenya. This allows us understanding the developmental impact of the financial sector in the Nigerian and Kenyan economies outlined by its inter-sectoral linkages to the other sectors and the overall economy as channels through which the financial sector affects the competitiveness of other sectors of the economy and the overall economy.

To do so, the study proceeds as follows. First, a brief outline on the relevance of inter-sectoral linkages is given, followed by a summary on the economic importance of financial services as well as a brief literature review, respectively. In section 5, a view on the current state of financial sector development in Africa in general and Nigeria and Kenya in particular is provided. In the main part of the study (sections 6 through 8) we analyze the financial sector's interconnectedness of the Nigerian and Kenyan economies respectively. As they already have a sufficiently well-developed financial sector – but not a world class one, such as South Africa – they provide a suitable framework for the analysis. The inter-sectoral connectedness analysis of the financial sector is done with the help of an input-output analysis, comprising assessments of linkages to the other sectors of the economy and the assessment of overall economic effects coming from the financial sector (multiplier effects). This additionally permits a characterization of the role of the financial sector by key sector assessment. In section 9 we discuss the results as well as policy implications.

## **2. The relevance of inter-sectoral linkages**

Inter-sectoral linkages reflect the interconnectedness between the sectors of an economy. Mutual interdependencies between the sectors are decisive for the extent to which growth in one sector contributes to growth of other sectors and overall growth. Tregenna (2008) outlines ten mechanisms through which sectoral growth may yield overall economic growth. Of those mechanisms, two very important channels are backward linkages and forward linkages.<sup>1</sup>

Backward linkages create additional demand for the output of upstream sectors which in turn induces increased upstream investment and an increased level of capacity utilization, as well

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<sup>1</sup> The other mechanisms comprise: compositional effects; specialization; trade; employment; innovation, technological progress and productivity growth; savings; fiscal and institutional mechanisms (Tregenna, 2008).

as possible upstream technological upgrading. The overall effect on the economy depends on the kind of sectors to which a sector is backwardly linked (Tregenna, 2008).

By contrast, sectors' forward linkages impact downstream sectors. Thus, decreasing costs of a sector's output can result in growth inducing effects to downstream industries. These could include downstream investment, technological upgrading, or increased productivity and resource utilization. Both of these growth inducing mechanisms – backward and forward linkages – are so-called Hirschman-type production linkages (Tregenna, 2008).

In his theory of inter-industrial linkage analysis, Hirschman (1959) especially emphasizes the role of backward linkages for growth stimuli. He further argues that forward linkages cannot exist in pure form since they are a result of the demand emanating from existing backward linkages. The existence of demand is therefore a condition for forward linkages. Accordingly, he states that forward linkages can be considered a powerful reinforcement of backward linkages. This consideration leads to the differentiation between industries that *induce* economic development via backward linkages and industries that *enable* economic development via forward linkages (Hirschman, 1959).

The most relevant sectors within an economy are the ones with both high backward and forward linkages. They are considered key sectors for economic development since investments into those yield overall economic effects (Hansda, 2001; Park, 1989). The inter-sectoral connectedness of the financial sector is of specific interest due to its central role within each economy.

### **3. The role of financial services**

The financial industry covers a broad range of services necessary to manage transactions between people and businesses respectively. In Africa, basic services are still not existent in the quality and frequency needed in particular to increase savings. These are necessary to finance investments (either via microcredits or regular credits), to facilitate the integration of enterprises in regional as well as global trade, and to support business with insurance. Put differently: the absence of such services increases transaction costs and may even be prohibitive for interactions, reducing income opportunities below the potential.

Financial services are provided by diverse organizations that manage money (e.g. credit unions, banks, insurance companies, accountancy companies, etc.). They are part of the so called backbone services of an economy. These are infrastructural services which play a

specifically important role for each economy and also comprise energy supply, transportation, communication and distribution.

The efficiency of backbone services is increased by service liberalization, including financial services. Deardorff (2001) demonstrates that liberalizing trade in services stimulates trade in goods significantly. He thereby focuses on what he terms trade services including transportation, communication, travel services, professional services and also financial services and insurance (Deardorff, 2001). Focusing on financial services, Francois and Schuknecht (1999) confirm a positive relationship between economic growth and openness of these services. In line with this, a cross-country analysis by Mattoo et al. (2001) shows that countries with open financial and telecommunication services are growing up to 1.5 percentage points faster than those missing that characteristic.

However, studies specifically focusing on the inter-sectoral connectedness of financial services are scarce. Existing studies focus on the analysis of the inter-sectoral connectedness of services in general by means of an input-output analysis.

#### **4. Studies on inter-sectoral linkages of the services sector**

The majority of studies deals with inter-sectoral linkages of services focus on industrialized countries. Scrutinizing for example the European economy for key markets and key sectors applying the input-output analysis, Rueda-Cantuche et al. (2012) find that the financial sector is a forward oriented sector (significant forward linkages to the other sectors of the economy) which is evenly spread throughout the whole economy. Individual studies deal with e.g. Scotland (Larreina 2008, Dewhurst 2010), Wales (Midmore et al. 2006) and Poland (Olczyk 2010). Breda and Cappariello (2010) analyze internationalization strategies of German and Italian firms using Input-Output analysis.

When looking at emerging economies however, studies on inter-sectoral connectedness predominantly only control for services in general, not for financial services in particular. Tregenna (2008) for example focuses on the manufacturing sector as the engine of growth and its linkages to the services sector for South Africa. Based on the examination of inter-sectoral linkages from 1980-2005, she concludes that the strong backward linkages from manufacturing to services indicate that cost and quality of services inputs are critical for the manufacturing's competitiveness (Tregenna, 2008). However, the study does not specifically control for financial services and its role within the economy and the inter-industry system. In order to assess the channels of service-led growth of the Indian economy, Hansda (2007) also applies an Input-Output analysis to control for inter-industrial linkages within the Indian

economy. He concludes that services in general have the largest inducing effect on the economy through forward and backward linkages to the other sectors of the Indian economy. Among the services sectors, Hansda (2007) identifies trade and transportation as leading services sectors with highest potential growth impacts, next to the heavy industry sector. Nevertheless, he stresses the need to further investigate inter-sectoral linkages, especially with regard to financial services since such an assessment is necessary for evaluating the benefits of pursuing the creation of a financial services hub. This result is backed by Singh (2006), who emphasizes the basic role of services for the industrialization process in India. Kaur et al. (2009) use econometric methods to confirm the growth enhancing importance of financial services linked to the primary and secondary sector respectively. Rashid (2004) argues that both services and manufacturing are instrumental for the development of the primary sector in Pakistan. Finally, Tounsi et al. (2013) try to identify key sectors in Morocco and come to the conclusion that data quality and year of investigation are critical for the robustness of the results. This warning has to be kept in mind. However, in light of the increasing necessity of developing countries to develop a suitable financial industry, the linkages of the financial sector are increasingly relevant and deserve a closer scrutiny.

## **5. Aspects of African financial sector performance in general and in Nigeria and Kenya in particular**

### **5.1 General aspects**

African countries were rather late, financial liberalization only started in the late 1980s and 1990s. The liberalization involved liberalized interest rates, a higher independence of central banks, privatizing state banks and pension payments, developing financial markets, and encouraging competition between banks (Omankhanlen, 2012). In line with the enhancement in the financial sector, access to financial services improved in Africa. New technologies such as mobile money broadened the access to financial services.

However, challenges remain both in terms of financial depth, which comprises the size of banks, other financial institutions and financial markets as well as in terms of financial access, comprising access of firms or individuals to financial services such as credit, payment or insurance. Despite the improvements in the financial sector, African financial systems still lag behind other developing countries (Demirgüç-Kunt and Klapper, 2012). African financial

systems are rather shallow with a relatively low financial and banking depth (The World Bank, 2006).

This evidence also holds for financial access. Principally, barriers to access financial services tend to be lower in countries with a more competitive, open and market oriented and well regulated financial system (World Bank, 2008). However, the majority of African countries' financial systems is characterized by weak regulation environments, poor corporate governance practices, absence of financial innovation, and inefficient payment and clearing systems (Ncube, 2007).

This is a major challenge especially for small end mediums sized enterprises being almost entirely excluded from access to financial services, which erects an obstacle to growth (Demirgüç-Kunt and Klapper, 2012). In line with this, only less than a quarter of adults have a formal financial institution account. A large part of the financial sector remains informal, including informal methods to save and borrow money (The World Bank, 2006).

Moreover, other financing sources such as equity markets are under-developed (Demirgüç-Kunt and Klapper, 2012). The nonbank sector even shows a lower degree of development than the banking sector, and less than half of African countries have stock markets and only a few of them are liquid (The World Bank, 2006). African stock exchanges are small and among the most illiquid in the world (World Bank, 2013). A notable exception is South Africa which has one of the most modern financial sectors in the world, including the stock exchange (World Bank, 2013). The South African economy has already been in the focus of a number of studies on inter-sectoral linkages (see for example Tregenna 2008; Stilwell et al., 2000; Chang et al., 2014).

Broadening studies on inter-sectoral linkages of the economies of other African countries will complement existing analyses. Regarding the inter-sectoral linkages of the financial sector, primarily countries with higher levels of financial development are of interest. For our analysis we therefore choose Nigeria and Kenya. As a result of a range of reforms, their financial systems are among the more developed financial systems of African countries. Moreover, the analysis of the role of the financial sector in both the countries is of relevance even beyond the country-level since both are financial hubs within their respective regions and can be considered as growth poles. Their financial sector performance therefore has a significant impact at the regional level.



### *The Nigerian financial sector*

In Nigeria, a number of reforms starting in 1952 aimed at economic and financial deregulation and targeted fiscal balance and consolidation policy in banking and insurance. Thereby, a market based financial system was enforced (Omankhanlen, 2012). After these reforms, the economy experienced an increase in savings and investment as well as in loans and credit. Subsequently, there were higher incentives to invest in more productive activities (Omankhanlen, 2012). However, the global financial crisis 2008/2009 had a severe impact on the Nigerian economy, leading to reduced capital and investment flows, impacting the national budget (Ajakaiye and Fakiyesi, 2009).

After all, being among the 62 leading financial systems worldwide in 2012 (rank 61; Drexler et al., 2012), Nigerias relatively well-developed financial system enables a profound assessment of its interconnectedness to the other sectors of the economy. This also includes relatively good ranks in the financial intermediation sector, including banking financial services (rank 62), non-banking financial services (rank 58) and financial markets (rank 60) (Drexler et al., 2012).

### *The Kenyan financial sector*

In Kenya a number of reforms, starting in 1989, led to a well-developed financial sector. Institutional and policy reforms, including inter alia the strengthening of regulations and supervision of the financial system and the development and implementation of specific restructuring programs for financial institutions. This package aimed at improving the mobilization and allocation of domestic resources (Ngugi and Kabubo, 1998). These reforms were accompanied by trade liberalization (Financial Stability Report, 2011).

Access to financial services has been dramatically increased with the help of the mobile-money system M-PESA (Mobile Pesa), which has been launched in 2007 by the mobile-network operator Safaricom. M-PESA is an electronic payment and store of value system which is accessible from ordinary mobile phones (Mas and Radcliffe, 2011). The system is used by over two-thirds of the Kenyan population. Transfers of money can also be done between the users of M-PESA, which increases the efficiency and timeliness of money transfers. This is especially important for Kenya where many workers in the cities transfer money to their families in rural areas (The Economist, 2013). M-PESA further impacts net household savings and investments since it is a safe storage system that makes long distance transfers cheap and feasible (Jack and Suri, 2011).

Kenya also ranks among the 62 leading financial systems worldwide (rank 54, Drexler et al., 2012), with banking financial services ranking 57, non-banking financial services 30 and financial markets 56 (Drexler et al., 2012).

## **5.2 Selected indicators of financial performance, financial depth and financial access**

The relatively good performance of the financial sector of the Nigerian and Kenyan economies is shown in Table 1 which depicts selected financial sector indicators for the African continent (average), Sub-Saharan African countries (SSA) (average) and the results for Nigeria and Kenya. The indicators illustrate business and regulatory environment/performance of the financial sector, financial depth and financial access. The *performance of the financial sector* which is taken from The World Bank's 'Country Policy and Institutional Assessment (CPIA) Financial Sector Rating' (World Bank, 2015a) reflects the above-African average performance of Nigeria and Kenya. Measuring financial stability, efficiency and access, CPIA rates (1=low, 6=high) of both Nigeria (value 3.5) and Kenya (value 4) are well above the African (2.91) and Sub-Saharan African (2.92) average ratings. By the same token the regulatory and business environment in Nigeria and Kenya are above African and SSA average as indicated by the World Bank's Ease of Doing Business Index (World Bank, 2015b). A first indicator illustrating *financial depth and size of the financial sector* is 'private credit to GDP' which indicates the domestic private credit to the real sector as percentage of GDP in local currency. Obviously, Kenya records a high private credit/GDP share (33.58%), which is above African average (26.11%) and Sub-Saharan African average (24%). Nigeria however records a value slightly below Sub-Saharan African average (22.91%). As alternative indicator for the size of the financial sector 'deposit money banks' assets to GDP' is a more comprehensive indicator as it also takes into account credit to government (next to private sector) and other bank assets than credit. Here, both Nigeria (36.34%) and Kenya (48.49%) record values above African (32.46%) and Sub-Saharan African (share of 28.98) average. The third indicator on financial depth and size indicates the size of stock markets ('stock market capitalization to GDP'). Here, Kenya (35.35 %) consistent with African (35.21%) and Sub-Saharan African (34.36%) average. Nigeria records a smaller share (17.30%). However, it has to be noted that only 15 African countries are included in the data since many are lacking stock markets. The good performance of Nigeria and Kenya is mirrored by selected parameters of *financial access* (account at a financial institution, saved at a financial institution; World Bank, 2015c). Here, Nigeria and Kenya

record again values above the averages of overall Africa and SSA. A special form of financial access turns out to be mobile money usage (mobile phone used to send money and used to pay bills; World Bank, 2015c). Overall African and SSA average are again relatively low for both parameters. Values for Nigeria are above average for ‘mobile phone used to send money’ but just within SSA average and even below African average for ‘mobile phone used to pay bills’. Kenya records by far the highest values – indicating that for example 60.48 % of people 15+ used the mobile phone to send money, and 13.43% to pay bills. This underlines the distinct particularity of the Kenyan financial sector, with a considerable prevalence of mobile money.

**Table 1** Selected indicators on the financial sector performance, financial depth and size and financial access in Africa, Sub-Saharan Africa, Nigeria and Kenya, latest available years

	CPIA Financial Sector Rating (1= low to 6=high) 2013	Ease of Doing Business Index 2014 (rankings: 1=low, 189=high)	Global Financial Development Indicators, 2011						
			Size of the financial sector			Access to financial services			
			Private credit by deposit money banks and other financial institutions to GDP (%)	Deposit money banks' assets to GDP (%)	Stock market capitalization to GDP (%)	Account at a formal financial institution (% age 15+)	Saved at a financial institution in the past year (% age 15+)	Mobile phone used to send money (% age 15+)	Mobile phone used to pay bills (% age 15+)
African average	2.91	142.94	26.11	32.46	35.21	21.31	10.12	8.28	3.24
Sub-Saharan African average	2.92	142.45	24.00	28.98	34.36	17.46	9.94	3.51	1.38
Nigeria	3.5	170	22.91	36.34	17.30	29.67	23.59	9.92	1.38
Kenya	4	136	33.58	48.49	35.35	42.34	23.28	60.48	13.43

Sources: World Bank (2015a), World Bank (2015b), World Bank (2015c)

An economic growth advantage for countries with higher levels of financial development is ascertained (Creane et al., 2003). Overall, the data of Table 1 underline the advanced financial sector performance of Nigeria and Kenya. A characterization of financial services as channels of economic development is possible by assessing their inter-sectoral linkages to the economy. In the case of Nigeria and Kenya an evaluation of inter-sectoral linkages of the financial sector has to pay attention to two distinct particularities: A considerable impact of the 2009 financial crisis within the economies was experienced. This was especially pronounced in the Nigerian economy. Second, the Kenyan financial sector is especially characterized by its considerably high prevalence of mobile money, with a high number of financial services being offered by telecommunication services. In order to incorporate these distinctive peculiarities into our study, we select three years for the analysis which capture pre-crisis, crisis, and post-crisis years (2007, 2009, 2011). Additionally, we do not only concentrate on the financial sector itself, we also take the communication sector into account as there are overlaps between both the sectors due to the prevalence of mobile money.

## 6. Methodology

The inter-sectoral linkage analysis is conducted by means of an Input-Output analysis, on the basis of Input-Output tables. It serves for describing the economic production structure and interdependencies and interconnectedness of production processes. An Input-Output table displays the production structure and transaction flows within an economy. Inter-sectoral flows describe the transactions from the producing sectors (sectors  $i$ ) to the purchasing sectors (sectors  $j$ ). Additionally, exogenous units comprising demand for products in terms of consumption, investment and exports are depicted in the *final demand*  $f_i$ . Further, Input-Output tables account as well for all primary inputs into production such as labor and capital. They are termed *value added* in sector  $j$  and denoted as  $v_j$  (Miller and Blair 2009, p. 13; Hanink 1997, p. 335).

### 6.1 Hypotheses

On the basis of the existing literature on the role of financial services, we hypothesize the following:

H1: The financial sector yields significant forward linkages to the other sectors of the economies.

H2: Changes in final demand or value added in the financial sector have a wide-spread impact on the rest of the economy.

H3: These effects are larger in Nigeria than in Kenya. Inter-sectoral linkages from the financial sector to the other sectors of the economy are expected to be less with higher levels of financial services being provided by telecommunication enterprises.

H4: Due to the overlap between financial and communication sector, the communication sector yields considerable high linkages to the other sectors of the economy.

### 6.2 Analyzing Input-Output data

In this study, Input-Output tables are analyzed based on the *static open quantity model*. It is referred to as *static* since variables are measured for a given point in time (Holub and Schnabl 1994, p. 91). It is further termed *open* since it depends on the existence of the final demand as an exogenous sector (Miller and Blair 2009, p. 34). Input-Output analysis is based on two basic assumptions: constant returns to scale and non-substitutability of inputs within the production process which implies that only one process is used for the production of each output. Both assumptions are deployed on the grounds of practicability (Christ 1955, p. 139-140; Raa, 2005, p. 14ff.), but are questionable as they are simplifying. The static character of

the model does not allow for dynamic aspects, like the change of technical coefficients in the course of changing demands. Furthermore, the assumption of fixed coefficients ignores the possibility of factor substitution. Another point of criticism of the open input-output analysis is the assumption of the final demand being exogenously given. This assumption ignores feedback effects and interdependencies between the production sectors and final demand. A higher production can result in higher final demand, which can again result in higher production (Holub and Schnabl, 1994, p. 421; Raa, 2005, p. 54). We address this issue in the robustness test of the analysis. Despite these limitations, the input-output analysis is a suitable approach for our study. For analytical purposes, its degree of abstraction is useful for understanding the extent of integration of an industry within an economy and for the illustration of its inter-sectoral connectedness.

In order to specifically measure a sector's backward or forward linkage to exclusively the rest of the economy we omit intra-sectoral transactions (net approach) and hence the on-diagonal elements within the input-output tables.

The two basic models for analyzing Input-Output tables are the Leontief (1936) and Ghosh (1958) approaches. Leontief's (1936) approach is a demand-driven model and relates sectoral gross outputs to the final demand, focusing on units of a product *leaving* the inter-industry system. By contrast, Ghosh (1958) developed a supply-driven model which relates sectoral gross production to primary inputs and to units *entering* the inter-industry system in the beginning of the production process (Miller and Blair 2009, p. 543). In detail, both models are built as follows:

The Leontief model is a set of linear equations, written in matrix representation by:

$$x = (I - A)^{-1}f \quad , \quad (1)$$

with  $x$  as a  $1 \times n$  column vector of the gross output of the  $n$  industries;  $f$  as the  $1 \times n$  final demand column vector;  $I$  is a  $n \times n$  identity matrix and  $A$  is a  $n \times n$  matrix of *direct input coefficients* with  $A = [a_{ij}]$ . The elements  $a_{ij}$  are also called *technical coefficients*. They denote the share of intermediate products of sector  $i$  bought by sector  $j$  ( $a_{ij} = z_{ij}/x_j$ ) (Miller and Blair 2009, p. 16). Whereas  $A$  displays *direct* input requirements for intermediates, the matrix  $L = [l_{ij}]$  displays *total* input requirements, comprising direct and indirect ones. Indirect requirements are requirements of sector  $i$  whose output is directly required for the production of sector  $j$ .  $L$  is denoted as:

$$L = (I - A)^{-1}, \quad (2)$$

with  $(I - A)^{-1}$  as the *Leontief inverse (input inverse)*. The elements  $l_{ij}$  illustrate the changes of outputs from sector  $i$  both directly and indirectly necessary to produce one additional unit of sector  $j$  (Holub and Schnabl 1994, p. 103).

Similarly, the Ghosh model is a set of linear equations. It is given by:

$$x' = (I - B)^{-1} v' \quad (3)$$

with  $x'$  as the transpose of the  $nx1$  output vector and  $v'$  as the transposed  $nx1$  vector of primary inputs.  $B = [b_{ij}]$  denotes a matrix of *direct output coefficients (allocation coefficients)* where its elements  $b_{ij} = z_{ij}/x_i$  represent the distribution of sector  $i$ 's output across sector  $j$  (European Commission 2008, p. 486; Miller and Blair 2009, p. 543). Analogous to the Leontief inverse (input inverse),  $(I - B)^{-1}$  denotes the *Ghosh inverse (output inverse)*:

$$G = (I - B)^{-1} \text{ with } G = [g_{ij}]. \quad (4)$$

The elements  $g_{ij}$  depict the induced value of production in sector  $j$  per unit of primary input in sector  $i$  (Miller and Blair 2009, p. 544).

Based on these two Input-Output models, parameters on the sectoral relevance for the economy and the inter-sectoral connectedness within the economy can be assessed.

### **6.3 Applied Parameters of Inter-sectoral Relevance and Inter-sectoral Connectedness**

#### **Inter-sectoral Linkages and Related Parameters**

##### *Backward linkages*

Backward linkages mirror the strength by which sector  $j$ 's production depends on inter-sectoral inputs (Miller and Blair 2009, p. 556). Chenery and Watanabe (1958, p. 492) suggest using the column sums of the direct input coefficient matrix  $A$  as a measure for direct backward linkages, thus:

$$BL_j^{CW} = \sum_{i=1}^n a_{ij} . \quad (5)$$

A total measure of backward linkages, comprising both direct and indirect effects has been suggested by Rasmussen (1956, p. 133-134). Total backward linkages mirror the change in economy-wide output in case the final demand for a particular sector increases by one unit (Miller and Blair 2009, p. 557). The total backward linkage of sector  $j$  is defined as the

column sum of the Leontief inverse  $L = [l_{ij}]$  (Miller and Blair 2009, p. 557). It is thus equivalent to the output multiplier (see section “Multiplier effects”):

$$BL_j^R = \sum_{i=1}^n l_{ij} . \quad (6)$$

For a reliable comparison of sectoral backward linkages, normalizations are useful (Miller and Blair 2009, p. 557). Accordingly, in order to calculate the relative strength of the total backward linkages, Rasmussen (1956, p. 134) developed the index of *power of dispersion* (normalized backward linkages). It reflects the relative extent to which an increase in final demand for the products of industry  $j$  is dispersed throughout the total inter-industry system (Drejer 2002, p. 5). It is described as:

$$\sum_i U_{ij} = \frac{\frac{1}{n} \sum_i l_{ij}}{\frac{1}{n^2} \sum_{ij} l_{ij}} , \quad (7)$$

with  $\sum_i l_{ij}$  as the column sums of the Leontief inverse (Drejer 2002, p. 5). Sectors with above average backward linkage reveal indices greater than one, indicating a strong integration with the rest of the economy. Those sectors with below average linkages have indices lower than one (Miller and Blair 2009, p. 558; Dasgupta and Chakraborty 2005, p. 8).

#### *Forward linkages*

Jones (1976, p. 327) suggests to utilize the Ghosh inverse  $G = [g_{ij}]$  for the calculation of forward linkages. He argues that using the Leontief inverse twice (which has been suggested by Chenery and Watanabe and Rasmussen)<sup>2</sup>, both as a measure of total backward and total forward linkages involves a problem of double counting causal linkages, inasmuch as sales from sector  $i$  to sector  $j$  are recorded as  $i$ 's forward linkage and  $j$ 's backward linkage. But only one of these linkages can be effectively causal. Using the Ghosh inverse as a measure of total forward linkages avoids this problem (Andreosso-O'Callaghan and Yuen 2004, p. 168-169). Accordingly, total forward linkages are defined as the row sums of  $G$ :

$$FL_i = \sum_{j=1}^n g_{ij} \quad (8)$$

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<sup>2</sup> An alternative approach is the application of the Leontief inverse as the basis for assessing forward linkages. Chenery and Watanabe (1958, p. 492) suggest a direct forward linkage index which is defined as the row sums of the direct output coefficient matrix  $B$ . For calculating total forward linkages, Rasmussen (1958, p. 136) developed a normalized index which describes the extent to which the total inter-industry system depends on the particular sector  $i$ . This index is called *sensitivity of dispersion*. It is defined as the row sums of the Leontief inverse (Drejer 2002, p. 5).

This measure is equivalent to the input multiplier (Miller and Blair 2009, p. 558) (see section “Multiplier effects”). Following Rasmussen’s sensitivity of dispersion index (see footnote 2), forward linkages based on the Ghosh inverse can be normalized correspondingly:

$$\sum_j U_{ij} = \frac{\frac{1}{n} \sum_j g_{ij}}{\frac{1}{n^2} \sum_{ij} g_{ij}}, \quad (9)$$

(following Miller and Blair 2009, p. 558).

### *Variation Indices*

It is important to notice that both backward and forward linkages are sensitive to extreme values. In case a sector buys for example large amounts only from few of the sectors within the economy, it still denotes high backward linkages (Hansda 2007, p. 16). Thus, the drawback of these indices is the lack of representing how evenly one sector draws on the other ones (Salami et al. 2012, p. 4). As an index of the relative evenness of a sectors’ purchases or sells to other sectors, Rasmussen (1956, p. 138) developed the *variation index*. The variation index of backward linkages is based on the elements of the Leontief inverse  $l_{ij}$  and is calculated as follows:

$$V_b = \frac{\sqrt{\frac{1}{n} \sum_{i=1}^n \left( l_{ij} - \left( \frac{1}{n} \sum_{i=1}^n l_{ij} \right) \right)^2}}{\frac{1}{n} \sum_{i=1}^n l_{ij}} \quad (10)$$

(Salami et al. 2012, p. 4). The variation index for forward linkages can be also calculated according to Jones’ method based on the Ghosh inverse, as illustrated by equation (11).

$$V_{fG} = \frac{\sqrt{\frac{1}{n} \sum_{j=1}^n \left( g_{ij} - \left( \frac{1}{n} \sum_{j=1}^n g_{ij} \right) \right)^2}}{\frac{1}{n} \sum_{j=1}^n g_{ij}} \quad (11)$$

(Rasmussen 1956, p. 138; Salami et al. 2012, p. 4-5).

A relatively large value of the backward variation index indicates that sector  $i$  purchases its inputs from only a few other sectors. Relatively large values of the forward variation index reflect that sector  $j$  sells outputs only to a few sectors within the economy (Hansda 2007, p. 16).



## **Multiplier Effects**

### *Output multipliers*

By definition, the output multiplier of sector  $j$  reflects the value of production in all sectors of the economy which is necessary in order to guarantee one additional monetary unit's worth of final demand for sector  $j$ 's output (Miller and Blair 2009, p. 245). The output multipliers are calculated with the help of the column sums  $\sum_{i=1}^n l_{ij}$  of the Leontief inverse  $L$ . They reflect the cumulative revenues induced by one additional unit of final demand for a certain commodity (European Commission 2008, p. 488; Miller and Blair 2009, p. 21). For practical purposes, this can be used to determine the overall economic effects of spending one additional monetary unit of public expenditure on the output of a particular sector (Miller and Blair 2009, p. 246).

### *Input multipliers*

The input multipliers are based on the Ghosh inverse  $G = [g_{ij}]$  and are thus supply oriented. They are assessed with the help of the row sums  $\sum_{j=1}^n g_{ij}$  of  $G$ . They reflect the effect on total output in all sectors of the economy associated with an additional unit of primary inputs for sector  $i$  (Miller and Blair 2009, p. 545). In practical terms, this indicates where an additional monetary unit's worth of provision of primary inputs is most beneficial for the whole economy (Miller and Blair 2009, p. 547).

## **Identifying Key Sectors**

According to Hirschman (1958, p. 104), sectors with both high backward and high forward linkages can be classified as key sectors of the economy. In normalized form, this comprises sectors with both backward and forward linkages greater than one (Miller and Blair 2009, p. 559).

## **7. Data and data processing**

Input-output data for Nigeria and Kenya are obtained from the Eora database, which provides input-output tables for 187 economies worldwide (Lenzen et al., 2012; Lenzen et al., 2013). Transaction flows within the input output tables are depicted in value added terms, giving a

good picture on domestic value adding activities in the specific sectors of the economy.<sup>3</sup> We use the input output tables for 2011 as they are the most recent ones and it is a post-crisis year. In order to control for the obtained results, we additionally apply the analysis to the input output tables of 2007 and 2009, as pre-crisis and crisis years. The input-output tables for Nigeria depict 26 sectors. The Kenyan input-output table is more disaggregated with 51 sectors included in them. This different level of sectoral aggregation is by itself not problematic since the sectors of our interest – the financial sector and the communication sector<sup>4</sup> - are in both cases depicted as one single sector. For the purpose of a better comparability, we adjust the Kenyan sectoral depiction to the Nigerian one. After making the Kenyan sectors comparable, 19 aggregated sectors of the economy emerge. See Annex 1 for a listing of the Nigerian and Kenyan economic sectors in the input-output tables and the classification of the Kenyan sectors to a higher aggregation.

## **8. Results**

### **8.1 Descriptive Analysis**

Before analyzing the inter-sectoral connectedness within the two economies with a specific consideration of the financial and the communication sector, we first take a look at the sectors' structural composition. To that end we take three basic indicators into account: total output, value added and final demand for the years 2007, 2009 and 2011.

Table 2 depicts the sectoral shares in total output, total value added and total final demand for Nigeria and Kenya for all three years. Looking at the 26 sectors of Nigeria, it is evident that the sector 'financial intermediation and business activities' records the highest share in all the three indicators for all three years (in total output around 29 %; in total value added around 38 % and in final demand around 32 %). The sector 'post and telecommunications' records consistently lower shares in all three indicators, ranking places 10 and 11 in total output (around 3.5%), places 6 and 7 for total value added (around 3.9%) and places 9 for total final demand (around 3.5%).

However, the picture is different when we look at these sectoral shares for the 19 aggregated sectors of the Kenyan economy. In contrast to the high shares of the financial sector in

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<sup>3</sup> Input-output tables in the Eora database are constructed based on different types of data: input-output tables from national statistical offices, I-O compendia from Eurostat, the UN National Accounts Main Aggregates Database, the UN National Accounts Official Data, the UN Comtrade international trade database, the UN Servicetrade international trade database (Lenzen et al., 2013).

<sup>4</sup> We cannot test the telecommunications sector in the narrower sense, since the data is aggregated and financial services within the communication sector are not mentioned separately.

Nigeria the Kenyan sector ‘financial services, real estate and insurance’ records relatively small shares for all the three indicators in all three years. The financial sector records around 5% for total output (ranking places 8), around 6.4% in total value added (ranking places 5) and 2.83% in total final demand (ranking places 8). The sector ‘communication’ records lower shares than the financial sector: around 2.3% in total output (rankings 11 and 13), around 2.9% in total value added (ranking places 12) and around 2.4% in total final demand (ranking places 10).

**Table 2** Sectoral shares in total output, value added and final demand for Nigeria and Kenya, for the years 2007, 2009 and 2011

	Nigeria											
	Financial Intermediation and Business Activities					Post and Telecommunications						
	2007	rank	2009	rank	2011	rank	2007	rank	2009	rank	2011	rank
share in total output	29,48%	1	29,51%	1	29,30%	1	3,52%	10	3,47%	10	3,46%	11
share in total value added	38,42%	1	37,80%	1	37,91%	1	3,96%	6	3,90%	7	3,91%	7
share in total final demand	32,96%	1	32,19%	1	31,87%	1	3,51%	9	3,46%	9	3,42%	9
	Kenya											
	Financial services, real estate and insurance services					Communication						
	2007	rank	2009	rank	2011	rank	2007	rank	2009	rank	2011	rank
share in total output	5,03%	8	5,05%	8	4,99%	8	2,35%	11	2,37%	11	2,35%	13
share in total value added	6,43%	5	6,43%	5	6,44%	5	2,91%	12	2,92%	12	2,93%	12
share in total final demand	2,83%	8	2,83%	8	2,83%	8	2,38%	10	2,38%	10	2,39%	10

Source: own calculations, based on the input-output tables from the Eora database (Lenzen et al., 2012; Lenzen et al., 2013)

## 8.2 Results from Input Output Analysis

In light of the considerably different sectoral shares in output, final demand and value added between Nigeria and Kenya, it is appropriate to apply a weighted approach for the following input-output analysis. This accounts for the relative importance of each sector. In the following analysis we calculate two of the indicators: value added and final demand weights. This is in line with Laumas (1976) and Hazari (1970). Each inter-sectoral linkage is weighted by the sectors’ shares in value added and final demand.

### Results for Nigeria

*(26 sectors included in input-output tables)*

#### Sector ‘financial intermediation and business activities’

Table 3 shows backward and forward linkage measures and backward and forward variation indices for all three years and both value added and final demand weights. Ranks of the relative position of the linkage values within the sectors of the economy are added.

**Table 3** Inter-sectoral linkages of the financial sector in Nigeria for selected years

		Financial intermediation and business activities											
		value added weights						final demand weights					
		2007		2009		2011		2007		2009		2011	
		value	rank	value	rank	value	rank	value	rank	value	rank	value	rank
Backward linkages	direct	0,00079	7	0,00808	6	0,00863	6	0,00022	25	0,00075	25	0,00726	8
	total (=output multiplier)	0,38420	1	0,38761	1	0,38942	1	0,32958	1	0,32338	1	0,32741	1
	total normalized linkage	9,98930	1	8,76338	1	8,76881	1	8,56918	1	4,48121	1	7,28150	1
Forward linkages	direct	0,00105	13	0,01036	13	0,01076	13	0,00758	1	0,07161	1	0,01191	10
	total (=input multiplier)	0,38420	1	0,39035	1	0,39198	1	0,32958	1	0,40293	1	0,33249	1
	total normalized linkage	9,98929	1	7,55928	1	7,53599	1	8,56919	1	9,05876	1	8,36872	1
Backward variation index		5,08815	25	0,99145	4	2,57554	19	5,09784	26	1,43882	22	2,19226	10
Forward variation index		5,08461	22	1,08471	5	2,34759	19	4,97989	12	0,00001	1	1,85622	5

Note: Inter-sectoral linkage measures comprise backward and forward linkages and backward and forward variation indices for the ‘financial intermediation and business activities’, for the years 2007, 2009 and 2011 (value added weights and final demand weights).

Source: own calculations, based on the input-output tables from the Eora database (Lenzen et al., 2012; Lenzen et al., 2013)

#### *Backward linkages and Forward linkages*

The financial sector records rather low **direct** backward linkage values, ranking 6<sup>th</sup> and 7<sup>th</sup> places for value added weights in all three years and places 25 (in 2007 and 2009) and place 8 (2011) for final demand weights. However, when the **total** backward linkage measure is applied, the financial sector records highest values for both value added and final demand weights (for value added weights: 0.38<sup>5</sup> resp. 0.39; for final demand weights: 0.32 resp. 0.33, i.e. for both weights ranks 1 in all years). This result is further emphasized when **normalizing** the **total** linkages in order to illustrate the power of dispersion index. According to this index, the financial sector records by far highest total backward linkage values (for value added weights: 9.99/8.76/8.77; for final demand weights: 8.57/4.48/7.28; i.e. ranks 1 in all years).

The high linkage values of the financial sector are confirmed by the results for forward linkages. But here again, the differing values between direct and total linkages are obvious.

<sup>5</sup> Results are rounded in the last cited figure. For detailed results see Tables.

**Direct** forward linkages predominantly record considerably low linkage values for value added weights (2007/2009/2011: 0.001/0.01/0.01, i.e. all ranks 13), while results for final demand weights are considerably higher (2007/2009/2011: 0.008/0.07/0.01, i.e. ranks 1/1/10). **Total** forward linkages in contrast record consistently highest values (ranks 1) for all three years (2007/2009/2011: 0.38/0.39/0.39 for value added weights and 0.33/0.40/0.33 for final demand weights). Their significance is underlined by the **normalization** of **total** forward linkages, where the financial sector also ranks highest (2007/2009/2011: 9.99/7.56/7.54 for value added weights and 8.57/9.06/8.37 for final demand weights, ranks 1 in both weights and all three years).

### *Multiplier effects*

On the basis of these results it is possible to illustrate multiplier effects of the sectors. As Table 3 shows, both input and output multipliers equal the total backward linkages (output multiplier) and total forward linkages (input multiplier), respectively. ‘Financial intermediation and business activities’ rank highest (ranks 1) for both multiplier measures in both weights for all three years. The high rankings of the financial sector imply the following considering the output multipliers: one additional unit of final demand for the ‘financial intermediation and business activities’ sector induces around 0.39 (for value added weights) or around 0.33 (for final demand weights) cumulative revenue for the overall economy. Moreover, the input multipliers show the economic overall effect of an additional unit of primary inputs into the ‘financial intermediation and business activities’ sector, which also accounts for around 0.39 (for value added weights) and around 0.33 resp. 0.40 (for final demand weights).

### *Variation index*

As the previous section outlined, the financial sector is characterized by considerably high total backward and total forward linkages. In order to furthermore specify the role of the financial sector, the consideration of the relative spread of these linkages to the other sectors of the economy is necessary. Table 3 also displays the relative evenness of the total backward and total forward linkages, applying the variation index. Low values (= high ranks) indicate a wide/even spread of the linkages to the other sectors of the economy, while high values (= low ranks) indicate more concentrated linkages. While ‘financial intermediation and business activities’ was consistently ranked first in total backward and total forward linkages, the ranks are considerably lower in the variation indices for both value added and final demand weights.

For value added weights, the backward variation index ranks highest in 2009 (0.99, rank 4), while remaining years rank considerably low (2007: 5.09, rank 25; 2011: 2.58, rank 19). Low ranks are as well recorded when applying final demand weights (2007/2009/2011: 5.10/1.44/2.20; i.e. ranks 26/22/10). The forward variation indices rank also relatively low for value added weights (ranks 22/5/19, i.e. 5.08/1.08/2.35). Looking at final demand weights there is a remarkable exception: in 2009, the financial sector ranks highest (rank 1; 0.00001), implying a considerable wide spread of its forward linkages to the rest of the economy. This result is however mitigated by the results for the other years where the financial sector ranks 12 and 5 (i.e. 4.98 and 1.89 for 2007 and 2011, respectively). A slightly wider spread of its forward linkages is noticeable.

#### *Key sector assessment*

The inter-sectoral linkage assessment allows for an assessment of the key sectors of the Nigerian economy. Sectors can be classified as key sectors when both the normalized backward (BLnorm) and normalized forward linkages (FLnorm) yield values higher than 1. The normalized backward and forward linkages for Nigeria for 2007, 2009 and 2011 (see Table 3), indicate that the sector ‘financial intermediation and business activities’ can be considered a key sector of the Nigerian economy as all the normalized linkage values are higher than 1 in all the years and for both value added and final demand weights.

#### **Sector ‘post and telecommunication’**

Backward and forward linkage measures and backward and forward variation indices for the ‘post and telecommunication’ sector are depicted in Table 4, including corresponding sectoral ranks.

**Table 4** Inter-sectoral linkages of the communication sector in Nigeria for selected years

		Post and telecommunication											
		value added weights						final demand weights					
		2007		2009		2011		2007		2009		2011	
		value	rank	value	rank	value	rank	value	rank	value	rank	value	rank
Backward linkages	direct	0,00050	11	0,00472	11	0,00486	11	0,00337	12	0,03188	12	0,00425	12
	total (=output multiplier)	0,03956	6	0,04403	7	0,04420	7	0,03510	9	0,06740	10	0,03870	10
	total (normalized linkage)	1,02844	6	0,99550	7	0,99516	7	0,91271	9	0,93393	10	0,86060	10
Forward linkages	direct	0,00207	4	0,02132	4	0,02272	4	0,00083	4	0,00803	6	0,02393	4
	total (=input multiplier)	0,03956	6	0,06203	4	0,06358	4	0,03510	9	0,04354	9	0,05969	6
	total (normalized linkage)	1,02844	6	1,20115	4	1,22235	4	0,91271	9	0,97896	9	0,70928	10
Backward variation index		5,03310	21	1,32379	22	2,31081	16	4,65719	19	1,18049	7	2,10926	17
Forward variation index		4,83700	16	1,11609	7	2,46016	20	4,97603	11	0,99671	14	1,67406	3

Note: Inter-sectoral linkage measures comprise backward and forward linkages and backward and forward variation indices for the ‘post and telecommunication’ sector, for the years 2007, 2009 and 2011 (value added and final demand weights).

Source: own calculations, based on the input-output tables from the Eora database (Lenzen et al., 2012; Lenzen et al., 2013)

#### *Backward linkages and Forward linkages*

Results for the sector ‘post and telecommunication’ are considerably different from the results for the financial sector. Backward linkages record lower values and with correspondingly lower ranks. Lowest ranks are recorded by **direct** backward linkages (value added weights: 2007/2009/2011: 0.0005/0.005/0.005 with ranks 11; final demand: 0.003/0.032/0.004 with ranks 12). **Total** backward linkages however record slightly higher ranks, both when value added weights (2007/2009/2011: 0.04/0.04/0.04 with ranks 6/7/7) and final demand weights (2007/2009/2010: 0.04/0.07/0.04 with ranks 9/10/10) are applied. The ranks do not change when **normalizing total** backward linkages (value added weights: 1.03/1.0/1.0 with ranks 6/7/7; final demand weights: 0.91/0.93/0.86 with ranks 9/10/10).

Forward linkages predominantly record higher ranks than backward linkages. This is especially evident for **direct** forward linkages (value added weights: 0.002/0.02/0.02 with ranks 4; final demand weights: 0.0008/0.008/0.02 with ranks 4/6/4). The higher rankings are also obvious in the case of **total** forward linkages, where linkages in terms of value added weights (0.04/0.06/0.06 with ranks 6/4/4) are mostly higher ranked than in the case of final

demand weights (0.04/0.04/0.06 with ranks 9/9/6). This is also the case after **normalizing total** forward linkages (value added weights: 1.03/1.2/1.22 with ranks 6/4/4; final demand weights: 0.91/0.98/0.71 with ranks 9/9/10).

#### *Multiplier effects*

Consistent with the results on linkage values, multiplier effects are lower for the sector ‘post and telecommunication’ than for the financial sector. As depicted for the three years an additional unit of final demand (output multiplier) would induce around 0.04 (for value added weights) resp. around 0.04 or 0.07 (for final demand weights) cumulative revenue for the overall economy. An additional unit of primary inputs (input multiplier) would have an overall effect of 0.04 resp. 0.06 (for value added weights) or 0.04 resp. 0.06 (for final demand weights).

#### *Variation Indices*

Along with the linkage results, the sector ‘post and telecommunication’ ranks lower in terms of backward and forward variation indices. Low rankings are evident for the backward variation index for value added weights (2007/2009/2011: 5.03/1.32/2.31 with ranks 21/22/16) and final demand weights (4.66/1.18/2.10 with ranks 19/7/17). This indicates a rather low spread of the backward linkages to the rest of the economy. Also forward linkages record a rather low spread to the rest of the economy, indicated by the forward variation index, both in value added terms (4.84/1.12/2.46 with ranks 16/7/20) and final demand terms (4.98/1/1.67 with ranks 11/14/3). Rank 3 in 2011 deviates from this result, indicating a relatively evenly spread of forward linkages.

#### *Key sector assessment*

The classification of the normalized linkages measures of the sector ‘post and telecommunication’ is not as clear as in the case of the financial sector. More specifically the criterion BLnorm and FLnorm higher than 1 is only met in 2007 when value added weights are applied (BLnorm 1.03; FLnorm 1.03). This allows a classification as key sector. For value added weights it is remarkable that in 2009 and 2011 FLnorm is higher than 1, too (1.20 and 1.22) and BLnorm is roughly 1 (0.99 and 0.99). Hence, for value added weights this sector may be considered as a border case key sector. Final demand weights BLnorm and FLnorm are roughly 1 in 2007 and 2009 and hence the sector is close to be characterized as key sector. This is not the case in 2011 (BLnorm 0.86; FLnorm 0.71).



## Results for Kenya

(19 sectors derived by higher aggregation of the input-output tables)

### Sector ‘financial services, insurance and real estate services’

Results for backward and forward linkages together with backward and forward variation indices for all three years and value added and final demand weights are depicted in Table 5. It additionally depicts the relative ranks of the sector’s results within the inter-industry system.

**Table 5** Inter-sectoral linkages of the financial sector in Kenya for selected years

		Financial services, insurance and real estate services											
		value added weights						final demand weights					
		2007		2009		2011		2007		2009		2011	
		value	rank	value	rank	value	rank	value	rank	value	rank	value	rank
Backward linkages	direct	0,00145	10	0,02229	8	0,00129	8	0,00100	11	0,01299	10	0,00154	16
	total (=output multiplier)	0,06577	5	0,10159	6	0,06577	5	0,02931	8	0,04871	11	0,02999	9
	total normalized linkage	1,20362	5	1,44687	6	1,19464	5	0,54714	8	0,89161	10	0,38765	9
Forward linkages	direct	0,00274	4	0,03189	5	0,00171	17	0,00141	7	0,01592	8	0,02888	8
	total (=input multiplier)	0,06714	4	0,12521	5	0,06620	7	0,02976	8	0,05990	9	0,52862	8
	total normalized linkage	1,24500	4	2,09830	5	0,98992	7	0,55212	8	1,00885	9	0,52862	8
Backward variation index		3,51344	17	3,20721	14	4,14950	16	2,64275	16	-8,37315	2	3,99765	12
Forward variation index		2,39015	12	2,32547	10	4,12120	16	2,37535	16	3,91350	14	4,15930	17

Note: Inter-sectoral linkage measures comprise backward and forward linkages and backward and forward variation indices for the ‘financial services, insurance and real estate’ sector, for the years 2007, 2009 and 2011 (value added and final demand weights).

Source: own calculations, based on the input-output tables from the Eora database (Lenzen et al., 2012; Lenzen et al., 2013)

#### *Backward linkages and forward linkages*

As for **direct** backward linkages, the financial sector ranks relatively low both for value added weights (2007/2009/2011: 0.001/0.02/0.001 with ranks 10/8/8) and final demand weights (0.001/0.010/0.002 with ranks 11/10/16). **Total** backward linkages rank slightly higher (value added weights: 0.07/0.1/0.07 with ranks 5/6/5; final demand weights: 0.03/0.05/0.03 with ranks 8/11/9). These rankings are similar in the case of **normalized total** backward linkages (value added weights: 1.20/1.45/1.19 with ranks 5/6/5; final demand weights: 0.55/0.89/0.39 with ranks 8/10/9).

The relatively low rankings of the financial sector are confirmed by the results for forward linkages (see Table 5). Still, slightly higher rankings are partly obvious for value added weights for **direct** forward linkages (0.002/0.03/0.002 with ranks 4/5/17) and final demand weights (0.001/0.02/0.03 with ranks 7/8/8). The relative rankings are similar when comparing the **total** forward linkages (value added weights: 0.07/0.13/0.07 with ranks 4/5/7; final demand weights: 0.03/0.06/0.53 with ranks 8/9/8) and the **normalized total** forward linkages (value added weights: 1.25/2.1/0.99 with ranks 4/5/7; final demand weights: 0.55/1.01/0.53 with ranks 8/9/8).

### *Multiplier effects*

Since multiplier values equal the total backward linkages (output multiplier) and total forward linkages (input multiplier) it can be expected that the relative low linkage rankings of the financial sector determine only small multiplier effects. The results of the three years reveal that one additional unit of final demand (output multiplier) into the ‘financial services, real estate and insurance services’ sector induces around 0.07 resp. 0.1 (for value added weights) and around 0.03 resp. 0.05 (for final demand weights) cumulative revenue within the economy. One additional unit of primary input yields an input multiplier around 0.07 resp. 0.13 (for value added weights) and 0.03/0.06 resp. 0.53 (for final demand weights) additional overall economic revenue.

### *Variation index*

The variation index provides information about the spread and the relative evenness of the backward and forward linkages in the Kenyan economy. In all years the relative high backward variation indices (value added weights: 3.51/3.21/4.15 with ranks 17/14/16; final demand weights: 2.64/-8.37/4.00 with ranks 16/2/12) and forward variation indices (value added weights: 2.39/2.32/4.12 with ranks 12/10/16; final demand weights: 2.38/3.91/4.16 with ranks 16/14/17) indicate a relatively low and uneven spread of backward and forward linkages to the other sectors of the economy (exception: rank 2 for backward variation index in 2009 for final demand weights).

### *Key sector assessment*

Table 5 allows a classification of the financial sector based on total normalized backward and forward linkages. Although linkage values are rather low, the results for value added weights reveal that the ‘financial services, insurance and real estate services’ sector can still be

considered a key sector in 2007 and 2009 (BLnorm and FLnorm higher than 1). In 2011 only BLnorm meets this criterion. For final demand weights however the values of BLnorm and FLnorm are less than 1 in all the years, with the exception of FLnorm in 2009 (1.009).

### Sector ‘communication’

Results for the linkage measures and variation indices the ‘communication’ sector are depicted in Table 6, including corresponding sectoral rankings.

**Table 6** Inter-sectoral linkages of the communication sector in Kenya for selected years

		Communication											
		value added weights						final demand weights					
		2007		2009		2011		2007		2009		2011	
		value	rank	value	rank	value	rank	value	rank	value	rank	value	rank
Backward linkages	direct	0,00040	12	0,00537	13	0,00137	7	0,00046	13	0,00573	13	0,00391	11
	total (=output multiplier)	0,02950	12	0,03745	12	0,03071	12	0,02428	10	0,03253	12	0,02804	10
	total normalized linkage	0,53994	12	0,53342	12	0,55784	12	0,45328	10	0,59547	11	0,36244	10
Forward linkages	direct	0,00070	11	0,01067	12	0,00399	10	0,00027	14	0,00458	14	0,02513	10
	total (=input multiplier)	0,02983	12	0,04868	13	0,03364	14	0,02409	10	0,03233	11	0,45993	10
	total normalized linkage	0,55316	12	0,81573	13	0,50309	14	0,44685	10	0,54453	11	0,45993	10
Backward variation index		2,67018	13	2,05625	5	4,03180	12	1,99897	9	-7,96388	3	3,58844	10
Forward variation index		2,23530	9	3,92828	15	3,66895	10	2,20187	12	3,75744	13	4,02175	10

Note: Inter-sectoral linkages comprise backward and forward linkages and backward and forward variation indices for the ‘financial services, insurance and real estate’ sector, for the years 2007, 2009 and 2011 (value added and final demand weights).

Source: own calculations, based on the input-output tables from the Eora database (Lenzen et al., 2012; Lenzen et al., 2013)

#### *Backward and forward linkages*

Results of backward and forward linkages of the ‘communication’ sector indicate relatively low linkage values. Rankings are predominantly lower than the ranks of the financial services sector. **Direct** backward linkages rank low both for value added weights (2007/2009/2011: 0.0004/0.005/0.001 with ranks 12/13/7) and final demand weights (0.0005/0.006/0.004 with ranks 13 resp. 11). This holds also for **total** backward linkages (value added weights: 0.03/0.04/0.03 with ranks 12; final demand weights: 0.02/0.03/0.03 with ranks 10/12/10). The ranks do not change substantially after **normalizing total** backward linkages (value added

weights: 0.54/0.54/0.56 with ranks 12; final demand weights: 0.45/0.6/0.36 with ranks 10/11/10).

Forward linkage values for the ‘communication’ sector are lower than the ones of the financial services sector. **Direct** forward linkages rank consistently low (value added weights: 0.0007/0.01/0.004 with ranks 11/12/10; final demand weights: 0.0003/0.005/0.03 with ranks 14/14/10), along with **total** forward linkages (value added weights: 0.03/0.05/0.03 with ranks 12/13/14; final demand weights: 0.02/0.03/0.46 with ranks 10/11/10). This is also underlined when considering the results for the **normalized total** forward linkages (value added weights: 0.55/0.82/0.5 with ranks 12/13/14; final demand weights: 0.45/0.54/0.46 with ranks 10/11/10).

#### *Multiplier effects*

Due to the relatively low linkage values, small multiplier effects are determined in all three years. The output multiplier (total backward linkages) indicates that one additional unit of final demand into the ‘communication’ sector induces around 0.03 resp. 0.04 (for value added weights) and around 0.02 resp. 0.03 (for final demand weights) cumulative revenue within the economy. The input multiplier (total forward linkages) indicates that one additional unit of primary input yields around 0.03 resp. 0.05 (for value added weights) and 0.02 resp. 0.03 and 0.5 (for final demand weights) additional overall economic revenue. Multiplier effects are higher for the financial services sector than for the communication sector.

#### *Variation index*

The backward and forward variation indices indicate a rather low and uneven spread of the linkages to the rest of the economy. Backward variation indices are predominantly low ranked (value added weights: 2.67/2.06/4.03 with ranks 13/5/12; final demand weights: 2.0/-7.9/3.6 with ranks 9/3/10) with the exception of 2009 where a wider and more even spread of the backward linkages is noticeable (value added weights rank 5, final demand weights rank 3). Forward linkages are as well rather unevenly spread, indicated by a high variation indices (value added weights: 2.24/3.93/3.67 with ranks 9/15/10; final demand weights: 2.20/3.76/4.0 with ranks 12/13/10).

#### *Key sector assessment*

The normalized backward and forward linkage measures of the ‘communication’ sector do not allow a classification of the sector as a key sector of the Kenyan economy. All the

normalized linkage measures are smaller than 1 for both value added and final demand weights in all three years.

### **Robustness test**

In order to confirm our results from the open input-output model, we additionally test our results by deploying the *closed* input-output model. We now include the final demand sectors and value added sectors into the inter-industry system. This endogenized model takes feedback effects and interdependencies between the production sectors and final demand sector into account. After endogenizing final demand and value added into the inter-industry system we proceed exactly as in the previous analysis. Again, linkages are weighted by final demand and value added weights. The now additionally included final demand and value added sectors are weighted by 1. We check for the same linkage measures and again specifically focus on the financial services and communications sectors.<sup>6</sup>

#### *Results for Nigeria*

The relatively high rankings of the financial sector for total backward and total forward linkages can be confirmed for both value added and final demand weights. The endogenized sector final demand ranks first place. However, this is rather intuitive as it is weighted by 1. Output multipliers vary considerably between the three years (2007/2009/2011: value added weights: 0.38/1.01/7.89 with ranks 2/20/2; final demand weights: 0.33/14.1/11.05 with ranks 2). Based on normalized backward and forward linkages, the financial sector can be classified as key sector in 2007 and 2011 and by approximation also in 2009 with normalized backward linkages of value added weights in 2007/2009/2011 with 3.46/3.89/5.3 (ranks 2/2/3), final demand weights with 3.46/0.88/1.23 (ranks 2) as well as normalized forward linkages of value added weights with 4.73/0.88/1.21 (ranks 2/4/5) and of final demand weights with 2.89/3.23/4.32 (ranks 2).

#### *Results for Kenya*

Results for Kenya are in line with the previous results based on the open input-output model. Total backward and total forward linkage values and rankings are relatively low for both sectors. Output multipliers of the financial sector rank low for both value added weights (2007/2009/2011: 0.07/0.29/0.07 with ranks 6) and final demand weights (0.08/0.44/0.09 with ranks 8/9/9). Normalized backward linkages record values smaller than 1 for both value added

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<sup>6</sup> Detailed results are available upon request.

weights (0.64/0.12/0.65 with ranks 6) and final demand weights (0.58/0.86/0.6 with ranks 8). Finally, normalized forward linkages record values smaller than 1 (value added weights: 0.61/0.70/0.63 with ranks 8/9/8 ; final demand weights: 0.27/0.06/0.28 with ranks 9/10/9).

## 9. Discussion

The sectoral interconnectedness of the financial services sector in the Nigerian and Kenyan economies has been illustrated by the results of this study. The discussion summarizes the relevant results for the financial services sector and relates them to the corresponding hypotheses formulated in section 6. The results for the financial services sector do not deviate substantially between the years 2007, 2009 and 2011 in both the countries.

While results for the **Nigerian** economy show relatively low direct *backward* and direct *forward linkages* for the financial services sector, values for total backward and total forward linkages rank highest in all three years. This result is of economic importance since both linkage measures represent growth inducing mechanisms – the so-called Hirschman-type production linkages (Tregenna, 2008, see section 2). The high total backward linkages indicate that the financial services sector creates additional demand for the output of upstream sectors, leading to increased upstream investment, capacity utilization and upstream technological upgrading (see section 2). Furthermore, the relatively high total forward linkages indicate a substantial impact on downstream sectors, including for example downstream investment or technological upgrading. The results for the high values of forward linkages are indicative for **Hypothesis 1** (The financial sector yields significant forward linkages to the other sectors of the economy). This is in line with Rueda-Cantuche et al. (2012). In addition to the assumed high total forward linkages, the high total backward linkage values underline the inter-sectoral connectedness of the financial services sector in Nigeria. This is of specific relevance for growth stimuli. While backward linkages *induce* economic development, forward linkages *enable* economic development. This allows a classification of the Nigerian financial services as a sector which both induces and enables development.

The picture is different for the inter-sectoral linkages in the **Kenyan** economy. Here, direct and total backward linkages as well as direct and total forward linkages rank relatively low. This does not support **Hypothesis 1**. The relatively low values of both backward and forward linkages do not allow a distinct assignment of growth inducing or growth enabling functions of the financial services sector in Kenya. Furthermore, the linkage values for the Nigerian

financial services sector are considerably higher. Yet, a direct comparison of the results should be done with caution as there are differences in the levels of sectoral aggregation and sectoral classifications between the two economies. A more disaggregated listing of its components would facilitate a direct comparison of the linkage results.

The differences in the linkage values naturally also imply differences in the economy-wide impact the financial services sector has within the two economies, as illustrated by the *multiplier effects* (equivalent to total linkage measures). The high total linkage values of the **Nigerian** economy imply high values of the output multiplier (equivalent to total backward linkage) and input multiplier (equivalent to total forward linkage) of the financial services sector. The high output multiplier of the financial services sector implies a high inducement of cumulative revenues by one additional unit of final demand in the financial sector (see 7.3). Furthermore, the high values of the input multiplier indicate that an additional unit of primary input into the financial services sector has a major impact on the total output in the other sectors of the economy. This is indicative for **Hypothesis 2** (Changes in final demand or value added in the financial sector have a wide-spread impact on the rest of the economy). However, the variation indices indicate for value added weights a rather concentrated spread of the linkages to the rest of the economy, whereas final demand weights approve a relatively wider spread of the linkages to the economy. This limits the approval of Hypothesis 2 slightly, since a wide-spread impact is only approved for final demand weights.

Results for the **Kenyan** economy lead to the conclusion that the financial services sector does not yield economy wide growth effects similar to Nigeria (at least not directly), as the values for the total backward and total forward linkages are relatively low which leads to low output multipliers and predominantly low input multipliers. In addition to that, the variation indices mainly indicate a low spread of the linkages of the financial services sector to the rest of the economy (except for final demand weights 2009). In sum, **Hypothesis 2** cannot be approved for the Kenyan economy.

The significance of the financial sector for the two countries furthermore becomes clear when looking at the *key sector assessment*. For **Nigeria**, results are evident for the key sector assessment method applied: based on normalized backward and forward linkages, the financial services sector clearly can be classified as a key sector of the Nigerian economy. Results for the key sector assessment of **Kenya** depend on the applied sectoral weights. When applying value added weights, the sector ‘financial services, real estate and insurance services’ can be considered a key sector of the Kenyan economy. However, this does not hold when applying final demand weights.

It is evident that results differ remarkably between the Nigerian and the Kenyan economies, which is a confirmation of **Hypothesis 3**. While results clearly indicate the significant role of the financial sector in Nigeria, this can only be proven in part for the case of Kenya. What should be kept in mind is that the development level of the analyzed countries influences the results. Since sectoral interdependence is largely the result of industrialization, high degrees of sectoral linkages indicate a relatively high level of development (see Hirschman 1959, p. 104,110 for a theoretical explanation, and Yotopoulos and Nugent 1973, p. 163 for empirical confirmation). While Nigeria is classified as a lower-middle income country, Kenya counts as a low-income country (World Bank, 2014). We cannot fully assume that this difference in income level solely accounts for the different extents of sectoral-interconnectedness of the financial sectors, but since Nigeria is a country with a considerably well-developed financial system, this can be conducive to it. The relative significance of the financial sector in the Nigerian economy is already illustrated by its shares in total output, value added and final demand (see Table 2). In this field, for a direct comparison of the two economies and the role of the financial sector, a more detailed and disaggregated listing of the financial sector can give details of this assertion.

The differences in the role of the financial sector within the economies may well be traced back to the high prevalence of mobile money in Kenya. However, when controlling for the role of the communication sector within both the two economies, results indicate strikingly low linkage values in both cases. While for the Nigerian economy it can still be classified as key sector (in part), this classification is not possible for the Kenyan economy due to considerably low linkage values. This is not indicative for our **Hypothesis 4**. This result is especially striking in the case of Kenya, as a large number of financial services is provided by telecommunication enterprises. One reason why the results of this study do not reflect the obviously high importance of communication services in these countries might be the relatively high level of aggregation of the data. Since the data does not allow distinguishing between the specific kinds of communication services, the distinction of financial services within communication services (mobile money) is not feasible. Moreover, relatively low values of inter-sectoral linkages might also be explained by a low degree of transparency and data collection when it comes to mobile money transfer. A considerable amount of mobile money transfer might not be captured by the input output data. Another important point for both the financial and the communication sector is the consideration of the informal sector. As a lot of financial transactions are still happening outside the formal financial sector, the data does not capture the real size and number of transactions.



Results of this study document the economic significance of the financial services sector. This is more evident for the Nigerian economy than for the Kenyan economy. But for both countries the inter-sectoral linkages of the financial sector are channels by which the rest of the economy is affected. Although the results differ between the Nigerian and the Kenyan economies, it is a fact that both the economies are regional growth poles with the potential to drive regional development. A complementary aspect is the consideration of the regional relevance of the financial services sectors of Nigeria and Kenya for their surrounding countries by developing multi-regional input-output tables. An efficient provision of financial services is thus of high importance. This is of specific relevance in the context of developing and enforcing the competitiveness of local companies which determines the ability to plug-in or to upgrade within global value chains.

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## Annex 1 Sectors listed in the Nigerian and Kenyan input-output tables and classification of the Kenyan sectors for a higher aggregation

Sectors in the Nigerian input output tables		Sectors of the Kenyan economy	Classification of the Kenyan sectors for higher aggregation
Agriculture	(1)	Maize	Agriculture
Fishing	(2)	Wheat	Agriculture
Mining and Quarrying	(3)	Rice	Agriculture
Food & Beverages	(4)	Barley	Agriculture
Textiles and Wearing Apparel	(5)	Cotton	Agriculture
Wood and Paper	(6)	Other grains	Agriculture
Petroleum, Chemical and Non-Metallic Mineral Products	(7)	Sugarcane	Agriculture
Metal Products	(8)	Coffee	Agriculture
Electrical and Machinery	(9)	Tea	Agriculture
Transport Equipment	(10)	Roots and Tubers	Agriculture
Other Manufacturing	(11)	Oils and Pulses	Agriculture
Recycling	(12)	Fruits	Agriculture
Electricity, Gas and Water	(13)	Vegetables	Agriculture
Construction	(14)	Cutflowers	Agriculture
Maintenance and Repair	(15)	Other Crops	Agriculture
Wholesale Trade	(16)	Beef	Agriculture
Retail Trade	(17)	Dairy	Agriculture
Hotels and Restaurants	(18)	Poultry	Agriculture
Transport	(19)	Sheep and Goats	Agriculture
Post and Telecommunications	(20)	Other livestock	Agriculture
Financial Intermediation and Business Activities	(21)	Fishing	Fishing
Public Administration	(22)	Forestry	Agriculture
Education, Health and Other Services	(23)	Quarrying and Mining	Mining and Quarrying
Private Households	(24)	Meat and dairy processing	Food & Beverages
Others	(25)	Grain Milling	Food & Beverages
Re-export & Re-import	(26)	Bakery and confectionary	Food & Beverages
		Beverages and tobacco	Food & Beverages
		Other food manufactures	Food & Beverages
		Textiles & wearing apparels	Textiles and Wearing Apparel
		Leather and Footwear	Textiles and Wearing Apparel
		Wood and Paper	Wood and Paper
		Printing and Publishing	Wood and Paper
		Petroleum and Gas	Petroleum, Chemical and Non-Metallic Mineral Products
		Chemicals and chemical products	Petroleum, Chemical and Non-Metallic Mineral Products
		Metals and Machinery	Metal Products
		Non-mettalic manufactures	Petroleum, Chemical and Non-Metallic Mineral Products
		Other Manufactures	Other Manufacturing
		Water	Electricity, Gas and Water
		Electricity	Electricity, Gas and Water
		Building and Construction	Construction
		Trade	Trade
		Hotels	Hotels and Restaurants
		Transport	Transport
		Communication	Communication
		Financial services, real estate and insurance services	Financial Intermediation and Business Activities
		Restaurants	Hotels and Restaurants
		Other Services	Education, Health and Other Services
		Public Administration	Public Administration
		Health	Education, Health and Other Services
		Education	Education, Health and Other Services
		Reexport/Reimport	Reexport/Reimport
		<i>Additional sectors in the Nigerian Input-output tables but missing in Kenya tables:</i>	
			Electrical and Machinery
			Transport Equipment
			Recycling
			Maintenance and Repair
			Retail Trade
			Private Households
			Others

Source: Lenzen et al., 2012; Lenzen et al., 2013