Valuation of telecommunication assets in sub-Saharan Africa

Aude Schoentgen

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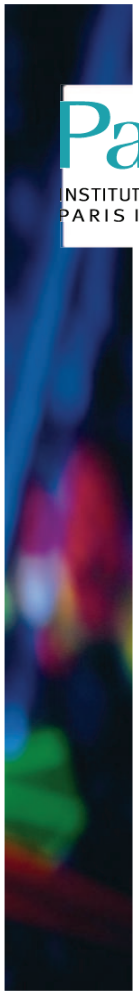

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La valorisation des actifs télécoms en Afrique sub-Saharienne

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La valorisation des actifs télécoms en Afrique sub-Saharienne

RÉSUMÉ : Deux problématiques ont été peu explorées dans la littérature économique et managériale:
- les méthodes d'évaluation des opportunités d'entrée et d'investissement par un opérateur télécom international,
- le cas du continent africain comme destination de ces investissements, qui fait l'objet de beaucoup d'intérêt de la part des grands opérateurs internationaux.

La thèse porte sur les investissements étrangers en Afrique dans le secteur des télécoms, en s'intéressant à deux modes d'entrée: l'acquisition d'une licence et le rachat d'un opérateur installé. Son objectif est de montrer dans quelle mesure les facteurs locaux, liés au pays d'accueil de l'investissement et à son marché télécom local, ont un impact sur la valorisation de ces investissements en Afrique sub-Saharienne. La thèse couvre la question de l'intérêt stratégique de ces investissements, les méthodes pour estimer ces opportunités, ainsi que la nature des différents facteurs à considérer dans cette estimation.

Une base de données a été développée, rassemblant les transactions effectuées par les principaux opérateurs multinationaux en Afrique sub-Saharienne sur la période 2000-2010. Plusieurs analyses quantitatives ont été menées à partir de cette base de données, afin d'identifier les déterminants des prix de ces transactions.
La thèse montre le manque de régularités et de rationalité dans les prix des transactions du secteur télécom sur le continent.

Mots clés : actifs télécom, licences mobiles, fusions-acquisitions, valorisation, prix, Afrique

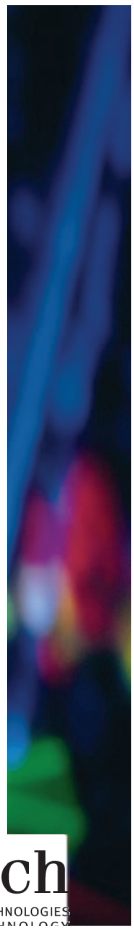
Valuation of telecommunication assets in sub-Saharan Africa

ABSTRACT: There is still scant knowledge in the economic and international business literature regarding two issues:
- Valuation methods of modes of market entry and of investment by an international telecom operator,
- The case of Africa as a host continent for these investments.

The thesis deals with foreign investments in Africa in the telecom sector, focusing on two entry modes: license awards and acquisitions of local operators. Its objective is to demonstrate on what extent « local » factors (related to the host country and its local telecom market) have an impact on the valuation of these investments in sub-Saharan Africa. This work covers the issues of the strategic interest of these investments, the methods to valuate these investment opportunities, as well as the different factors to take into account in this valuation.

A database has been developed, gathering all deals made by multinational operators in sub-Saharan Africa over 2000-2010. Several quantitative analyses have been conducted as from this corpus, in order to identify the determinants of deal amounts.
This work demonstrates the lack of regularity and rationality in deals' prices of the telecom sector in Africa.

Keywords: telecommunication assets, mobile licenses, M&A, valuation, price, Africa



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This thesis is dedicated to E. and M.

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December 2014

ACRONYMS

ADSL	Assymetric Digital Subscriber Line
ARE	Autorité de Régulation de Mauritanie (Mauritanian Regulatory Body)
ARPU	Average Revenue Per User
ARTP	Autorité de Réglementation des Télécommunications et des Postes (Togolese Regulatory Body)
BB	Broadband
BTS	Base Transceiver Station
CAGR	Compounded Annual Growth Rate
CAPEX	Capital Expenditures
CAPM	Capital Asset Pricing Model
CAR	Central African Republic
CC	Control of Corruption (WGI)
CDMA	Code Division Multiple Access
CFAF	CFA Francs
COFACE	Compagnie Française d'Assurance pour le Commerce Extérieur
CPI	Consumer Price Index
CST	Communication Service Tax
DCF	Discounted Cash Flow
DJTTEL	Dow Jones Telecommunications Titans 30 Index
DRC	Democratic Republic of Congo
EBIT	Earnings Before Interest and Taxes
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization
ECA	Export Credit Agency
ECGD	Export Credits Guarantee Department
EDGE	Enhanced Data Rate for GSM Evolution
EFI	Index of Economic freddom
EMTS	Emerging Markets Telecommunications Services (Nigerian operator)
ENPV	Expended Net Present Value
EV	Enterprise Value
FCF	Free cash Flow
FCPA	Foreign Corrupt Practices Act
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GE	Government Effectiveness (WGI)
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
GSMA	Groupe Special Mobile Association
HIV	Human Immunodeficiency Virus
HSDPA	High Speed Downlink Packet Access

HSUPA	High Speed Uplink Packet Access
ICRG	International Country Risk Guide
ICT	Information and Communication Technologies
IMF	International Monetary Fund
IRR	Internal Rate of Return
IRS	Interest Rate Swap
IT	Information Technologies
ITU	International Telecommunication Union
JV	Joint Venture
LTE	Long-Term Evolution
M&A	Mergers and Acquisitions
MDF	Main Distribution Frame
MHz	Megahertz
MIC	Millicom International Cellular (Millicom Tigo)
MIGA	Multilateral Investment Guarantee Agency
MNC	Multinational Company
MNE	Multinational Enterprise
MRO	Mauritanian Ouguiya (currency)
MTC	Multinational Telecommunication Company
MTN	Mobile Telephone Networks (South-African operator)
NHIL	National Health Insurance Levy
NPV	Net Present Value
OECD	Organisation for Economic Cooperation and Development
OLI	Ownership, Location and Internationalisation
OPEX	Operational Expenditures
P&L	Profit and Loss statement
PCA	Principal Component Analysis
PGR	Perpetual Growth Rate
POS	Point of Sales
PRS	Political Risk Services
PV	Political Stability and Absence of Violence/Terrorism (WGI)
R&D	Research and Development
RL	Rule of Law (WGI)
ROV	Real Option Value
RQ	Regulatory Quality (WGI)
SEC	Security Exchange Commission
SFR	Société Française du Radiotéléphone (French operator)
SIM	Subscriber Identity Module

SMS	Short Message Service
sSA	sub-Saharan Africa
TGR	Terminal Growth Rate
TV	Terminal Value
ULL	Unbundled Local Loop
UMTS	Universal Mobile Telecommunication System
USA	United States of America
USD	United States Dollars
VA	Voice and Accountability (WGI)
VAT	Value Added Tax
VSAT	Very Small Aperture Terminal
WACC	Weighted Average Cost of Capital
WCIS	World Cellular Information Service
WCM	Working Capital Movements
WGI	Worldwide Governance Indicators
WOS	Wholly-Owned Subsidiary
XOF	CFA Francs currency code (West African Economic and Monetary Union)
ZTE	Zhongxing Telecommunication Equipment Company Limited (Chinese telecom manufacturer)

TABLE OF CONTENTS

ACRONYMS 6

CHAPTER 1: GENERAL INTRODUCTION 13

I. Emergence of a new Africa since the 1990s 13

II. The recent evolution of African telecommunications markets 17

III. Africa: a new territory of investment for international telecom operators 25

IV. Problem statement and research issue 31

V. Scope of research 39

a) Multinational Telecommunications Companies in the mobile market 39

b) Types of investments covered 41

c) Geographical scope 44

d) Period covered 46

VI. Chapters' presentation 46

CHAPTER 2: RESEARCH BACKGROUND AND LITERATURE REVIEW 49

I. FDI and MNE investments in developing countries 50

a) The O.L.I paradigm as theoretical framework (J. Dunning) 50

b) MNE foreign investments and market entry strategies 52

c) FDI inflows to developing countries and their determinants 57

d) Conclusion 65

II. Asset valuation in developing countries 66

III. Other topics related to our research 67

IV. Conclusion of Chapter 2 69

CHAPTER 3: THEORETICAL VALUATION OF A TELECOM ASSET IN SUB SAHARAN AFRICA 71

I. Current practices of telecom asset valuation 73

a) Intrinsic valuation: Discounted Cash Flow method 73

b) Relative valuation: Multiples & comparables 84

c) Contingent claim valuation: Real options methodology 85
d) Conclusion on valuation practices 88
II. Classification of factors influencing the valuation 89
a) The exogeneous environment: Country factors 92
b) The endogenous environment: market-related factors 102
c) Firm-specific factors 107
III. Conclusion on Chapter 3 and research hypotheses 108
CHAPTER 4: TELECOM ASSET VALUE IN SUB-SAHARAN AFRICA OVER 2000-2010: QUANTITATIVE ANALYSES 113
I. Corpus presentation 113
a) Indicators included and excluded 115
b) Harmonization and allocation rules 116
c) Data sources and methodological issues 117
II. Factors' definitions and data sources 118
a) Deal-related factors 118
b) Country factors 120
c) Local market factors 123
d) Governance and regulation factors 125
e) International market factor 139
III. Descriptive statistical analysis in two dimensions 140
a) General information about deal amounts evolution over the decade 142
b) Deal amounts and country-related factors 156
c) Deal amounts and market-related factors 172
d) Conclusion on descriptive analysis 185
IV. Descriptive statistical multidimensional analysis: Principal Component Analysis 186
a) PCA n°1: Licenses awarded 187
b) PCA n°2: Operators acquired 192

c) PCA n°3: All deals (license awards and operators' acquisitions) 197
d) Conclusion on Principal Component Analysis 204
V. Business model explaining the price of a telecom asset based on local factors 206
VI. Multiple regression analysis 210
a) Analyses and results 210
b) Conclusion on regression results 226
c) Discussion on hypotheses 233
VII. Hypotheses on other potential determinants of deal amounts 233
CHAPTER 5: GENERAL CONCLUSION 238
I. Summary of main findings and contribution 239
II. Recommendations for future work 241
LIST OF CHARTS 244
LIST OF MAPS 247
LIST OF GRAPHS 248
LIST OF TABLES 251
APPENDICES 252
Appendix 1. Sub-Saharan Africa, Latin America and East Asia indicators 253
Appendix 2. Details on P&L 254
Appendix 3. Details on database sources 259
Appendix 4. The Index of Economic Freedom 260
Appendix 5. Worldwide Governance Index 263
Appendix 6. Additional descriptive analyses 274
Appendix 7. Regressions – Results 279

CHAPTER 1

GENERAL INTRODUCTION

CHAPTER 1: GENERAL INTRODUCTION

I. Emergence of a new Africa since the 1990s

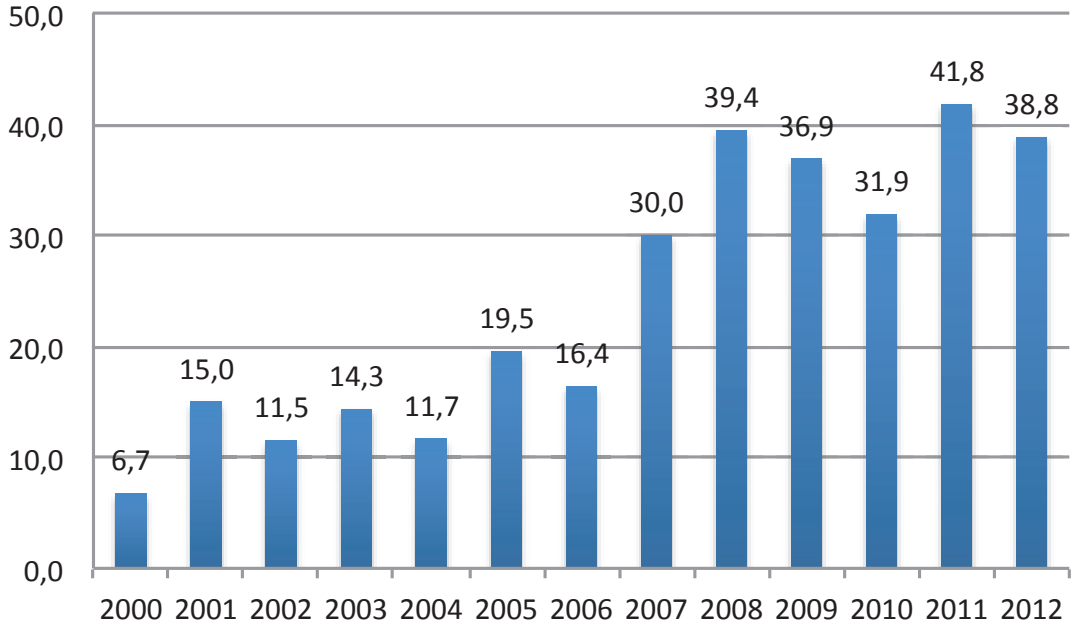
"Let's face it – think of Africa and the first images that come to mind are war, poverty, famine and flies." (Pr. Henry Louis Gates)

Africa is made up of 54 countries; one billion inhabitants live on an area of more than 30 million km^2. The situation of the continent has changed significantly in the past 20 years: sub-Saharan African daily life is not made up by dictatorships, civil wars, diseases and famines anymore, contrary to some occidental deep-rooted preconceptions. Access to education has improved; deaths by malaria, HIV and child mortality have decreased. Half of the countries have democracies today (against only 3 beginning of the 1990s) *(Map 1)*.

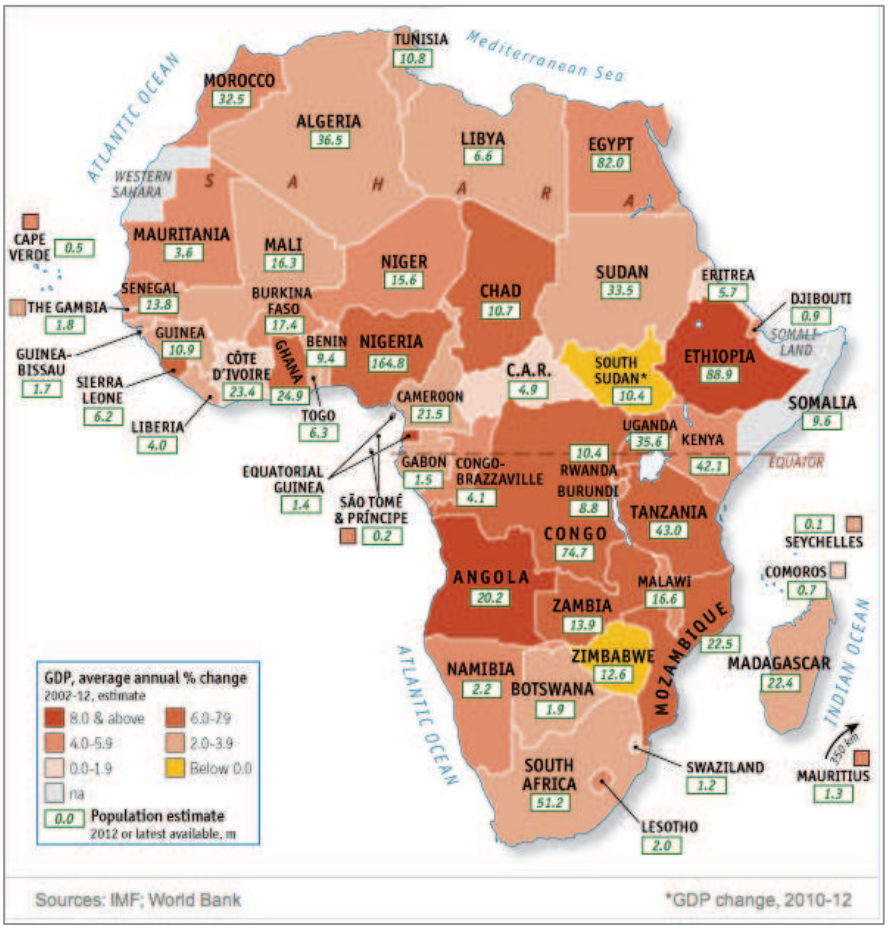
Map 1: Democracies in Africa
Source: The Economist, Special report, March 2nd 2013

One of the key pillars of these improvements is the boom of the African economy, that has the fastest growth in the world: foreign investment inflows have kept increasing in the 2000s *(Chart 1)* and after a period of double-digit growth in the 2000s, the GDP is expected to maintain a yearly increase of 6% in the following years *(Map 2)*. Even if indicators related to African countries are not always reliable, data roughly demonstrate that the gap in terms of development and economics between Africa and other emerging regions of the world has progressively reduced in the past few years.

Chart 1: FDI net inflows (US$) to sub-Saharan Africa
Source: World Bank databank



Map 2: GDP annual growth and populations in Africa
Source: The Economist, Special report, March 2nd 2013



Nevertheless, compared to other **emerging regions like East Asia and Latin America, sub-Saharan Africa has some specific characteristics** (We will come back later to the potential impact that these African specificities have on the telecommunication sector):

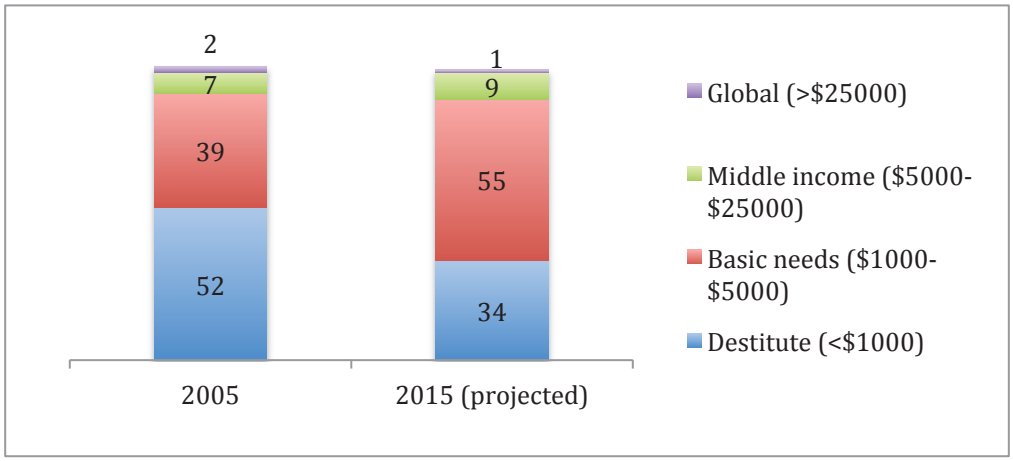
- Demographic specificities:
  - A young population: 41,8% of total population is under the age of 15, compared to 27,9% in Latin America and 31,9% in East Asia[1].

[1] Data of this paragraph are 2010 and come from World Bank databank (for detailed data, see *Appendix 1*).

- Rurality: 61,7% of population live in rural areas, compared to 35,8% in Latin America and 56,6% in East Asia.
- Low population density: 95 inhabitants per square meter, compared to 191 in Latin America and 128 in East Asia.
- Literacy is still low compared to Latin America and East Asia[2]

- Even if the real income per person has increased by 30% in the last 10 years and despite the emergence of a new middle-class in some African countries, disposable income and standard of living remain low for a large majority of population compared to other regions of the world *(Chart 2).*
- Most of sub-Saharan African countries are low-income countries. GDP per capita remains low: 1800US$ per capita in 2010 compared to 6411US$ in Latin America and 2335US$ in East Asia.
- Most of these countries face challenges: political (institutional weaknesses, contract incompleteness, etc.), economic (poor infrastructure networks, etc.) and social. The Worldwide Governance Indicator for Regulatory Quality is 30% in 2010 for sub-Saharan Africa, compared to 56% for Latin America and 44% for East Asia.[3]

Chart 2: Breakdown of Africa's population by income bracket
Source: McKinsey[4]



Figures do not sum to 100%, because of rounding.
Source: Global Insight, McKinsey analysis

[2] Data unavailable or difficult to compare on World Bank databank
[3] Source: World Bank (http://info.worldbank.org/governance/wgi/index.aspx#home)
[4] http://www.mckinsey.com/insights/economic_studies/africas_path_to_growth_sector_by_sector (Accessed 16 July 2014)

In this context, many industries and services have emerged. The exploitation of natural resources (oil, gold, diamonds, copper, cocoa beans, etc.) still represents a large part of the African economy but remains dependant on the international commodity prices. Agriculture is still a large economic sector. Consumer goods sector has grown rapidly in the past decade and banking, agro-business, infrastructures and retail keep developing. And as per our topic, the telecommunications sector has also naturally gained from the exceptional development and growth of Africa in the past twenty years.

To sum up, then, Africa has demographic peculiarities and is still trailing other developing continents (low standard of living and country incomes). But it also has a significant economic growth potential from which the telecom sector has started to benefit.

II. The recent evolution of African telecommunications markets

In the last two decades, the African telecommunications have experienced two phenomena in parallel:

- Mobile telephony networks have been implemented: All countries were equipped in 2001 against only 20% in 1993.
- The telecom sector was progressively liberalised: Telecom was a monopoly in 20% of countries in 2004 against 80% in 1998.

Let's take a step back and have a look on the recent history of the sector in Africa, in order to understand its development and it status today.

Compared to the rest of the world, the telecommunication sector in Africa was lagging behind till the end of the XXth century. Its early stages of development concerned the fixed lines, but due to a lack of investment in infrastructures and of political stability, telecommunications were poorly developed and reserved to businesses and to an elite. Like in most countries of the world, the sector was considered to be a natural monopoly: in most African countries, State monopolies were in charge of telecommunications and posts, as the public sector was considered as the only one to be able to sustain the huge investments necessary to develop a national infrastructure. In the 1980s and in the early 1990s, some African countries started telecom reforms related to separation of telecom and post, creation of some regulatory bodies and capitalisation of public incumbent. Some mobile networks started to be run, but their services were still only affordable to elites.

A first change happened in the late 1990s: New laws on telecom liberalisation were signed and some telecom incumbents were partially privatised such as Telkom South Africa, Sonatel (Senegal) and Côte d'Ivoire Telecom in 1997, Mauritius Telecom in 1999 and Mauritel in Mauritania in 2001. Also separate regulatory bodies have been created, for example in Sudan and Botswana in 1996, in Cameroon in 1998 and Angola and Kenya in 1999.

As from the 2000s, a real momentum was taken in African telecommunications: the different market stakeholders participated in democratizing and generalizing telecommunications in Africa. Structural programs were implemented, supported by international funding institutions such as the World Bank and the International Monetary Fund. These institutions recommended that investment for ICT development in Africa had to come from private investors and that market regulation had to be undertaken by independent regulatory bodies, in order to further prevent conflicts of interest and encourage market competition. In parallel, privatizations of incumbent have kept going on, with foreign operators entering African markets: Orange acquired 51% of Kenyan incumbent Telkom Kenya in 2007, Vodafone was granted 70% of Ghana Telecom in 2008 (the 30% left remaining in government's hands), Maroc Telecom (Vivendi) bought 51% of Sotelma in Mali in 2009. Benin Telecom, Nitel in Nigeria, Zamtel in Zambia, Onatel in Burundi all started a privatization process in 2009. Privatizations have not always been a success and in some countries such as Ghana, Gambia, Guinea, Tanzania, Niger and Nigeria, operators have then been renationalized. These failures can be due to different reasons: lack of relevant expertise of the private investor in the sector, cultural distance between the host country and the investor, absence of bidders and uncertainty about the company's value, etc. In 2010, most of sub-Saharan African countries had set up regulators, with various levels of independence and power.

In parallel, the authorities have been more and more knowledgeable about the interaction between economic development and ICT in general (Baliamoune-Lutz, 2003; Papaioannou & Dimelis, 2007), and between economic development and telecommunications in particular (Norton, 1992; Röller & Waverman, 2001; Waverman, Meschi & Fuss, 2005). Speeches and statements in favour of telecommunications have multiplied, such as this statement by Tryphon Kin-Kiey Mulumba, ICT Minister of Democratic Republic of Congo: "*Nowadays, communication is like eating and drinking, it is part of basic human needs. Citizens need to communicate and we should be able to bring communication to all*

our villages. We cannot pretend to be moving to a modern society if we do not bring communication"[5]. Institutions have progressively acknowledged that populations and businesses needed a wide access to telecommunications and that it would contribute to economic development. But on the other hand, it has remained difficult for states to lose control over the telecom sector, as it is a large source of revenues: the sector represents around 7% of tax income for states (Source: ITU).

The liberalization of the 2000s has brought competition on the market (new operators have entered by acquiring local operators or by applying for a licence). The mobile telephony has strongly taken off (the case of Ivory Coast illustrated by *Chart 3* being representative of most sub-Saharan African markets), particularly because the need in infrastructures is lighter and the technology is cheaper than for the fixed telephony. In fact, Africa is the only continent where revenues from fixed telephony are lower than revenues from mobile telephony. Penetration rate of fixed telephony in sub-Saharan Africa is of 1 per 100 inhabitants, whereas the penetration rate of mobile telephony is around 30 SIM cards per 100 inhabitants[6]. Fixed telecommunication networks have generally remained de facto monopolies, as there are not considered as a relevant investment for operators (high costs and low return).

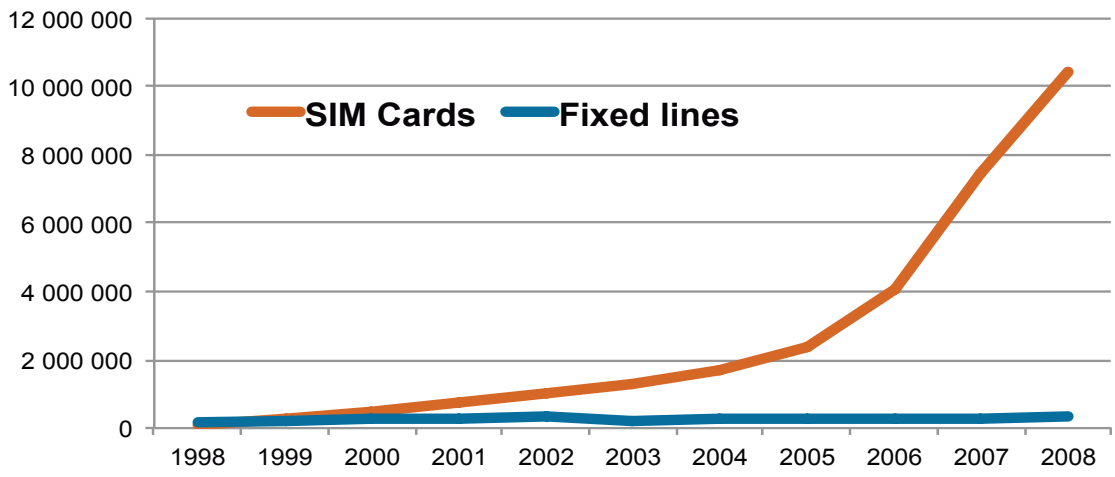
This is basically how the telecommunication sector – mobile telephony and Internet – "has swung from being a 'public service'-type organisation to becoming a competitive organisation, seen as contributing to greater well-being and tending to foment event faster innovation"[7].

[5] Original version in French: *« Aujourd'hui, la communication c'est le manger et le boire, c'est un droit reconnu à l'homme. Pour être citoyen, il faut pouvoir communiquer et nous devons pouvoir apporter la communication dans tous nos villages. Nous ne pouvons pas aller à la société de la modernité si nous n'apportons pas la communication.» Interview:* http://www.congoopportunities.net/la-delegation-chinoise-conduite-par-le-ministre-de-ptntic-fasse-a-la-presse-congolaise/ *(accessed June23rd 2014)*

[6] L. Gille, Telecom ParisTech, Telecommunications in sub-Saharan Africa : development and regulatory issues (International Telecommunications Society 18th Biennal Conference, Tokyo, Waseda University, June 27-30, 2010

[7] Idem

Chart 3: Ivory Coast – Number of subscriptions
Source: ATCI (L. Gille, Les telecommunications en Afrique)



The total sub-Saharan African mobile market (excluding southern Africa) represented only 1.8% of the world market in 2008, but it has great potential, as its profitability and growth are high[8] *(Map 3)*. Its revenue growth in the past ten years has been higher than the rest of the world and is now stabilizing *(Chart 4)*.

[8] L. Gille, Telecom ParisTech, Telecommunications in sub-Saharan Africa : development and regulatory issues (International Telecommunciations Society 18th Biennal Conference, Tokyo, Waseda University, June 27-30, 2010

Map 3: Top 20 mobile markets
by % growth (number of subscriptions) in 2011
Source: WCIS, Africa Summary 2011

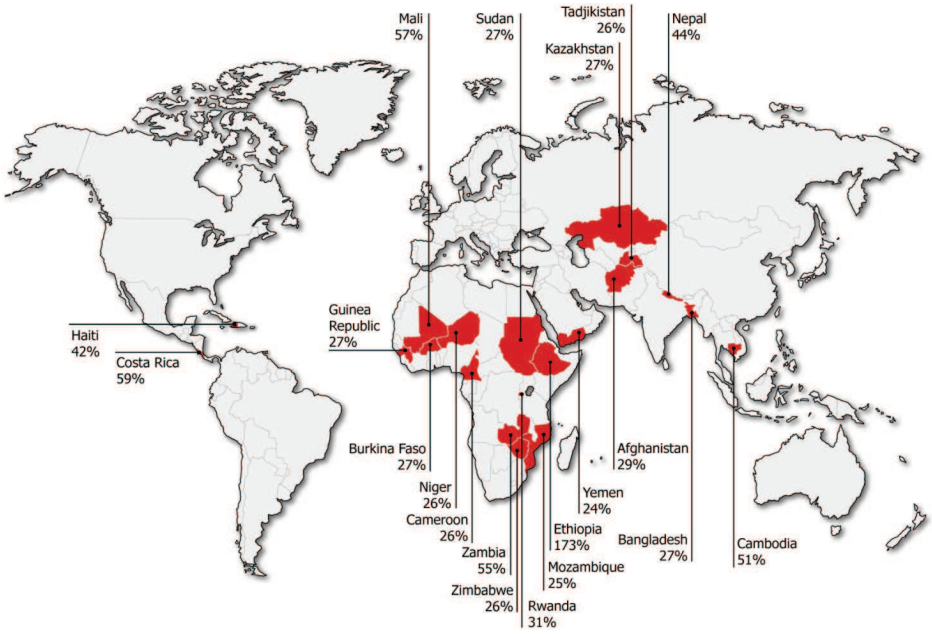
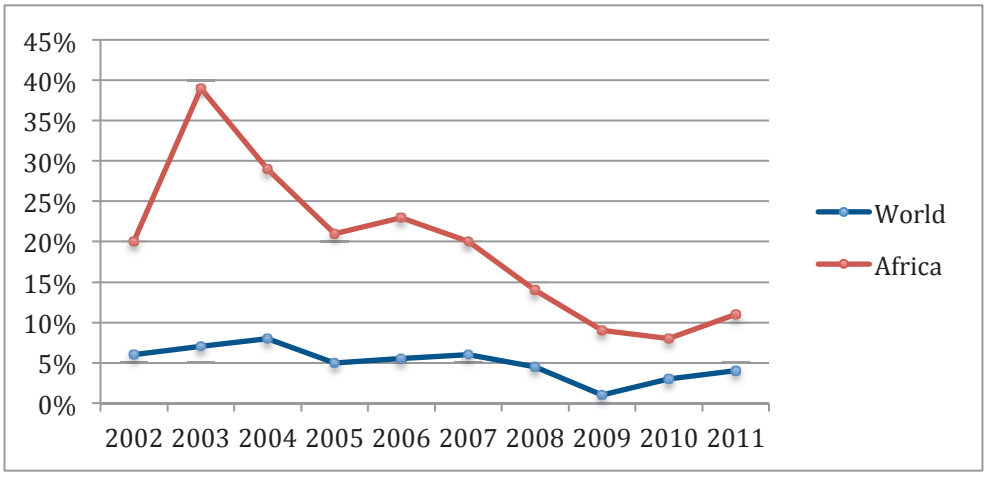


Chart 4: Annual growth of telecommunication service revenues
in Africa as compared to world growth
Source: Idate, 2012



The number of subscribers keeps strongly increasing in Africa; according to Idate, there were five times more SIM cards in Africa in 2011 than in 2005 *(Charts 5 and 6)*.

Chart 5: Growth of mobile subscriber base in Africa (million SIM cards)
Source: Idate, 2012

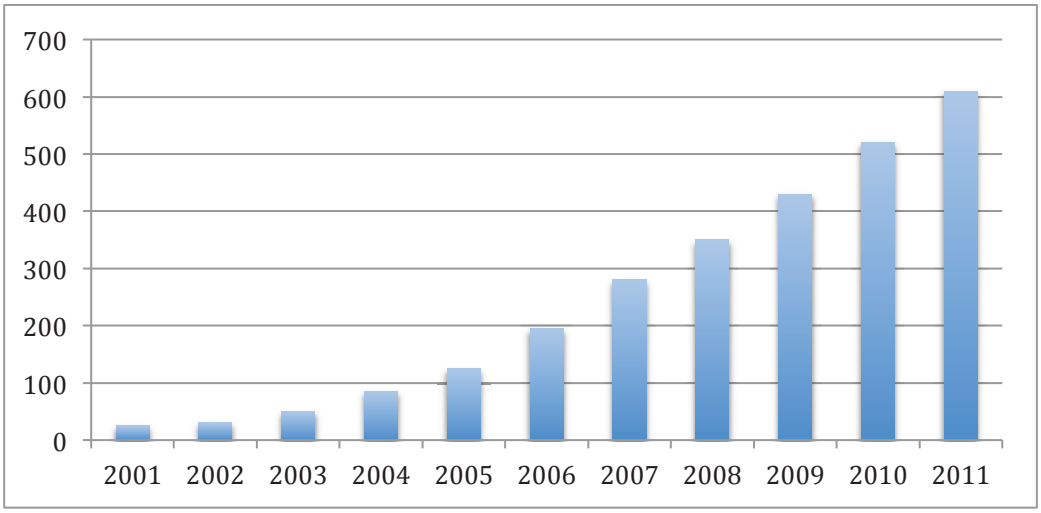
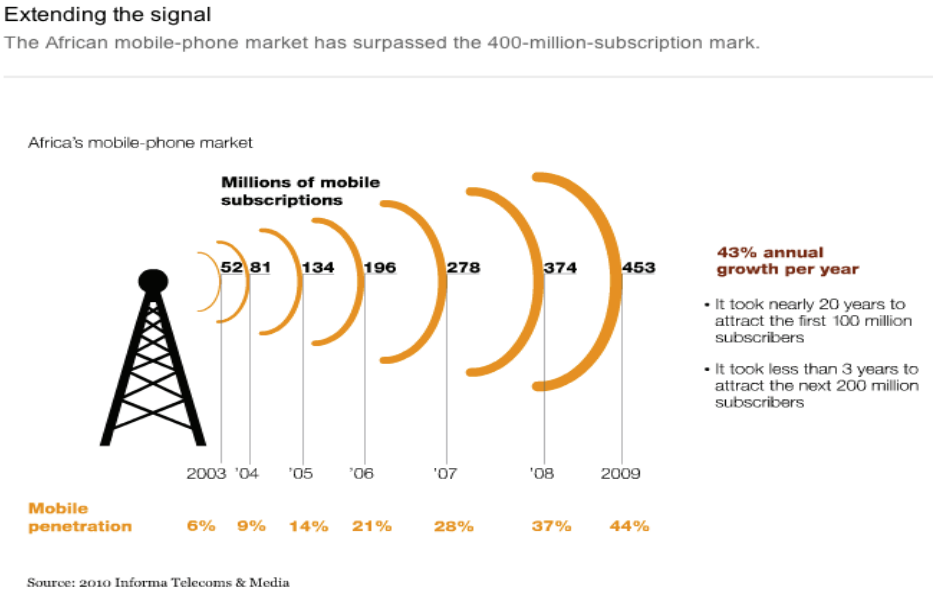


Chart 6: Growth of mobile subscriber base in Africa (million SIM cards)
Source: McKinsey[9]



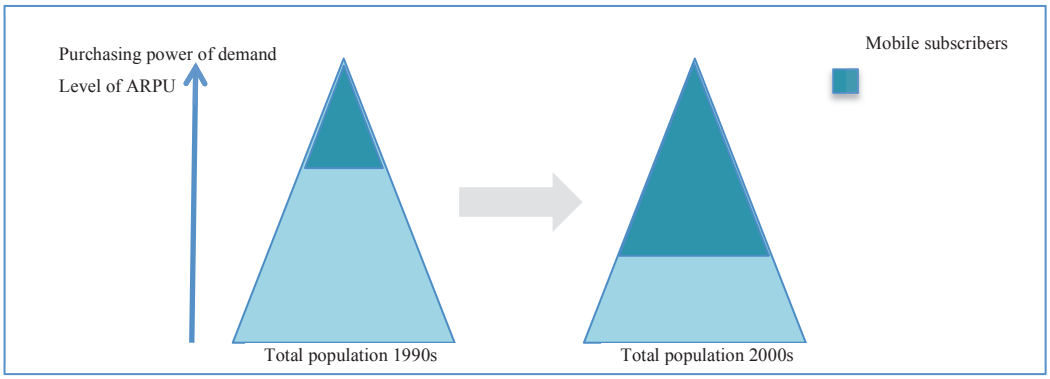
[9] http://www.mckinsey.com/insights/economic_studies/africas_path_to_growth_sector_by_sector (Accessed 16 July 2014)

The specific features of Africa – detailed above - have led to specific behaviours of stakeholders: specific usages and way of consuming for the population, specific business models for operators and specific challenges for institutions.

It is true that African population – 42% of which is younger than 15 – has been progressively willing to benefit from globalization, technological progress and digitalization. Mobile telephony has thus reached larger parts of the population.
Operators have gone from a model with high margins on a small number of customers (with a high purchasing power) to a model with low margins on a much larger customer base. These new subscribers have a lower purchasing power and the Average Revenue Per User (ARPU)[10] of operators has thus become mechanically lower. *Box 1* illustrates this effect: As networks develop, new subscribers with a lower purchasing power are being connected and thus generate lower revenues for operators. Sub-Saharan African ARPU is low compared to other regions of the world (average monthly between 5 and 15US$): 4,9US$ for Tigo[11] and from 3,63US$ in Rwanda to 10US$ in Nigeria for MTN[12]. In comparison, Vodafone UK has an ARPU of 33,93US$, MTN Cyprus 32US$, MTN South Africa 19,54US$, Telefonica Chile 16,40US$ and Orange France 43,73US$[13]. Moreover, sub-Saharan African ARPU has started to decrease: between 2007 and 2011, -60% in Sudan, -69% in Rwanda and -40% in Kenya[14]. This mechanic effect is not necessarily bad for operators' margins, as larger subscriber bases enable economies of scale.

[10] Average Revenue Per User (ARPU): Used most in the context of a telecom operator's subscriber base, ARPU offers a useful measure of growth performance. It is the average income per subscriber in a unit of time (per month or per year).
[11] Millicom Tigo, Annual Report 2011
[12] WCIS
[13] Idem
[14] GSMA Africa Mobile Observatory report, sept. 2011

Box 1: The impact of growth on the level of ARPU



Despite a low disposable income, African households are willing to pay for mobile communications, as they enable families to make savings on transportations that are very expensive services. Households in Namibia, Ethiopia and Zambia spend up to 10% of their monthly income in mobile services (vs. 3% in developed countries)[15]. Also, disparities in incomes have entailed development of specific practices such as beeping someone so that this person calls back (and bears the cost of the call) and such as credit transfer between subscribers (a subscriber can buy some credit for another subscriber by transferring money into his account by SMS)[16]. The vast majority of mobile subscribers use prepaid[17] in Africa, which is mainly due to the low proportion of households with a bank account and the inability to sustain monthly payments over a long contract period.

African people have developed new needs and usages – some of them specific to emerging countries (mobile payment, mobile banking…). A non-formal network of distributors is usually in charge of distribution, whether they are fixed or moving shops. Access to mobile telecommunications is done in many ways, whether by a personal device or by a shared access (payphone, cybercafé, etc.). Nevertheless, usages mainly focus on voice, as African

[15] Les enfeux financiers de l'explosion des télécoms en Afrique sub-Saharienne, IFRI, H. Tcheng & al., February 2010
[16] L. Gille, Telecom ParisTech, Telecommunications in sub-Saharan Africa : development and regulatory issues (International Telecommunciations Society 18th Biennal Conference, Tokyo, Waseda University, June 27-30, 2010
[17] « A prepaid mobile connection (also commonly referred to as pay-as-you-go) is a mobile connection for which credit is purchased in advance of service use. » (Source: GSMA Intelligence)

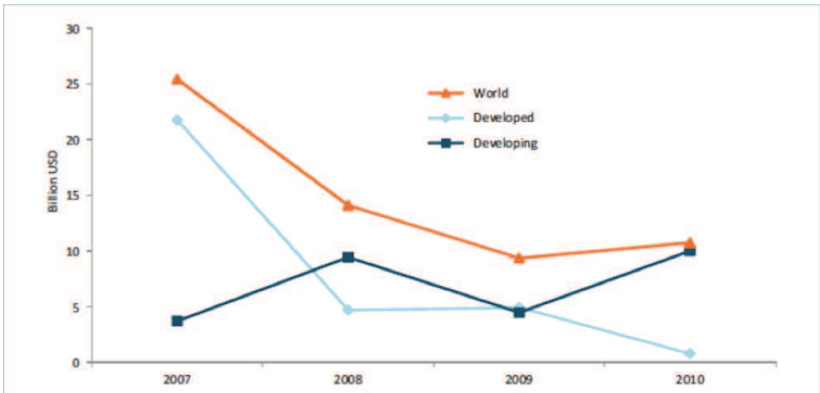
countries are fulfilling basic communication needs at this stage. Data usage is still at infancy stage (3G deployment remains limited and urban areas-focused). Low literacy rate does not facilitate the usage of the Internet and rurality is a challenge for operators in terms of coverage and costs, as territory is huge, villages are located far apart and infrastructures underdeveloped.

All these specificities represent great opportunities and challenges for operators as well as for regulators and make the issue of telecommunications development in Africa particularly interesting to investigate.

III. Africa: a new territory of investment for international telecom operators

As mentioned earlier, there has been an increase in foreign investments inflows to Africa in the past decade: This phenomenon includes of course the telecommunication sector, whether it is in the development of infrastructures (sub-marine cables, terrestrial networks) or in the telecom services. The chart below *(Chart 7)* clearly shows the decrease of Foreign Direct Investments in telecom services in the developed countries and the up trend they take in the developing countries.

Chart 7: FDI inflows in telecom services
Source: ITU, 2010

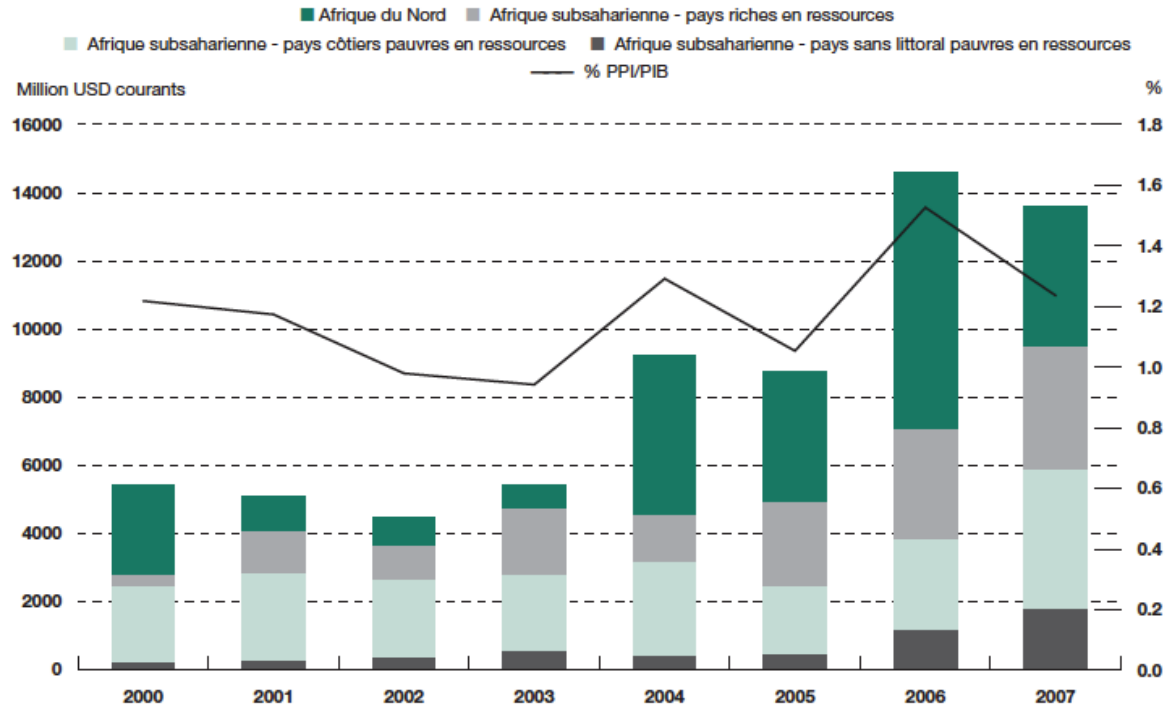


Source: ITU, based on data from UNCTAD, OECD and ITU.
Note: Trends are based on a dataset of 49 economies with complete data series for the entire period and representing almost two-thirds (63 per cent) of global GDP in 2010. Included were 21 developed economies (accounting for 74 per cent of developed economies' 2010 GDP) and 28 developing economies (accounting for 42 per cent of developing economies' 2010 GDP). Aggregates were used to calculate trends rather than to estimate absolute figures.

During the 2000s – as stated earlier - the generalization of telecommunications in Africa was supported by international organizations (World Bank, IMF…). In parallel, private

investment was encouraged to sustain economic growth and development. Ramamurti (2004) states that around one third of FDI inflows to emerging countries in the 1990s was related to privatization of infrastructure sectors (power, water, transportation and telecommunications). The chart below *(Chart 8)* shows the increase in private investment in the African telecommunication sector over 2000-2007.

Chart 8: Private sector in African telecommunications
Source: Perspectives Economiques en Afrique, www.africaneconomicoutlook.org



Source : Base de données de la Banque mondiale sur la participation du secteur privé aux infrastructures (PPI), 2007.

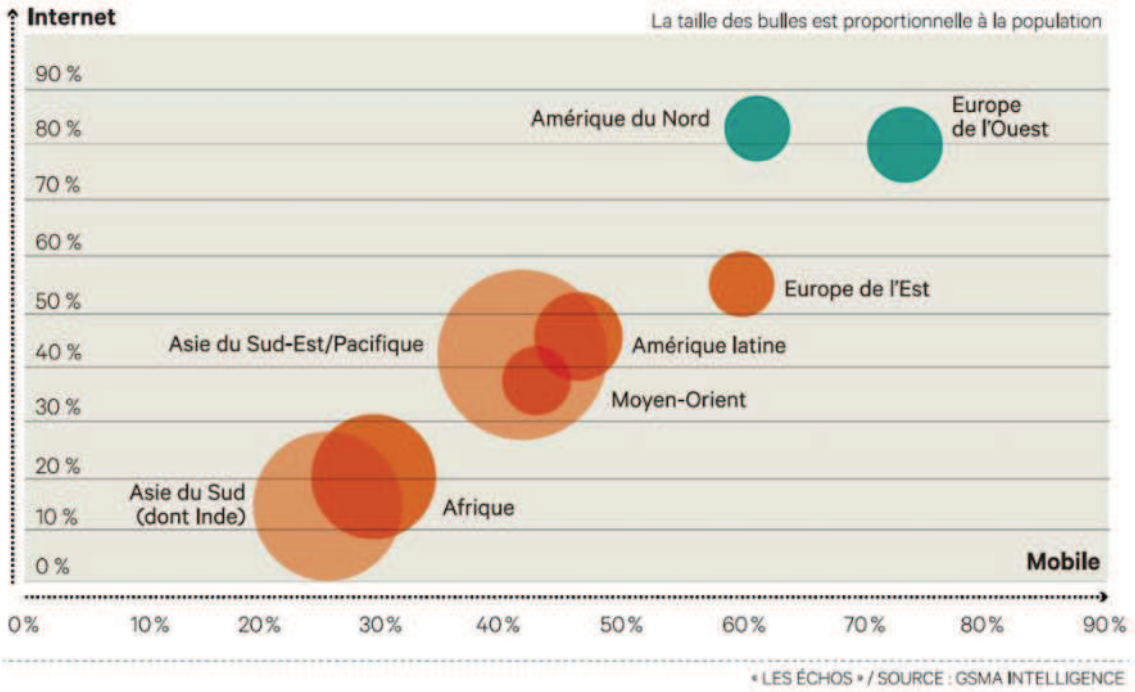
"Multinational Telecommunications Companies" (MTC) have strongly participated in investing in Africa. Some of them come from Middle East and Europe, where telecom markets have come to saturation in terms of subscribers base: All Western Europe countries are above 100% mobile penetration rate (from 101.8% in France to 123.1% in UK, 124.7% in Spain, 127.3% in Germany 167.1% in Finland and even 190.3% in Cyprus[18]) as well as

[18] 2Q 2011 data (Informa WCIS September 2011)

in Middle East countries (178.5% in Saudi Arabia and around 150% in Qatar, Kuweit and UAE[19]). *Chart 9* shows both the penetration of mobile and Internet services in regions of the world. The size of the bubbles represents the size of the population. This chart illustrates quite well the comparison of growth potential between developed regions (including North America and Western Europe) and developing regions (such as South Asia and Africa). Western Europe is also declining in terms of revenues: Its total mobile market has come from 154.9Bn€ in 2007 to 145Bn€ in 2011[20]. Finding growth drivers on their own (mature and competitive) markets has indeed become quite complex. This is why these MTC have been looking for new sources of growth and chose - among other strategies - to invest in emerging economies and heavily rely on them for growth. For instance, Deutsche Telekom (Germany) has invested in Latin America and Asia, Telefonica (Spain) and América Móvil (Mexico) in Latin America, Telia Sonera (Sweden) in Eastern Europe and Asia. This enables them to exploit their own skills and know-how in less mature markets and to take the opportunity to develop new services responding to local usages.

[19] Idem
[20] Yankee Group – Global Mobile Forecast (September 2011)

Chart 9: Mobile and Internet penetration by region
Source: GSMA Intelligence[21]



This new strategy of MTC has deeply transformed the African mobile landscape. Today, the African mobile telecom sector is made - to a large extent - by these MTC from Europe, Middle East and India, which have chosen to invest on the continent, attracted by the growth of the sector. Most of these MTC that share the African telecommunications market are among the biggest MTC in the world. *Table 1* presents the market capitalization of some of these investors on the African market as well as the capitalization of some other European MTC so as to give a range of values. Market capitalization, also called market value, is the "total dollar market value of all of a company's outstanding shares. [It] is calculated by multiplying a company's shares outstanding by the current market price of one share. The investment community uses this figure to determine a company's size, as

[21] Press article Les Echos (access Nov.14th 2014):
http://www.lesechos.fr/journal20141009/lec2_high_tech_et_medias/0203841327925-ces-territoires-que-le-mobile-peine-encore-a-conquerir-1051529.php

opposed to sales or total asset figures."[22] Companies with the largest market capitalizations are above $10 billion, 'mid caps' are between $2 billion and $10 billion and 'small cap' are less than $2 billion. It is interesting to underline here the comparable sizes of MTC from Africa (MTN, Vodacom) and some MTC from Europe (Orange, SFR).

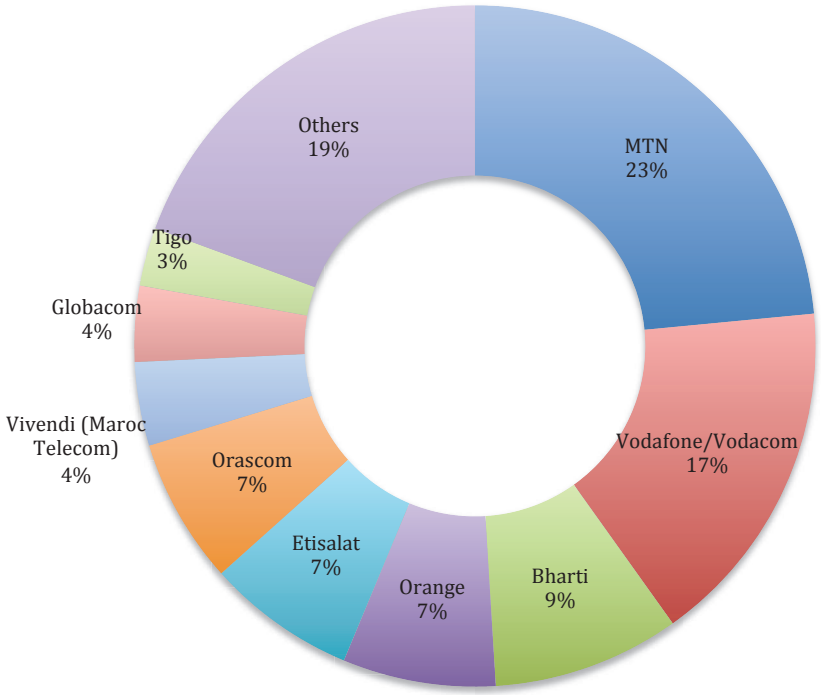
Table 1: Market capitalization of some MTC (April 2014)
Source: Google Finance & Stock exchange websites

Company	Code ticker	Exchange	Market cap (mUS$) April 2014
Vodafone	VOD:LN	Euronext	95 540
Telefonica	TEF:US	OTC US	73 043
Deutsche Telecom	DTEGY:US	OTC US	70 060
Orange	FTE	Euronext	38 280
MTN	MTNO.Y	Johannesburg	38 180
Vivendi (SFR)	VIV:FP	Euronext	37 214
Etisalat	ETISALAT	Bahrein	24 752
Bharti Airtel	BHARTIARTL	Nigeria	21 720
Vodacom	VOD	Johannesburg	19 690
Iliad	ILD:FP	Euronext	15 946
Bouygues SA	BOUYY:FP	Euronext	12 896
Maroc Telecom	IAM	Casablanca	10 838
Millicom	MICC	Nasdaq	10 230
Orascom Telecom Holding (OT)	ORTE / ORTE.CA	Cairo	6 389
Numéricable	NUM:FP	Euronext	5 160
Sudatel	SUDATEL	Bahrein	355

Today, big African operators like MTN (South Africa) and Orascom[23] share the African markets with Middle East (Etisalat) and Indian players (Bharti Airtel), with the British Vodafone (and its South African subsidiary Vodacom) and the French Orange. Millicom Tigo is based in Luxembourg; it is a subsidiary of the Swedish investment company Kinnevik. It is dedicated to emerging markets, operating in Latin America and Africa. MTN, Vodafone (including its African subsidiary Vodacom) and Bharti Airtel gather 50% of total subscribers in the Africa Middle East region (*Chart 10)*.

[22] Source : Investopedia
[23] Orascom, Egyptian operator, had its international assets bought in 2011 by Vimpelcom (Russia) and Maroc Telecom.

Chart 10: MNOs market shares (mobile subscribers)
Africa Middle East region, Q2 2010
(Source: Pyramid Research)



The table below *(Table 2)* presents these 9 biggest MTC that operate in the Africa Middle East region (80% of mobile subscribers).

Table 2: Largest MTC of Africa (2011)

MTC	Country of origin	African footprint (2011)	Brands
MTN	South Africa	Benin, Botswana, Cameroon, Congo, Côte d'Ivoire, Ghana, Guinea Republic, Guinea Bissau, Liberia, Nigeria, Rwanda, South Africa, Sudan, Swaziland, Uganda, Zambia	MTN
Vodafone	UK	DRC, Egypt, Ghana, Kenya, Lesotho, Mozambique, South Africa, Tanzania	Vodacom, Safaricom
Bharti Airtel	India	Burkina Faso, Chad, Congo, DRC, Gabon, Ghana, Kenya, Madagascar, Malawi, Niger, Nigeria, Rwanda (since 2012), Sierra Leone, Tanzania, Uganda, Zambia	Airtel, Zain, Celtel
Orange	France	Botswana, Cameroon, Central Arican Republic, Côte d'Ivoire, Egypt, Equatorial Guinea, Guinea Republic, Guinea Bissau, Kenya, Madagascar, Mali, Mauritius, Morroco, Niger, Senegal, Tunisia, Uganda	Orange
Etisalat	United Arab Emirates	Benin, Central African Republic, Côte d'Ivoire, Egypt, Gabon, Niger, Nigeria, Sudan, Tanzania, Togo	Moov, Telecel, Atlantique Telecom, Zantel
Orascom	Egypt	Algeria, Burundi, Central African Republic, Egypt, Namibia (sold), Tunisia (sold), Zimbabwe	OTA, Leo, Telecel, Mobinil
Vivendi (Maroc Telecom)	France/Maroc	Burkina Faso, Gabon, Mali, Morocco, Mauritania	Telmob, Malitel, Mauritel
Globacom	Nigeria	Benin, Ghana, Nigeria, South Africa	Glo
Millicom Tigo	Luxembourg (Sweden: Kinnevik)	Chad, DRC, Ghana, Mauritius, Rwanda, Senegal, Tanzania	Tigo

It is about this context of international investment in African telecommunications that our research issue has been developed.

IV. Problem statement and research issue

In order to meet its financial, industrial and strategic goals, an MTC has to analyse and forecast what will be its profitability, its growth, its opportunities of international development, etc. Two types of growth strategies are used in parallel: internal and external growth.

Internal growth (also called organic growth) consists of increasing turnover, by relying on its own resources and reinvesting its own profit. It can be, for instance, targeting more attractive customers, developing traditional markets, new value added services or new products (3G, mobile internet, convergence, etc.).

External growth is another strategy for MTCs. It includes implementing mergers and acquisitions (M&A) or signing up strategic alliances with other companies (joint-ventures, partnerships, etc.). It can also be acquiring a mobile license in a country where the MTC does not operate yet. As in some other sectors (e.g. retail trade industry in some European

countries), telecommunications market entry is regulated. The MTC needs indeed to be granted a license, which is an authorisation by country authorities to provide telecommunication services or operate telecom facilities. This market entry regulation is differentiated according to the country of entry. For example, in Europe, regulation on mobile market entry is enforced, whereas regulation on fixed market entry is more flexible. In Africa, regulation is enforced both on mobile and fixed markets.
This research focuses on two types of external growths for an MTC to enter an African market: acquiring a license in the country and acquiring a local operator through an M&A. If the MTC buys its 'entry ticket' to the country by bidding for a license, it will have to build its network then. This is called a 'greenfield' operation. In the case of the MTC acquiring an existing operator that already holds this 'entry ticket', either the target already owns its proper network or its network is hardly developed and the investor will have to develop it.

Thus, in order to enter the African telecom markets – that are very attractive markets in terms of international development opportunities – MTC either bid for new licences and start operations from scratch or acquire local operators that already exist (either state-owned or private).

These agreements have recently reached high amounts of money, particularly when investments are made in Maghreb. In 2010, Orange (France) acquired 40% of Meditel (Marocco) for 640m€ and VimpelCom (Russia) acquired 51,7% of Orascom Telecom (Egypt) for 5Bn€. Regarding licenses, Etisalat acquired the third license in Egypt for 2.3Bn€ in 2006 and Orascom got a 2G licence in Algeria in 2001 for 579m€.

In sub-Saharan Africa, the biggest deal was closed in 2010, when Bharti Airtel (India) acquired African assets of Zain (Koweit) for 8Bn€. Previously in 2009, Vodafone acquired 70% of Ghana Telecom for 572m€ and Orange acquired 51% of Telkom Kenya for 390m€ in 2007. Moreover, many observers have recently noted there were large disparities in prices of 3G licenses awarded between African countries: prices strongly differ from one country to the other[24] *(Table 3)*.

[24] Balancing Act, Issue n°524, Oct.1st, 2010, "3G license prices in Africa: How are they set?" http://www.balancingact-africa.com/news/en/issue-no-524

Table 3: Examples of 3G licenses awarded in sub-Saharan Africa
Sources: WCIS, World Bank

Country	Award date	Number of licenses awarded	Total license fees (million US$)	License fees/capita (US$)	License fees/subscriber (US$)	License fees to GDP ratio (%)
Nigeria	2007	4[25]	600 (150 each)	4.1	14.4	0.36%
Ghana	2009	3[26]	450 (150 each)	19.3	29.9	5.5%
Kenya	2009	3[27]	30 (10 each)	0.8	1.5	0.17%

These amounts have initially been determined by the stakeholders and then possibly discussed in the framework of a negotiation process. They are based on the initial valuation of the asset – whether it is an operator or a license that is acquired.

On the MTC's side, its decision of how much capital will be spent on the investment opportunity (acquisition of an operator or of a license) is based on the future profit perspectives of this investment, including of course environmental factors. Before making the decision, - and besides contractual specifications and obligations - the investing MTC studies local consumption metrics (ARPU, minute per user, etc.), demographics, regulatory context, competitive landscape, etc. In its analysis, it also takes into account uncertainties and risks (that can be related to local market, institutions, regulation, corruption, etc.) - particularly strong when investing in a developing country. Assessing these environmental factors can be a delicate task. Some host country and market characteristics (such as

[25] Celtel, Globacom, MTN, Alheri (license then sold to Etisalat in 2010)
[26] Millicom Tigo, MTN, Vodafone
[27] Airtel, Telekom Kenya (Orange), Vodafone

country population and market penetration) might be easier to assess than others (e.g. political and civil instability). It appears indeed to be tricky for an MTC to reflect risks at best in its valuation, mainly because the investor is not always aware of them (some risks are unpredictable or even hidden). The information asymmetry is increased in the case of cross-borders acquisitions and can be even stronger when investing in developing countries for many reasons.

On local institutions' side (governments and regulatory bodies), they hardly intervene in M&A (Mergers & Acquisitions) deals' valuation, except when the government itself is a stakeholder of the acquired operator. For licences awards however, host country's institutions are a major stakeholder, as they also have to assess the value of the license to be awarded and are the beneficiary of the amount paid.

Valuation is the most important part of an acquisition process (Roll, 1986). A "fair" valuation is indeed important, on one hand for the deal's stakeholders and on the other hand for the country as international investments' host.
First of all, making a deep evaluation of strengths and weaknesses of the target and paying the right price is a critical success factor for M&A (Muwonge, 2007): If target valuation is wrong, an overpayment will lead to a loss for shareholders of the acquiring firm (undervaluation of risks can lead to important financial difficulties or investment failures) and an underpayment to a loss for shareholders of the acquired firm. Following cases about Kenya and the Arab Spring *(Boxes 2 & 3)* show examples of the difficulty of a target assessment.

Box 2: Orange in Kenya

In 2007, France Télécom acquired 51% stakes in the Kenyan incumbent, Telkom Kenya, for USD300m and possibly under-evaluated risk. The Kenyan State is the other shareholder with 49% stakes in Telkom Kenya (3,2% market share in 2011), but also has stakes in Telkom's competitor Safaricom (market leader with 72% market share in 2011).

France Télécom has had to face many types of risks here and it had not subscribed any MIGA insurance on this case because Kenya was considered to be a politically stable country.

First of all, **civil war** started three months after the investment, leading to some network destructions (as the incumbent, Telkom Kenya was considered as representing the State and thus a target for protestors). Secondly, France Télécom threatened to withdraw its investment after a **failure to trace certain assets** that were in the books at the time of purchase. Almost 80% of positions were overestimated FTE, which created a serious problem of lack of skills. Also, there were finally less fixed subscribers than indicated in the books. France Télécom had asked for access to Information Network during the due diligence in order to get a view on the number of active cards of Telkom Kenya, but access had not been given. But most of all, the government's behaviour was a real issue for Orange in this acquisition. Being a shareholder of Telkom Kenya and of the market leader Safaricom, the Kenyan state has a tendency to decide a regulation in favour of the market leader, to the detriment of smaller competitors. A **regulatory risk** to face for France Télécom was the drop in costs of call termination, that were initially asymmetric and in favour of Telkom Kenya. Finally, on a **commercial point of view**, a price war started on the mobile market (price per minute) after the acquisition of Zain by Bharti in 2010, in a country where there is a large market power of Safaricom, Telkom Kenya being a challenger. The entry of Bharti on the market, with its low cost strategy, dropped prices for around 50%, destroying value only 3 years after the entry of France Telecom into Telkom Kenya's capital.

Based on DCF and comparables, Telkom Kenya's enterprise value could be assessed today between USD100m and USD150m. The French Group has put its stake in Telkom Kenya for sale in October 2013. Viettel Group (Vietnam) was interested but has withdrawn its offer end of 2014.

Source: MIGA, J. Zelmanovitch (VP M&A Orange Group), D. Saint-Jean (former CEO Orange Kenya)

Box 3: The Arab Spring

The Arab Spring was a series of protest movements that occurred in some Arab countries, starting in December 2010 in Tunisia. These events have been an important risk for operators that have invested in these countries. Northern Africa was considered as a quite stable area of investment, compared to other African countries. France Télécom/Orange had stakes in Tunisia and Egypt. Even if risks had been anticipated and taken into account in the valuation (with for example a WACC at 21% for Egypt), the Orange Groupe faced bad financial results in both countries: 50% less profit than budget in Tunisia and first losses in Egypt.

Source: J. Zelmanovitch (VP M&A Orange Group)

Then, disparities between deals' amounts such as the 3G licences example *(Table 3)* – if not rationally justified - might lead to scepticism of foreign investors about the "real" value of a license and to reluctance to apply for those.

The valuation issue in emerging countries has become an important and challenging topic in business research: "How do *best practitioners* value investments in emerging markets? Field surveys of *best practitioners* in emerging markets would yield fruitful insight into the way that projects are evaluated and firms are valued in these markets" (Bruner & al., 2002). And this is particularly more challenging for the analyst than in a developed country (Damodaran, 2009), mainly due to the specificities and risks inherent to emerging countries.
Moreover, if this valuation issue is of interest for MTC, it might thus be also of particular interest for governance & regulatory bodies in developing countries: "flows to emerging countries are large enough that improved valuation practices could have a material impact on the welfare of investors and their targeted investments. Not to be ignored is also humanitarian consideration: better valuation practices may enhance the flow of investment capital, the allocation of resources, and thereby increase social welfare in emerging markets." (Bruner & al., 2002)

In sub-Saharan Africa, on one hand, cases of undervaluation have occured for some licences, when the mobile market potential and thus the value of the licences awarded have been underevaluated. On the other hand, the cases of over-investment might be due to:

- A strategic choice of the MTC (ex. Sudatel's 2G licence in Mauritania – *Box 8*)
- An undervaluation of risks (ex. Orange in Kenya – *Box 2* Arab Spring – *Box 3*)
- A government's opportunistic attitude (for example favoritism towards the incumbent operator – *Box 4* Orange CAR - or opportunistic behaviour towards a profitable sector by fixing high licence prices like for 3G licences in Burkina Faso)

These wrong assessments are made to the detriment of stakeholders, of the market and of final customers; hence the importance of a relevant integration of « local » factors[28] in the valuation of deals' amounts.

Box 4: Orange in Central African Republic

In April 2007, France Télécom Group is granted a mobile and Internet license in Central African Republic, but misjudges regulation risks. At that time, the government significantly increases revenue share and favours the incumbent (Socatel) on many aspects: 10Mhz spectrum are offered (on 900Mhz and 1800Mhz spectrum bands), a 3G license is granted for free, distribution points of sales are granted in administration offices and subsidies (availability of unbilled state agents). France Télécom had previously taken a MIGA (Multilateral Investment Guarantee Agency) insurance for this investment. MIGA is part of World Bank Group and its mission is to 'promote Foreign Direct Investment into developing countries' by providing investment insurance against non-commercial risks. In this case, France Télécom was insured against these brutal changes in regulation as well as against expropriation. Nevertheless, implementation of insurance – following the changes in regulation - has turned out to be complicated and the French group has kept losing several dozens million euros per year in this country.

Source: J. Zelmanovitch, VP M&A Orange Group

[28] 'Local' factors relate to the country and market factors that potentially impact the level of FDI (the amount of investment by the MTC) in a sub-Saharan country. They will be detailed later on in the document.

In this African market context of high growth and uncertainties, one could legitimately wonder to what extent the deal amounts are linked to the country- & market-contexts and to their growth potential. The main issue of this thesis is to investigate what have been the determinants of these deal amounts.

The objective is to identify the links between prices paid by MTC for acquiring assets (operators or licences) and local factors (host country characteristics), first in MTC's theoretical rationale when making their valuation, then in the reality of acquisitions of operators and licences in sub-Saharan Africa over the decade 2000-2010 (The scope will be detailed below).

Thus the research question is the following: "To what extent 'local' factors (characteristics and risks of the host country and of its telecom market) have an impact on the valuation of telecom investments in sub-Saharan Africa?"

Regarding MTCs' investments made in Africa in the past few years, cases of undervaluation, overvaluation and disparities between deals have been observed. General hypothesis is made that there have been mixed deals' valuations (overevaluations and underevaluations) in the African telecom sector over the decade. An analytical approach based on an inductive method has been chosen: As from the amounts of existing deals and the local factors associated to each deal, we have attempted to modelize an existing link between both.

The sub-objectives of the research are to:

- Understand MTC's rationale when they valuate a telecom asset in Africa, particularly regarding characteristics and risks of the host country and market,
- Identify the factors that should theoretically be taken into account in such a valuation,
- And understand what factors are taken into account in practice.

The related research questions are:

- What are the existing valuation methods for operators' and licenses' valuation in the telecom sector in sub-Saharan Africa?
- What local factors do operators face when investing in sub-Saharan Africa?
- What local factors impact telecom asset's valuation in sub-Saharan Africa?

To answer these questions, an original corpus has been developed: a database gathering quantitative and qualitative data on acquisitions in the mobile sector (local operators' acquisitions and licences awards) in sub-Saharan Africa between 2000 & 2010, including information on the context of deals. Other corpus elements have been gathered, such as a simple generic business model of a telecom investment (for the acquisition of an operator or a license) and a classification of the factors impacting a telecom investment in Africa.

Data sources used to create the corpus are literature (research papers and theory), archives (reports, studies and databases) and discussions (regulatory bodies, MTC, international organisations).

The research output is made up of the 'local' factors that are taken into account in the deal amounts – for licences and for acquisitions of operators – and a model explaining the relationship between deal amounts and 'local' factors.

V. Scope of research

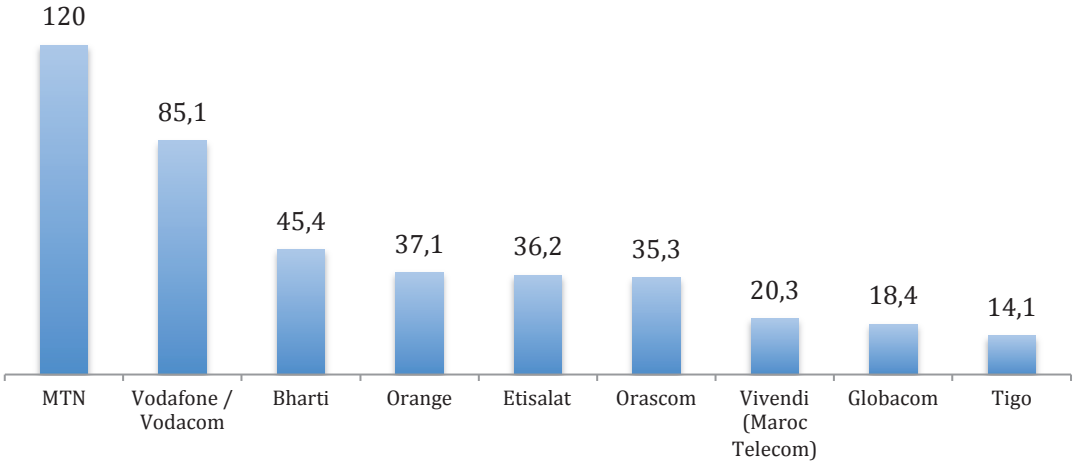
a) Multinational Telecommunications Companies in the mobile market

In sub-Saharan Africa, two types of operators share the telecommunications market: MTC (Multinational Telecommunications Companies) and local operators.
The MTC dominate the African market. They operate transnationally to and in Africa, coming from other African countries (MTN), from Europe (Vodafone, Millicom Tigo…), the Persian Gulf (Etisalat) and India (Bharti Airtel). These large investor groups have the financial ability to invest abroad and make choices between entry modes in a country.
Local operators such as Camtel (Cameroon), Comores Telecom (Comoros) and Visafone Communications (Nigeria[29]) hold a smaller share of the African market. Their financing issues are different: cash management and network investment are for example more difficult for them.
This research focuses on the investments of MTCs that have already invested in Africa.

[29] 4,2% market share, June 2009

As shown in *Charts 10 and 11*, nine MTC gather 80% of the 511 million Africa Middle East subscribers (2010). MTN, Vodafone (including its subsidiary Vodacom) and Bharti Airtel are the main groups operating in this region, with 50% of total subscribers.

Chart 11: Mobile subscribers (in million)
Africa Middle East – Q2 2010
(Source: Pyramid Research)



Scope of research includes these nine MTCs. Essar and Sudatel have also been included because of the significant acquisitions they have made on the African continent over the period studied. Essar has acquired Warid Telecom African assets in Uganda and Congo in 2009 for 160m$ (which it then sold in 2011). Sudatel has made many acquisitions between 2006 and 2009: acquisitions of operators in Nigeria, Ghana and Sierra Leone, as well as acquisitions of licenses including high bids in Mauritania for 100.7m$ and in Senegal for 205m$.

Thus, scope of research covers 11 MTC operating in sub-Saharan Africa:

- Four from Africa: MTN, Orascom, Globacom, Sudatel
- Four from Europe: Vodafone (including Vodacom), France Télécom (Orange), Tigo (Millicom), Vivendi (Maroc Telecom)
- Two from India: Bharti Airtel, Essar Communications
- One from Persian Gulf: Etisalat

b) **Types of investments covered**

A definition of investment is the following: "the allocation of capital to a proposal whose benefits are to be realized in the future" (Van Horne, 2008). When entering a country, an MTC has the opportunity to either bid for a license (and thus buy its 'entry ticket' to the country) or acquire an existing operator that already holds this 'entry ticket'.

This thesis focuses on these two types of investments made by MTC in Africa: acquisitions of a license and acquisitions of a local operator.

A license is an authorization granted to an operator (the 'licensee') by the regulation authorities of a country to operate a network (operating licensing), in order to provide telecommunications services to the public or to use radio frequencies (spectrum licensing). It also defines the terms and conditions of the agreement, and the rights and obligations of the licensee. Objectives of the regulatory authorities are multiple there: regulating the market activity and protecting the public interests (by promoting investment and equity on the telecommunications market) and being able to allocate and manage scarce resources. The thesis only covers mobile national licenses and does not include Long-Distance International licenses, such as the one Glo acquired in November 2009 in Côte d'Ivoire. Mobile licenses are usually dedicated to one technology: GSM, GPRS, UMTS, etc. *(Table 4)*. Recently in some African countries, some technology neutral licenses have been granted. They allow 'any noninterfering technology to be used in the specified band, leav[ing] operators free to evolve their services as the technology advances.' (Source: GSMA). *Box 5* details the different steps of a license acquisition.

Table 4: Mobile technologies

Mobile Telephony Generation	Technology
1G	NMT (Nordic Mobile Telephone), AMPS (Advanced Mobile Phone System)
2G	GSM (Global System for Mobile Communication)
2.5G	GPRS (General Packet Radio Service)
2.75G	EDGE (Enhanced Data Rate for GSM Evolution) – based on existing GSM
3G	UMTS (Universal Mobile Telecommunication System)
3.5G (3G+)	HSDPA (High Speed Downlink Packet Access)
3.75G	HSUPA (High Speed Uplink Packet Access)
3.9G	LTE (Long-Term Evolution)
4G	LTE (Long-Term Evolution - Advanced)

Box 5: The different steps of the award of a license

As we said above, license acquisition is mandatory for a telecom market entry in any country. If the MTC acquires a local operator, its license is part of the deal. If the MTC decides to enter the country by making a *greenfield* investment, local authorities requires the MTC to buy a license. This will be an official authorization to the MTC to provide telecom services or operate telecom facilities in the country.

Awarding licenses can be made by different mechanisms that are usually competitive because the resource (radio frequency spectrum) is considered as scarce. It can be made through (Börgers, 2003):

- An **auction**: License price is based on the bids and the license is awarded to the competing operator that has made the highest bid
- Or a **beauty contest**: Competing operators submit a business plan that will be examined by the government. The government then assigns the license to the selected operator and fixes its price.

Fees structures of a license can be a one-off fee or a recurring fee (annual fee or example).
Getting a license is not only a right, but it comes with a **set of constraints**, that are aimed at making sure that the licensee will exploit the license and will not let customers without service. These constraints can typically be the following ones:

- Non-transferability of license: The operator is not allowed to resell the license.
- 'Performance bonds': The operator must achieve a degree of coverage (of territory, of population) within a timeframe, both specified in the contract. The operator must achieve the objectives of investment.

The acquisition of a license by an MTC has quite similar steps to the acquisition of an operator.

- An 'Expression of Interest' is sent by the government, so that companies interested in bidding can let it know
- A pre-qualification step based on financial & legal criteria
- 'Invitation to tender' is sent, including an information memorandum. This step implies, on the bidder's side, a due diligence and preparation of its offer (business plan, technical, financial and marketing aspects)
- License is granted; this is the signing step (subject to conditions precedent).
- Then the following months are a negociation phase, the licensee negotiates with the local government license conditions and requirements (usually under a performance bond or a first-demand guarantee)
- Closing step includes signature and effective license award.

Acquisitions of operators relate to M&A ('Mergers & Acquisitions'). A Merger is the result of the consolidation of two companies into one. An Acquisition is made when a company takes over another one (the target) and becomes its owner. In the case of MTCs investing in Africa, it is usually more about Acquisitions than Mergers. When an MTC acquires a local operator, its license can be part of the deal or negotiated separately with the authorities. *Box 6* details the different steps of an operator's acquisition.

Box 6: The different steps of the acquisition of an operator

The **acquisition of an operator** is a long-term and complex process for a MTC, with the objectives of growth and value creation. The acquisition process is made of two main phases:

- The top down phase includes all the steps before the acquisition (from the choice of the target to the final agreement) and is conducted by the top management of the company
- The bottom up phase is the post-acquisition phase, conducted by managers and employees. It includes the integration of both structures (culture, human resources, etc.) to implement synergies.

It might be interesting to take a view here on the different steps of the top down phase (the bottom up phase is not subject of this thesis).

When planning the acquisition of a business (whether a local operator or a license), the investor starts with a **pre-acquisition review**. It must assess its current situation (its financial performance, core competencies, market shares, etc.), its objectives (Should an acquisition be considered?) and the plan to implement its objectives. At this stage, the investor defines the reasons for this decision of acquisition: to create synergies and thus increase its performance and make economies of scale, to diversify its activities or to focus on its core business, to compensate for saturation of its home market and enter new geographies where market is growing, to improve its bargaining power and make savings, etc. For MTCs investing in emerging countries and particularly in Africa, the main reason for investing in local operators and licenses is to benefit from growth of the African telecom market.

Then comes the search and selection of potential targets. **Selection of targets** can be made either based on:

- Market opportunities to seize: e.g. there is a license renewal period in a country, a potential target is currently undervalued, etc.

- Or an assessment of potential targets that meet the acquirer's objectives: e.g. acquiring shares in a local operator, investing in a license and start its network from scratch, etc.).

This step implies to study the country and market on which the potential target operates, its legislation and regulation, competition, and target performance.

Once the target has been selected, the potential investor prepares the assessment of the **target valuation**, which will confirm whether or not the target is a good fit to the acquiring MTC. Valuation methods will be detailed below. **Synergies** are also assessed at this stage: they are sources of value creation either by providing an increased turnover or by enabling economies of scale. The **due diligence process** then enables the buyer to confirm that the different information and data gathered and discussed do correspond to the reality. It includes reviews of operations, strategies, financials, etc. This step enables the buyer to detect any potential anomaly and to define the risks related to the deal (and the possibility to mitigate them).

Then comes the **negociation** step, when the following points must be discussed: assessment of synergies, acquisition premium, payment mode and conditions, management of the new structure).

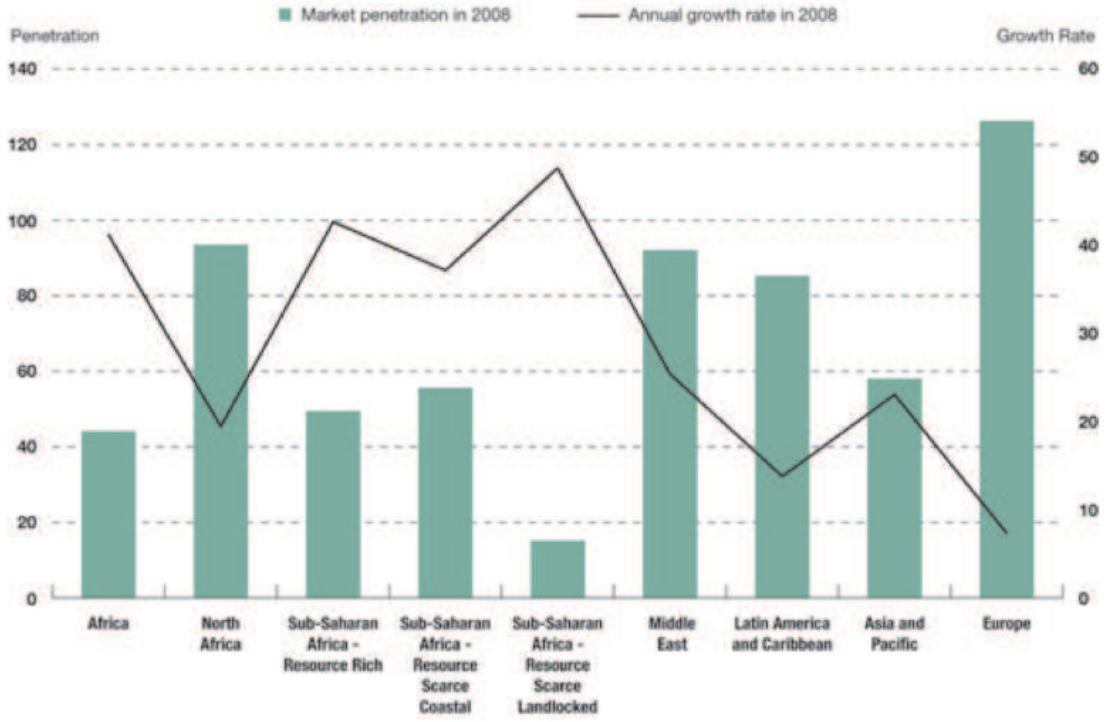
Deal is closed in two steps. Signing step includes signature of a share purchase agreement (subject to conditions precedent). Closing step comes after lifting of all conditions precedent. Stakeholders' majority vote has then been done, regulatory bodies have approved it, existing contracts with customers and suppliers have been transferred to the new entity's name and all legal documents have been signed.

c) Geographical scope

Regarding the geographical scope, this research covers low-income sub-Saharan African countries: This region has the highest growth of fixed and mobile markets with the lowest penetration of fixed, mobile & internet in the world.

Out of 54 African countries (including South Sudan), 35 will be part of the scope. Northern Africa, including Morocco, Algeria, Tunisia, Libya and Egypt are out of the scope: Mobile markets of these countries are more comparable to those of Middle East than to the rest of Africa, in terms of penetration and growth, as shown in the figure below *(Chart 12).*

Chart 12: Market penetration and growth rates for Mobile Telephony
Source: African Economic Outlook[30]



Out of 49 sub-Saharan African countries, choice has been made to consider only low-income countries, with a GDP per capita below 5000$[31]. This means that the following countries are out of the scope: Southern Africa (Angola, Namibia, Botswana, South Africa), Equatorial Guinea, Gabon, Seychelles and Mauritius. Despite their GDP/capita below 5000$, Sao Tome & Principe, Cape Verde, Comoros, Swaziland and Lesotho are also out of the scope because of their particular geographical situation. South Sudan has been considered as one single country with Sudan, as it became an independent state only in 2011. Scope of analysis thus covers 35 low-income sub-Saharan countries.

[30] Source: http://www.africaneconomicoutlook.org/en/in-depth/ict-africa/technology-infrastructure-and-services-in-africa/
[31] Based on World Bank data, 2011

d) **Period covered**

The 2000-2010 period is particularly interesting when it comes to the ICT (Information & Communication Technology) sector in Africa: As described in previous paragraphs, the sector has tremendously evolved over the decade, driven by the mobile sector. The number of mobile subscribers was multiplied by 10 in the world (from 479 million in Dec. 1999 to 4603 million in Dec. 2009) and by more than 60 in Africa (from 7,2 million in Dec. 1999 to 453 million in Dec. 2009). Africa's share of total number of subscribers in the world went from 2% (December 1999) to 10% (December 2009) [32]. Usages have also strongly evolved: In the late 1990s, telecommunications were mainly used for voice telephony, whereas in the late 2000s, telecom usage had progressively diversified with mobile Internet, applications, etc. This fast-paced environment has put some pressure on operators and institutions to constantly adapt and evolve.

VI. Chapters' presentation

The thesis has been structured in five chapters.

Chapter 1, the current chapter, is the **general introduction** of the thesis. It presents the African context of telecommunication markets and how this context has been attractive for MTC investments in the last fifteen years. Chapter 1 introduces the research issue and questions, the corpus that has been developed to address them, the output expected, as well as the scope of research.

Chapter 2 is a **literature review**. The topic of multinational telecom operators investing in Africa is based on various literature bodies in economics and international business. There has been an abundant academic work done about the impact of multinational companies on the socio-economic environment of the host country. The inverse causation – the impact of the host country characteristics on foreign investments – has been studied on a much lesser extent. Moreover, Foreign Direct Investments (FDI) flows to emerging economies have been more and more a subject of research in the 2000s, focusing on Latin America and Asia. Only few studies have looked at Africa as a host destination for FDI. This research background underlines the interest of our research.

Chapter 3 focuses on the **theoretical valuation of telecom assets**, identifying the current methodologies used: the intrinsic valuation (Discounted Cash Flow methodology) and the

[32] WCIS data

relative valuation (multiples & comparables) are often complementary, whereas the contingent claim valuation (real options) is still underused in the sector. Chapter 3 then presents and classifies the different factors – environmental determinants related to the characteristics and the risks of the country and of the local market – that impact the different steps of valuation. This work ends up with the four main hypotheses of our research.

Chapter 4 is the core chapter of the thesis, focusing on **quantitative analyses**. It details the original database that has been prepared during the research process, gathering all acquisition deals made by MTC between 2000 and 2010 in sub-Saharan Africa. This chapter then presents the factors that have been analysed in the different analyses (deal-related, country, local telecom market, governance & regulation, international market factors). It is important to underline here that this research only involves 'local' factors – those linked to the country and the market – and does not look at factors that are specific to the investing MTC (e.g. its strategy) neither to the target (e.g. financial issues proper to the acquired firm). Three types of analyses have been conducted: the statistical analysis in 2 dimensions gives a first approach to the database and the Principal Component Analysis enables to identify the most meaningful variables of our dataset. Based on these first results, a short model of valuation has been developed and multiple regression analysis has been made. Chapter 4 then concludes on research hypotheses and discusses which other factors can explain asset value.

Finally, **Chapter 5** is the general conclusion of the thesis. It summarizes main findings, research limitations and gives some insights for future research.

CHAPTER 2

RESEARCH BACKGROUND & LITERATURE REVIEW

CHAPTER 2: RESEARCH BACKGROUND AND LITERATURE REVIEW

Africa has progressively become a subject of research in the literature in the 2000s, whether it is on a strategy point of view (Hoskisson & al. 2000, Demirbag & al. 2010) or on a regulatory point of view (Berg 2002, Bodammer 2005, Gasmi 2010, Estache & al. 2009). More particularly regarding the telecommunications sector, Africa has proved itself to be an original and interesting area of research (Röller 2001, Benitez & al. 2002, Estache 2005, Iimi 2007) mainly because of the extraordinary growth the sector has experienced in the past fifteen years: The issue of the relationship between the sector and the economic development has been studied in many papers (Easterly & al. 1994, Pohjola 2001, Röller 2001, Baliamoune-Lutz 2003, McNamara 2003, Sachs 2005, Papaioannou 2007, Hosman 2008). Nevertheless, this chapter will show how the literature on telecom asset valuation in Africa is still quite scant.

This issue is at the centre of various literature bodies in economics, international business and finance: it relates to different subjects such as multinational enterprises investment strategies, valuation methods used for investment evaluation, investments in the telecommunication sector, in developing economies, in Africa. Chapter 2 presents a state of the art on these topics and shows on what extent our research question is relevant.

Chapter 2 has been written according to the two main approaches related to our issue:

- The approach of the **international business and economic literature** regarding Foreign Direct Investments (FDI) and Multinational Enterprises (MNE)[33] investments in developing countries
- The approach of the **financial literature** regarding valuation in developing countries

First part summarizes what has been researched and written since the early 2000s about MNE investments abroad, particularly in developing host countries. Second part discusses

[33] In Chapter 2, the term MNE (Multinational Enterprise) is used as it can cover all types of sectors, depending on the study. The rest of the document uses the term MTC (Multinational Telecommunication Company) as it focuses on the telecom sector.

the asset valuation topic regarding the developing countries and the telecommunication sector. Valuation in emerging and developing economies is a more recent issue in the literature.

I. FDI and MNE investments in developing countries

When it comes to determinants of foreign investments, the O.L.I (Ownership, Location, Internalization) has been the most commonly used framework in the international business literature. After explaining what this paradigm is about and how our research has been based on it, this part will then focus on national investments made by MNE - more particularly on the determinants of MNE's entry modes in host countries - and finally on the determinants of foreign investments inflows.

a) The O.L.I paradigm as theoretical framework (J. Dunning)

There has not been any unified theoretical framework on Foreign Direct Investment whether about their determinants or about their impact.
A commonly used theory in the field of foreign investments is the 'eclectic paradigm' of John Dunning (1977[34], 1998, 2000, 2001), also named O.L.I framework: O.L.I for Ownership, Location and Internalization. It states that FDIs are determined by three sets of interdependent variables:

- **'Ownership advantages' (or firm specific advantages)** refer to core competencies of the investing company. To invest and be profitable abroad, a multinational company must have some specific advantages compared to its competitors that will offset the cost of operating abroad. It can be for example a trademark, a patent or a technology specific knowledge.
- **'Location advantages' (or country specific advantages)** refer to host country specific advantages. This relative attractiveness of a country might vary over time. It includes economic advantages (market size, factors of production, availability of raw materials, etc.), political advantages (government policies, specific regulations

[34] Dunning, John H. 1977. "Trade, Location of Economic Activity and the MNE: A Search for an Eclectic Approach." In Bertil Ohlin, Per-Ove Hesselborn, and Per Magnus Wijkman, eds., The International Allocation of Economic Activity. London: Macmillan. The first statement of the OLI approach, later refined and extended in many books and papers by the author and his collaborators.

regarding foreign investments, trade, etc.), social and cultural advantages (cultural distance between home and host country, difference of languages, position towards foreigners and free enterprise).

- **'Internalization advantages'** refer to the advantages of developing its own production rather than relying on a partnership.

If a company has Ownership advantages, it can choose licensing as market entry. If it has Ownership and Internalization advantages, it can choose export to enter the new market. If it has the three categories of advantages – Ownership, Internalization and Locational advantages – the company can choose FDI, as it is the most capital-intensive type of market entry.
This paradigm suggests that the more O and I advantages the firm possesses and the more L advantages of exploiting these O and I advantages, the more FDI will be done. It results in a classification of 4 types of FDI: market-seeking, resource-seeking, efficiency seeking and strategic asset seeking. Market-seeking investments are made to access a market that is attractive in terms of size or growth. Resource-seeking investments are made to exploit local natural resources. Efficiency-seeking investments are made to take advantage of local cost-efficient production conditions (local workforce, infrastructure and administrative costs). Strategic-asset seeking investment aims at taking advantage of man-made assets (qualified workforce, brand name, etc.).

The O.L.I theory was criticized because of its static approach: For example, it does not consider the strategic choices of other local firms on the foreign market. Dunning (1993) attempted to give a dynamic approach to his theory, by introducing the evolution of the three sets of variables, O, L and I, over time. Also, the pure microeconomic approach of the eclectic theory location advantage was also criticized, as it does not take into account the macroeconomic specific advantages of a country relatively to another (Kojima, 1990).

Our present research has focused on the **'L' ('Location') part of the O.L.I paradigm**, applied to foreign investment.
In this thesis, we will name "local factors" the variables that influence the level of FDI inflows from a MNE to a host country. They include economic advantages ("cheap labor and other natural resources, market size and openness of the market, rapidly growing economy, macroeconomic environment and its stability, etc."), as well as political and institutional environments (Stefanovic 2008). These "local factors" will relate, in the rest of

the document, to country and market factors that potentially impact the level of FDI (the amount of investment by the MNE) in a sub-Saharan country.

b) **MNE foreign investments and market entry strategies**

Entry mode is the way an international company will choose to enter a new foreign market. It is ‘‘a structural agreement that allows a firm to implement its product market strategy in a host country either by carrying out only the marketing operations (i.e. via export modes), or both production and marketing operations there by itself or in partnership with others (contractual modes, joint ventures, wholly owned operations)’’ (Sharma & al. 2004). In international management, entry mode appears to be the third most researched topic behind foreign direct investment and internationalization” (Canabal 2008).
Entry modes can either be equity-based or non-equity based (Tse & al. 1997). Both differ in the level of resources they require, in the level of risk they entail and in their expected return on investment.

- Equity-based entry modes include Joint Ventures (JV) (shared ownership model) and Wholly Owned Subsidiaries (WOS)
- Non-equity entry modes include export and contractual agreements such as licensing.

Our research on telecommunication investments in Africa covers acquisitions of operators in the host country (acquisition) and licenses awarded by the host country (greenfield investment). This is why the present work focuses on **equity-based entry modes** (called solely ‘entry modes’ below).

When a MNE decides to invest equity abroad, it makes then two types of decisions (Ruiz-Moreno, 2007; Dikova & Van Witteloostuijn, 2007)

- Its **entry mode (ownership structure)**: decision between a JV and a WOS
- Its **diversification or establishment mode**: decision between an acquisition and a *greenfield* investment.

Regarding sequential order between the two decisions, there has not been any consensus so far. Some empirical findings show that the entry mode decision is made before the diversification mode decision (Ruiz-Moreno & al. 2007) but some other analyses show the sequential order is not clearly determined (Estrin 2004).

MNE decision of entry modes and diversification modes in a foreign country is an issue of corporate strategy. For a telecom MNE, this foreign investment decision (the choice to invest in a particular country as well as the choice between taking a stake in an existing operator and bidding for a license) is most of the time based on opportunities than on a deliberate choice between investment modes: when a license is to be granted in a particular country, when there is an opportunity of taking stakes in an existing operator, etc. This literature body usually focuses on particular countries but not on particular sectors. No paper has been found specifically on the telecommunication sector. But it remains interesting to investigate what has been found regarding the determinants of MNE entry strategies.

In the international business literature, the issue of **entry mode determinant**s has strongly increased in the last 30 years (Canabal & al., 2008) and has largely been studied in the light of transaction cost theory and of resource-based theory.
According to the **transaction cost theory** (Williamson 1981), the firm will choose the alternative that minimizes its transaction costs (transaction costs are costs incurred by making an economic exchange; in the case of entry modes, costs incurred by the investment & by the entry mode choice). Transaction cost theory does not take into account the factors specific to the host country and to the local environment, considering them as constant or as being 'moderators', more than direct determinants (Yiu & Makino 2002).
According to the **resource-based theory** (Penrose 1959), the firm will make its choice according to its competitive advantage and its specific capabilities: the firm will decide entry mode depending on its existing capabilities, either by deploying them to the host country or by gaining new ones from the host country.[35] [36]
Literature body based on transaction cost and resource-based theories states that the entry mode decision is exclusively based on **determinants that are internal to the investing company**: its corporate strategy (Caves & Mehra 1986, Harzing 2002), its resources and capabilities (Caves 1996, Peng 2001, Anand and Delios, 2002, Luo 2002), its learning

[35] Caves RE. 1996. Economic Analysis and the Multina-tional Corporation (2nd edn). Cambridge University Press: Cambridge, U.K.
[36] Absolute and Relative Resources as Determinants of International Acquisitions; Author(s): Jaideep Anand and Andrew DeliosSource: Strategic Management Journal, Vol. 23, No. 2 (Feb., 2002), pp. 119-134

perspectives (Barkema & Vermeulen 1998) and its need to minimize transaction costs (Hill, Hwang, and Kim, 1990).

In the 2000s, there has been a move towards more research on the **influence of local context** on the entry mode decision. Entry mode choices have increasingly been studied in the light of the **institutional theory** that takes into account the influence of local institutions on this decision (Scott 1987, Coase 1998). This theory has been used to enrich and refine existing results, rather than to replace the transaction cost theory (Brouthers & Brouthers 2000, Meyer & al. 2001, Hitt & al. 2004, Meyer & al. 2009).

Indeed, some studies demonstrate the **impact of both investing firm's characteristics and local context of host country** on the entry mode choice. According to Luo (2001), the nation, the industry, the firm and the project influence the entry mode choice. Working on data of Chinese companies, the authors finds that the JV is preferred (rather than a WOS) by the investor in the following cases: when the investor perceives possible intervention of local government, when there is a high level of uncertainty of the local environment, and when the investor has no or little previous experience in the host country. On the contrary, WOS is preferred (rather than a JV) when intellectual property rights are not protected well in the host country, when the number of firms in the sector is rapidly growing and when the project is led in an open economic region.
These findings have been confirmed by Yiu & Makino (2002). The paper states the importance of using both transaction cost and institutional theories to get relevant results on foreign entry mode choices, by underlying the "significant incremental contribution in explaining entry mode choice decisions" of institutional factors. Based on the study of more than 300 Japanese overseas subsidiaries, the analysis shows that the investing firm chooses an entry mode through a JV, when local "regulative and normative pressures" are high, and when there is an important local ethnocentricity and cultural distance. When the firm has an experience of the host country, when it has a high R&D intensity, it will better choose a WOS investment.

More recently, the **influence of the sole local context and uncertainties** on the entry mode decision has been studied (Meyer & al. 2009, Demirbag & al. 2010), and results confirm some previous ones.
Basing their work on the institutional theory, Meyer & al. (2009) examine how MNE investing in emerging economies make a choice between joint venture, acquisition and

greenfield investment, arguing that local institutions directly affect this strategic choice. The authors test their hypotheses on a cross-country panel of data from India, Vietnam, South Africa and Egypt, to run their multinomial regression model. The results clearly show that the development of local institutions directly impacts entry strategies: the more they are developed in the host country, the most likely the company will go for an acquisition or a greenfield project (therefore a WOS), instead of a JV.

Focusing specifically on MNEs coming from emerging economies, Demirbag & al. (2010) study the role of local uncertainties on the entry mode choice and finds out that JV will be preferred compared to WOS in some particular local contexts. The authors have used the integrated risk management framework of Miller (1992) that we will also use in our research, and have extended it by adding other variables like corruption, based on data gathered from Turkish companies that have invested in Central Asian Republic economies. The most important finding of this paper is the strong relationship between the entry-mode chosen by the investors and the uncertainties of the local environment. Their model brings support to the following hypotheses: Firms will have a preference for a JV over a WOS in the following contexts: when ethical uncertainties are high, when legal uncertainties are high, when intervention risk by the local government (in the various regulations, taxation, pricing, exchange rate…) is important and when corruption level is high. Thus, JV appears to be a more secured choice when local uncertainties are high. In conclusion, "assessments of environmental uncertainties and corruption are critical factors in entry mode decision making for FDI".

More specifically, the literature studying the influence of host country characteristics on the choice between a JV and a WOS finds out that the investing MNC will tend to prefer a JV when competition on the host market is high (Kim & Hwang 1992, Hennart & Larimo 1998, Cui, Jiang & Stening 2007) or when country risk, political and economical uncertainties are high (Brouthers & Brouthers 2000, Cristina & Esteban 2002, Tahir & Larimo 2006, Cui, Jiang & Stening 2007). On the contrary, healthy institutions represent a safe framework for an investor: thus, when clear regulations exist in the host country, the MNC will prefer a WOS (Mutinelli & Piscitello 1998, Pan and Tse 2000, Brouthers 2002, Cui, Jiang & Stening 2007).

Let's now have a look at the literature studying the determinants of **diversification mode:** the choice between acquisition and *greenfield* investment. Here research has more largely studied the MNE characteristics as determinants of its choice than the host country impact. **Characteristics of the investing firm** - such as its experience – are parts of the

determinants of its diversification mode choice. Chang & Rosenzweig (2001) highlights the importance of international experience in the diversification mode choice and states that the MNE will prefer going for a *greenfield* investment when it has a competitive advantage over local firms, when it has experience of international sales and when there is a strong cultural distance between both markets. On the contrary, MNE will prefer go for an acquisition when entering a new product line of business. Kamal (2009) also lays the emphasis on the firm's experience. Their work is based on data of Japanese investments to four countries: Indonesia, Malaysia, Taiwan and Thailand. First, their results underline that both the size of the parent company and the cultural distance have an impact on the choice: Bigger companies will likely go for an acquisition, instead of a *greenfield*; and the bigger the cultural distance, the more the firm will go for a *greenfield* instead of an acquisition. Besides this, firm's experience is also relevant in its choice: When the investing MNE has host country experience, it will be more inclined to start a new venture instead of acquiring an existing one and thus to choose *greenfield* investments. Harzing (2002) states that the diversification mode choice depends on the international strategy of the investing company: acquisitions will be preferred by firm with a multinational strategy (lower global competition and local competition, products adapted to local markets, autonomous subsidiaries) and *greenfield* investment will be chosen by firms that have a global approach (competition globalization, national product markets interconnected, economies of scale).
Brouthers & Brouthers (2000) have included the effects of both the **MNE characteristics and the local context**. They study the impact of variables mixing characteristics of the investing MNE and of the local context (institutional, cultural and transaction cost variables) on the diversification mode choice of a sample of Japanese firms entering Western Europe. Their results show that the company will be more likely to choose a *greenfield* investment (rather than an acquisition) when size of the investment compared to the size of the investing firm is pretty small, when the investing firm is technologically intensive, when the firm has international experience, when market of host country is growing fast, when cultural distance between country of the investing firm and host country is small, when the firm is less diversified, when the firm is risk-averse and when the firm enters the host market with a 'related-product'.

To conclude, there has been a large body of research on the determinants of entry strategies in MNE foreign investments, represented by a binary choice in the literature either between Wholly Owned Subsidiaries vs. Joint-Ventures or between *greenfield* investment vs.

acquisition. The literature has first focused on the characteristics of the investing MNE as determinants of the entry strategy, then on the local context of the host country.
The influence of the host country local context is the one that interests us for our research: It has been a research subject particularly for the choice between WOS and JV.
In the existing literature, there is a **form of consensus on the determinants of the entry-mode choice** (ownership structure): A host country environment that would be less favourable to investment (economical, ethical, legal uncertainties, corruption, possible intervention of government, etc.) influences the investment decision towards a JV instead of a WOS. Indeed, when uncertainties are high, JV appears to be a safer choice to the investor than a WOS: avoiding full ownership enables the investor to be more flexible in case of local changes. On the contrary, MNE tend to go for a full ownership when host country offers fewer uncertainties.

In terms of host countries studied, it appears that **Africa** has not really been researched as a host region in this literature body. Among emerging regions, only China and other Asian countries are part of top 8 (Canabal & White, 2008). Africa thus remains a host region to investigate in terms of FDI and MNE investments.

c) FDI inflows to developing countries and their determinants

i. MNE strategy to developing countries

Research related to firm strategy in emerging countries has been growing in the past decade (Wells 1998, Hoskisson & al. 2000, Meyer 2004, Ramamurti 2004, Wright & al. 2005, Peng 2008). There has been an abundant academic work done about the impact of Multinational Enterprises (MNE) and of FDI (Foreign Direct Investments) on the socio-economic environment of the host country (Meyer 2004, Ramamurti 2004). Most of papers state that FDI contribute to the host country's prosperity and to integrating developing markets into the global economy (UNCTAD 1999).

Research on the reverse causation between MNE and host country environment - the "**impact of developing country context and policies on MNE behaviour**" - has emerged but has remained an issue for future research (Ramamurti, 2004). Uncertainties and risks of the local environment are indeed a critical factor for investment decisions (Demirbag & al. 2010). This is why Meyer (2004) calls for more international business research on the

influence of the context on MNE decisions, in order to better understand the behaviour and the 'inner logic' of MNE in emerging countries.

ii. FDI inflows to developing countries and their determinants

Multinational company investment in the developing countries is part of what is called Foreign Direct Investment. **Foreign Direct Investment (FDI)** is a type of international investment that involves ownership, control position and, most of the time, management in the domestic firm (It can be an acquisition, a joint-venture or a wholly-owned subsidiary). On the contrary, a "foreign indirect investment" – commonly called Foreign Portfolio Investment – is the passive holding of an investment portfolio made of foreign securities (e.g. stocks, bonds). Our research focuses on FDI, as it covers acquisitions by MNE of local operators or of local licences.

Ramamurti (2004) notes "the stock of FDI in developing countries nearly doubled from 1980 to 1990 and has since more than quadrupled, reaching $2340 billion in 2002". He also underlines that FDI has "become the single most important source of foreign capital for these countries, displacing by a wide margin previously popular alternatives, such as official aid and private commercial bank lending." Indeed, **FDI inflows to developing countries** have kept increasing in the 2000s compared to inflows to developed countries and have been more and more a subject of research in the 2000s, focusing on Latin America and Asia. Looking particularly at the telecommunication sector, the almost totality of FDI inflows in telecom services goes to developing countries in 2010 *(Chart 7, FDI inflows in telecom services, ITU, 2010)*, which confirms the relevance of research on this subject.

Research corpus on the determinants of FDI inflows to developing countries generally underlines the prevalence of **political, governance and regulatory framework** of the host country in the MNE investment decision (Wilhelms 1998, Dupasquier & al. 2006, Kirkpatrick & al. 2006, Asiedu 2006, Musonera 2008, Fedderke & al. 2008, Luiz & Stephan 2011).
Indeed, working on a sample of low and middle-income countries between 1990 and 2002, Kirkpatrick & al. (2006) study the relationship between quality of host country regulation and FDI in infrastructure. The authors state that an effective domestic regulatory framework has a positive impact on FDI inflows. On the other hand, a regulation that is vulnerable to capture by the country government or by the private sector is a factor of

reluctance of potential foreign investors to implement large infrastructure projects. This supports Wilhelms' (1998) findings who has worked on 67 emerging economies between 1978 and 1995 and argues that the way institutions, policies and laws are handled in a country is significantly more important on FDI inflows than population size and sociocultural context. Henisz (2000) states that foreign companies are more likely to enter a country with credible political rules and Globerman & Shapiro (2002) show the correlation between host country governance quality and FDI flows.

The research corpus also studies the impact of other determinants on FDI, whether it be on developing or developed countries, such as country size and wealth as well as economic, business and legal environments (Onyeiwu 2004). Empirical results are generally conflicting, as illustrated in *Table 5.*

Table 5: Effect of selected variables on FDI

Determinants of FDI	Positive	Negative	Insignificant
Real GDP per capita	Schneider and Frey (1985) Tsai (1994) Lipsey (1999)	Edwards (1990) Jaspersen, Aylward, and Knox (2000)	Loree and Guisinger (1995) Wei (2000) Hausmann and Fernandez-Arias (2000)
Infrastructure quality	Wheeler and Mody (1992) Kumar (1994) Loree and Guisinger (1995)		
Labor cost	Wheeler and Mody (1992)	Schneider and Frey (1985)	Tsai (1994) Loree and Guisinger (1995) Lipsey (1999)
Openness	Edwards (1990) Gastanaga *et al.* (1998) Hausmann and Fernandez-Arias (2000)		
Taxes and tariffs		Loree and Guisinger (1995) Gastanaga *et al.* (1998) Wei (2000)	Wheeler and Mody (1992) Lipsey (1999)
Political instability		Schneider and Frey (1985) Edwards (1990)	Loree and Guisinger (1995) Jaspersen *et al.* (2000) Hausmann and Fernandez-Arias (2000)

Nevertheless, only some few studies have looked at Africa as a host destination for FDI: The share of sub-Saharan Africa in host developing countries is still very small compared to other regions of the world (Asiedu 2006, Musonera 2008 and *Table 6*).

Table 6: FDI inflows to different regions of the world (1970-2006)
Source: Lahimer, 2009

	Sub-Saharan Africa	East Asia & Pacific	South Asia	Middle East North Africa	OECD	World
In value (Bn current US$)						
1970-1979	0,81	1	0,04	0,66	16,56	21,93
1980-1989	1,3	3,69	0,26	1,16	73,28	91,21
1990-2000	4,36	40,95	2,23	2,15	281,76	396,06
2000-2006	12,23	69,95	9,01	9,77	710,53	982,32
2006	15,41	104,97	22,92	26,55	900,11	1352,44
In % PIB						
1970-1979	0,91	0,3	0,04	0,66	0,46	0,49
1980-1989	0,49	0,74	0,09	0,44	0,64	0,66
1990-2000	1,37	3,4	0,45	0,82	1,26	1,42
2000-2006	2,67	2,85	1,04	1,93	2,51	2,65
2006	2,12	2,92	2	4,19	2,56	2,82

Africa has become an interesting region to study for economic and international business researchers in the past ten years, but it still remains under researched when it comes to FDI.

Asiedu (2006) states that only 5 papers have been found on the Econlit database when searching for the keywords "FDI" and "Africa", and none of them studies the impact of corruption and political risk on FDI.

Nevertheless, the fact that FDI to Africa are much lower than FDI to other emerging economies *(Table 6)* - added to the fact that FDI are generally recognized as contributing to the host country economic and social development (Hosman 2008) - make the subject of the determinants of FDI to sub-Saharan Africa very relevant in terms of research. This topic has started to be researched recently in the literature, since the second half of the 2000s.

Asiedu (2006) analyses a panel data for 22 countries in sub-Saharan Africa over the period 1984–2000, in order to study the determinants of FDI to Africa. Her results supports existing reports of multinational companies operating in Africa: They state that FDI is higher in large and wealthy markets (GDP), in countries with natural resources, low inflation, developed infrastructures, efficient legal system and investment framework; on the contrary, corruption and political instability have a negative effect on FDI promotion.

Musonera (2008) studies the impact of host country factors (**economic, financial and political risks**) over the FDI flows to sub-Saharan African countries between 1990 and 2002. Based on regression analyses, he states that the three types of risks have an impact on the level of FDI into the host country (**political risk having the highest influence**) and that low levels of FDI to a country are due to a risky business and investment environment. Musonera underlines the importance of the role of policy makers in implementing relevant policies in order to minimize country risks: this way, "developing countries can experience more FDI inflows, which in turn would contribute to sustainable economic growth and development."

More recently, **Luiz & Stefan (2011)** have specifically looked at the foreign investments of telecommunication firms from South Africa to sub-Saharan African countries. They examine the main factors that are considered by the firms when planning an investment to sub-Saharan Africa, by using an interview survey process made of written questionnaires and interviews. The authors find out that the most important determinants of this investment decision are **market size, regulatory environment and government policy** (confirming Kazmi & Manarvi 2009). **Market size** is a mix of potential number of customers in the host country and their potential average revenue per user. Regulatory environment refers to the ability of the regulator to create an enabling environment for ICT companies. **Government policy** is a mix of transparency and clarity of investment terms and conditions.

Political stability is an important but not significant factor: Respondents take a longer view and do not see changes in government as a threat for their operations. They add that new governments usually honour previous governments' decisions. **Macro-economic stability** is also important in their decision but not significant, as respondents plan to compensate this instability by their activity growth. **Infrastructure and logistics** are not a significant factor as investing firms have developed their own logistics capacities that enable them to not rely on local ones. **Openness of the local economy** is also an important but not significant factor: Some governments impose local shareholding to foreign investors, but respondents state that they also see advantages in having local partners. Other factors such as **competition**, **governance** (including corruption), **currency** issues, high **investment and operating costs**, **labour** and **cultural** considerations, as well as **project financing** (financial challenges to finance a project) have been found as not significant.

Pigato (2001) and Dupasquier & Osakwe (2006) both point out the deficiencies of the African context in attracting FDI inflows. Pigato (2001) underlines that the legal, business and economic contexts are still inadequate (barriers to entry in certain sectors, discretionary powers maintained in the allocation of investment incentives, poor effectiveness of FDI promotion) and that more competitiveness in investment climate must be developed despite significant improvements. Asiedu (2002) argues that there is a specificity of Africa regarding foreign investments: Her results show that the determinants of FDI to other developing countries are different from those to Africa, suggesting that the African continent is usually "perceived as overly risky".

Dupasquier & Osakwe (2006) argues that the high degree of uncertainty in Africa exposing investors to important risks is one of the reasons for reluctance to invest on the continent: political and macroeconomic instability, lack of policy transparency, corruption and weak governance.

iii. Uncertainties as a critical factor for investments in developing countries

As we said, uncertainties and risks of the local environment are indeed a critical factor for investment decisions in developing countries (Porter 1980, Demirbag 2010), because they are:

- First, an intrinsic issue of investment decisions in general (Dixit and Pindyck, 1994, Savvides 1994)
- And then, specifically high in developing countries where "economic and political shocks have greatly increased the uncertainty and risk for [...] foreign investors." (Hoskisson & al. 2000). Estache & Wren-Lewis (2009) have worked on the

institutional weaknesses of emerging countries: limited regulatory capacity, limited accountability, limited commitment and limited fiscal efficiency.

The notions of risk and uncertainty are quite tricky in terms of definition: The use of terms in the international management literature varies.

F.H.Knight gave the following **definition of risk** (Risk, uncertainty and profit, 1921): "Risk is present when future events occur with measurable probability" Assessing risk is calculating a probability of failure (drain on financial resources in case of an investment) and a probability of success (exceeding breakeven point). Miller (1992) states that: "The strategic management field lacks a generally accepted definition of risk" and defines it as "variation in corporate outcomes or performance that cannot be forecast ex ante".

In the same book, F.H.Knight defined uncertainty the following way: "Uncertainty is present when the likelihood of future events is indefinite or incalculable". Specifically applied to the firm, another **definition of uncertainty** is the "unpredictability of environmental or organizational variables that have an impact on corporate performance". They can have various sources, such as the market (market structure, volatility of demand & supply, volatility and inefficiencies of capital markets), the product and services usages (quite specific for telecoms in Africa), the political, institutional, regulatory, business environments…

To make a link between both notions, one can say that **uncertainty** (whether it is about environmental or organizational variables) reduces predictability of corporate performance, and thus increases **risk** (Miller 1992).

Our research will include a classification of the different factors potentially impacting the telecom asset valuation in sub-Saharan Africa. This classification is based on the theoretical "framework for integrated risk management in international business" by Miller (1992). Miller advocates a multidimensional approach of uncertainties instead of focusing at one type of uncertainty at a time, as it has been done in the international management literature in the past. He proposes a framework for classifying and assessing the range of interrelated uncertainties and proposes different strategic and financial responses to them. Miller defines three categories of uncertainties to be faced by corporate management *(Table 7)*:

- **General environment** (country or regional level of analysis) includes uncertainties linked to political, government policy, macroeconomic, social and natural areas.
- **Industry uncertainties** (market level of analysis) come from input market, product market and competition.

- **Firms uncertainties** are listed as follows: operating, liability, R&D, credit and behavioural.

Table 7: Integrated framework of uncertainties faced by firms operating internationally
Source: Miller (1992)

General environmental uncertainties (country or regional level of analysis)

Political uncertainties	War Revolution Coup d'état Democratic changes in government Other political turmoil
Government policy uncertainties	Fiscal & monetary reforms Price controls Trade restrictions Nationalization Government regulation Barriers to earnings repatriation Inadequate provision of public services
Macroeconomic uncertainties	Inflation Changes in relative prices Foreign exchange rates Interest rates Terms of trade
Social uncertainties	Changing social concerns Social unrest Riots Demonstrations Small-scale terrorist movements
Natural uncertainties	Variations in rainfall Hurricanes Earthquakes Other natural disasters

Industry uncertainties (market level of analysis)

Input market uncertainties	Quality uncertainty Shifts in market supply Changes in the quantity used by other buyers
Product market uncertainties	Changes in consumer tastes Availability of substitute goods Scarcity of complementary goods
Competitive uncertainties	Rivalry among existing competitors New entrants Technological uncertainty (product & process innovation)

Firm uncertainties

Operating uncertainties	Labour uncertainties (labour unrest, employee safety) Input supply uncertainties (raw material shortages, quality changes, spare parts restrictions) Production uncertainties (machine failure, other random production factors)
Liability uncertainties	Product liability Emission of pollutants
R&D uncertainties	Uncertain results from research & development activities
Credit uncertainties	Problem with collectibles
Behavioural uncertainties	Managerial or employee self-interested behaviour

This framework has been adapted to telecommunication international investments in Chapter 3.

d) Conclusion

The economic and international business literature has addressed the issue of foreign investments at two different angles: regarding the entry mode (binary choice) and regarding the level of FDI inflows (in absolute terms).

The present research has been based on the **Location axis of the O.L.I** (Ownership, Location, Internalization) framework (Dunning), as it focuses on the **"local" factors** that impact the investment decision and asset valuation (determinants related to country macroeconomics, politics, governance, regulation, etc.).

The present research has used the **Miller's classification of uncertainties** to develop a specific classification of the potential factors influencing investment decision and telecom asset valuation.

The issue of determinants of foreign investments has been developed in the 2000s decade and more focus has been made on developing countries in the last ten years. A large body

of literature has studied the subject of the influence of the local context on investment decision and two main findings are worth to be noted here:

- When uncertainties are high (economical, governance, etc.), MNE are more likely to choose a joint venture than a wholly owned subsidiary, in order to keep some flexibility in case of local changes.
- Higher FDI inflows are strongly determined by an effective political, governance and regulatory framework.

These issues have been treated scarcely in the existing literature when it comes to Africa and to the telecommunication sector, giving the present work a particularly strong interest. The present research has built on this existing literature to develop its rationale as well as its research hypotheses, and proposes to go further by developing and using an original quantitative corpus.

II. Asset valuation in developing countries

The financial literature has also addressed the issue of valuation of international investments in the developed countries. Theoretical models of valuation have been detailed in Chapter 3: the Discounted Cash Flow methodology, the multiples and comparables, as well as the real option theory. Damodaran (2006) and Wang (2010) have worked on the different valuation methods, emphasizing the need for future research in valuation, given the more and more complex environment in which firms operate.

Research on the more specific issue of **asset valuation in developing countries** has developed more recently, in the late 2000s. Already in 2002, Bruner & al. underlined the importance of working on "best practices" for asset valuation in emerging economies, first because emerging markets are different from developed ones "in areas such as accounting **transparency, liquidity, corruption, volatility, governance, taxes, and transaction costs**" and then because of the increasing international investment flows going to these economies. Some recent papers argue that the most popular valuation methods used in emerging and developing countries remain the traditional ones such as the DCF (Pereiro 2006, Aidamenbor 2008). Other research pieces underlined the risks associated with the asset valuation in emerging countries (Damodaran 2009, Stenfeldt 2010). Damodaran details – in "The dark side of valuation" (2009) - the specific challenges when valuating a company of emerging countries compared to a company of developed countries: currency volatility, country (macroeconomic) risk, political and economic risks, unreliable market

measures, information gaps & accounting differences, corporate governance and discontinuous risk (volatility).
To conclude, the literature argues that the most widely used **valuation method** for investments in developing countries remain the **most traditional ones, such as the DCF**, and underlines the specificities of emerging and developing markets for valuation compared to developed ones.

More specifically on **spectrum license valuation**, some econometric analyses have started to be done, on national 3G European licences. Böhlin & al. (2010) states that winning bids depends on national and mobile market conditions, spectrum package attributes, license process and post-award operator requirements. Lower post-award coverage requirements contribute to a higher deal price.

III. Other topics related to our research

Some additional literature bodies have been investigated during the research process, but appear to be less relevant than the ones detailed above. It concerns the **M&A literature** as our research covers acquisitions of local operators, as well as the **license award literature** as our research also covers licences.

In general, the financial literature that addresses the issues of **Mergers & Acquisitions (M&A)** has largely focused on the **developed countries**. This is particularly the case of literature on M&A and value creation, which focuses mainly on the USA (Weaver 1991, Damodaran 2001, Seth & al., 2002) and, for some papers, on Europe (Cartwright, 2006).
A large body of M&A literature relates to **post-acquisition performance of the firm** first by stating that acquisitions do not enhance the acquiring firm value (Asquith 1983, Malatesta 1983, Agrawal, Jaffe, & Mandelker 1992, Loderer & Martin 1992, King, Dalton, Daily & Covin 2004, Moeller, Schlingemann & Stulz 2003, Seth, Song & Pettit 2002) and secondly by focusing on moderators of acquisition performance (Bower 2001, Zollo and Winter 2002, Devers, Cannella, Reilly & Yoder 2007).
Another literature line on M&A has worked on the **pre-acquisition process**, mainly on motives for mergers (Seth 2000, Uhlenbruck, Hitt, and Semadeni 2006, Puranam and Srikanth 2007, Schilling & Steensma 2002).
Haleblian & al. (2009) propose a review of what has been published regarding M&A in the management, economic and financial literature and criticize the fact that research in this

field has remained fragmented, preventing from reaching a unified M&A theory. The authors state that the literature has focused on the reasons why firms acquire (value creation, management self-interest (value destruction), environmental factors and firm characteristics) and on the factors that moderate acquisition performance (why acquirer do not benefit from acquisition) such as deal characteristics, managerial effect, firm characteristics and environmental factors. They underline the importance of « more deeply assess[ing] the relative merits of established factors and to more clearly understand their relative effects on acquisition decisions and outcomes. » No reference is made to pre-acquisition asset valuation, which confirms the fact that little attention has been given in literature to M&A valuation (Weaver 1991).

Literature on mobile licences and auctions has also been investigated and - as for the M&A literature - it has largely focused on **developed countries** (Ausubel 2002, Klemperer 2002, Jehiel & al. 2003, Börgers & al. 2003, Börgers & al. 2005). Coase (1959) was one of the first to advocate auctions for spectrum.
The auction theory applied to mobile telecommunications has focused on the most efficient way of managing spectrum, particularly on the **license award methods** and on the **interaction between license fees and the evolution of wireless market**.
The **different award methods** have been compared - particularly auctions and beauty contests (Genty 1999, Prat 2000, Börgers 2003) - and auction performance has been analysed (Cramton 2002, Ausubel 2002, Klemperer 2002). Auctions are considered to be a more transparent award method than beauty contests (Cramton 2002). Genty (1999) summarizes research findings in license award methods and underlines that auction may be preferable to beauty contest when "the country is large and with few borders" (Spicer 1996), "the number of licences is large" (McAfee and McMillan 1996, Salant 1997), "many homogeneous bidders participate" (Milgrom 1995, Vickrey 1961, Wilson 1993), "the license is flexible" (Minasian 1975), "the regulator has know-how and ability in auction design" (Milgrom 1995), "many licences have to be awarded at once" (Salant 1997), "the service is new" (McMillan 1995) and that "there is a risk of collusion between the regulator and the applicants" (McMillan 1994, Spicer 1996).
Another body of literature tackles the **interaction between license fees and the evolution of wireless market.** Some studies states that, as license fees are a sunk cost of investment, they do not influence the evolution of the wireless market (Cave & Valetti 2000). Other studies have demonstrated that auctions and license fees contribute to lower the number of

competitors on the market, to increase market price level and slow down network deployment (Noam 1998, Gruber 2001, Bauer 2001).
Nevertheless, working on 3G licencing process in 15 European countries and comparing auctions and beauty contests, Börgers (2003) underlines the **complexity of telecom operators' bidding strategies** and the fact that no pattern has emerged yet on this subject.

These papers and studies have been part of the research process, but have not been used in the present work as they have turned out to be less relevant with our research issue.

IV. Conclusion of Chapter 2

Asset valuation in developing countries has increasingly become a focus of study, but asset valuation in Africa particularly remains an unexplored subject. This issue is at the centre of various literature bodies in economics, international business and finance, that underline the following main findings:

- In a host country where uncertainties are high in terms of economical context, local governance, etc., the investing multinational companies are more likely to choose a "lighter" mode of investment – a joint venture rather a wholly owned subsidiary.
- An effective framework of politics, governance and regulation is a strong determinant of FDI inflows to a host country.

Therefore the literature underlines that a favourable local context in the host country (political, economic, governance, etc.) attracts stronger modes of foreign investments (in terms of ownership) and higher levels of foreign investment inflows.

The literature on asset valuation in developing countries is more recent. It shows that this type of valuation has some specificities in terms of transparency, volatility and governance among others, but methods used remain traditional ones (e.g. DCF method).

These issues have scarcely been treated on Africa and on the telecommunication sector, which makes the present work of particular interest. Telecommunications in Africa have been a subject of study in the economic and business literature when it comes to the link between the telecom sector and the economic development. Nonetheless, Africa has not been yet a subject to research as a host region of international investment. This research will build on this nascent literature to develop its research hypotheses.

CHAPTER 3

THEORETICAL VALUATION OF A TELECOM ASSET IN SUB-SAHARAN AFRICA

CHAPTER 3: THEORETICAL VALUATION OF A TELECOM ASSET IN SUB SAHARAN AFRICA

By investing in sub-Saharan Africa, the objective of MTC is to create value. Creating value is launching a project that includes risks (market, competitive, implementation, regulatory, country risk…), financing this project (by debt or equity: the higher the risk, the higher the cost of financing) and draw from this project a higher return than cost of risk.
A profitable investment is an investment that will increase the value of the economic asset. The value of the economic asset is function of a bet on future. This bet depends on the implementation of a business plan over the coming years, on the different identified risks (listed above) and on the opportunities (technological advantage, strategic advantage, experience, network).

When an MTC explores investment opportunities – either by assessing a particular asset or by comparing values of several assets – it uses valuation methodologies. Investment decision can be for instance to find a trade-off between buying an existing operator and buying a *greenfield* operation (like a license and start a business from scratch).
Roll (1986) states that valuation part is the most important part of the process. Making a deep evaluation of strengths and weaknesses of the target and paying the right price is a critical success factor for M&A (Muwonge, 2007). If target valuation is wrong, the acquirer will overpay for it, which represents a loss for shareholders of the acquiring firm. It is also important to note here that the information asymmetry between the bidder and the target is particularly high in the case of cross-border takeovers. According to the 'hubris hypothesis' (Roll, 1986), bidding managers can make errors and overvalue their targets.

Damodaran (2006) lists three different approaches to valuation:

- **Intrinsic valuation:** Asset value is based on its intrinsic characteristics: "its capacity to generate cash flows and the risks in the cash flows. In its most common form, intrinsic value is computed with a Discounted Cash Flow valuation, with the value of an asset being the present value on expected future cash flows on that asset."

- **Relative valuation:** Asset value is estimated by "looking at the pricing of comparable assets relative to a common variable like earnings, cash flows, book value or sales." Multiples and comparables are the common methodology here.
- **Contingent claim valuation:** It "uses option pricing models to measure the value of assets that share option characteristics". This can be computed by the methodology of real options.

Based on these three approaches, a large number of models can be used to value an asset. Focus will be made here on the three main ones: First, the Discounted Cash Flow method, second the multiples & comparables method and finally the real options method. It is usually recommended to use at least two of them and calculate an average, in order to get the fairest possible result. Wang & Halal (2010) propose a literature review of asset valuation methods including their pros and cons.

Chapter 3 presents the **existing methodologies for asset valuation** and details particularly the Discounted Cash Flow method that is the most widely used in telecom international investments. Based on a Profit & Loss statement of the asset that the MTC plans to acquire (whether it is a local operator or a license), the future value of the asset is evaluated. This chapter will then detail the **various factors** that potentially impact the P&L statement and thus the asset value:

- **Country-related factors** such as demographics, stability, economic, financial, governance and political characteristics and risks
- **Market-related factors** such as competition, demand- and supplier-related factors
- **Factors related to the asset acquired**, whether it comes to operational or financial characteristics and risks.

Chapter 3 is based on a deductive method: As from a generic P&L statement of a telecom asset and the factors impacting this P&L in an African context, we will attempt to identify what main factors influence deal prices. This background work will help developing the **research hypotheses** that we will then test in analyses in Chapter 4.

The sources used to write this chapter have been the financial and international business literature, as well as discussions with operators and financial analysts.

I. Current practices of telecom asset valuation

In order to assess the level of profitability and performance of the asset it plans to acquire (either a local operator or a license), an MTC has several tools at its disposal. The most commonly used method to valuate a telecom asset is the Discounted Cash Flow method. It is complemented by sensitivity analyses depending on the hypotheses made by the investor.

a) Intrinsic valuation: Discounted Cash Flow method

i. From P&L statement to Free Cash Flow

In order to valuate the targeted asset, first step is to prepare a Profit & Loss (P&L) statement (or income statement), including future revenue growth and cost evolution. The P&L statement assesses in advance an approximative profit of the asset over a long-term period. It tackles the issues of growth, cost structure and profitability of the asset.

P&L statement starts with the estimation of future **revenues** and **operational expenses.**
Revenues include retail and wholesale revenues. **Retail revenues** include prepaid revenues[37], postpaid revenues[38], mobile roaming in, fixed line revenues and Internet revenues. **Wholesale revenues** are mainly made of interconnection revenues and potentially of VSAT (satellite internet) or potential submarine cables, depending on the asset concerned. More specifically on the sub-Saharan African market, revenues can be simplified on a case-by-case basis:

- In 2010, prepaid connections represented 98,7% of total number of mobile subscriptions over the countries covered by our research scope[39]. Thus postpaid revenues can be considered as being equal to zero.
- Roaming market is still nascent in sub-Saharan Africa, representing only 1,8% of total mobile revenues of this region (Raval 2012). Thus, it can be ignored for simplification reasons.

[37] Prepaid connections are mobile connections "for which credit is purchased in advance of service use", Source: GSMA Intelligence.
[38] Postpaid connections are mobile connections "where usage is billed after each period and for which a contract is signed, typically for a fixed term", Source: GSMA Intelligence
[39] Source: Market statistics database, GSMA, Mobile for Development Intelligence

- Fixed telephony is very low and even declining in certain countries: its penetration went from 1.0% in 1998 to 1.4% only in 2008.
- Internet revenues can be considered as closed to 0: Fixed access to the Internet has remained closed to 0,1%, as deployment of ADSL is strongly constrained by the limited number of fixed telephone lines[40]. Mobile Internet shows greater potential than fixed Internet: It has started to grow since 2006 but was still at 0,9% penetration rate in 2008.

Operational expenses (Opex) include products & services costs, network costs and costs of personnel. **Products & services costs** include all the expenses that are directly and indirectly related to the products and services sold, as well as to customer relationship. N**etwork costs** include network operations and maintenance, as well as interconnection costs. C**osts of personnel** include salaries, training and recruitment.
Further detail on revenues and costs is given in *Appendix 2*.

Substracting operating costs (Opex) from total revenues gives the EBITDA. The **EBITDA (Earnings before Interest, Taxes, Depreciation and Amortization)** is a popular performance indicator: It is equal to the operating income (difference between revenues and Opex) before applying interest, taxes, depreciation and amortization. EBITDA is computed the following way:

EBITDA = Revenues – Operating costs

EBITDA gives investors the opportunity to assess profit performance and operating results of telecommunication assets that have large Capex (Capital Expenditures): Because EBITDA does not include taxes, depreciation, amortization and Capex, the investor can have a visibility on the baseline business and see whether it is profitable on a regular basis.

Then, **Capex** refers to **Capital Expenditures** on tangible and non-tangible assets and they are usually split into 'network' and 'non network'.

- The **'network' part** includes all infrastructure development and upgrade. It can be source of debt: Some foreign telecom equipment providers (such as Huawei and ZTE from China) sign agreements with African operators to build their network, implying big loans. Moreover, during some due diligences, some cases have been

[40] Source: ITU World Telecommunications / ICT Indicators database

identified where the network Capex included costs for a doubled core network. This is attributed to corruption of some decision makers of local operators who award contracts to several suppliers for the same network.

- The **'non-network' part** mainly includes licences and IT (Information Technology for accounting, reporting, billing). Telecom license fees are included in administrative costs in Opex (when it comes to annual fees, in k€ ou m€ for bigger countries) and in Capex (when it comes to license acquisition cost, in m€).

The **Change in Working Capital** is the difference between current assets and current liabilities. The calculation of EBITDA minus Capex, minus change in Working capital (receivables and payables), minus corporate taxes, gives the **Free Cash Flow** (FCF).

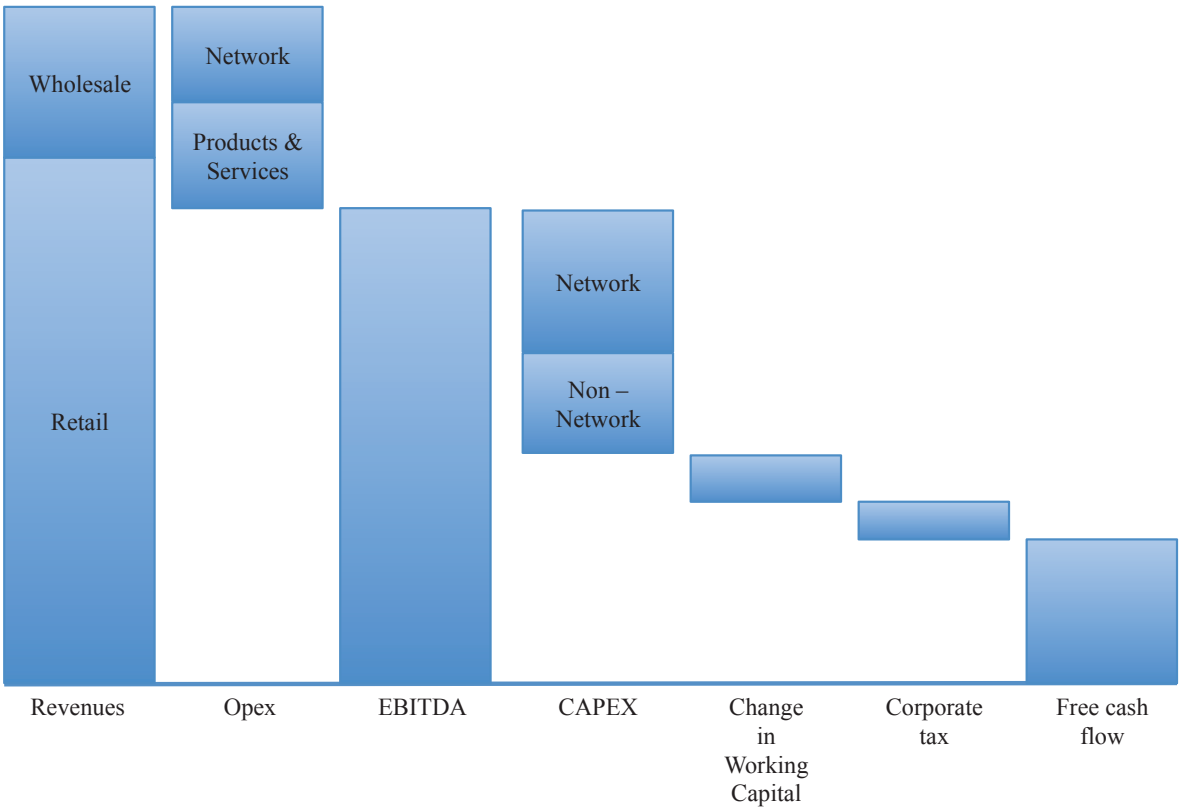
Table 8 and *Chart 13* illustrate the different parts of a telecom asset's business model.

Table 8: Business model

		Year 1	Year 2	Etc.
Retail revenues ($)	(1)			
Wholesale revenues ($)	(2)			
Total revenues ($)	(3)=(1)+(2)			
Operational expenses ($)	(4)			
EBITDA ($)	(5)= (3)-(4)			
Capital expenditures (network & non-network)	(6)			
Change in working capital	(7)			
Corporate taxes	(8)			
Free Cash Flow	(9)=(5)-(6)-(7)-(8)			

Free Cash Flow (FCF) is a measure of financial performance: It "represents the cash that a company is able to generate after laying out the money required to maintain or expand its asset base."

Chart 13: From revenues to free cash flows



ii. From Free Cash Flow to asset valuation

Telecommunications are a fast-moving sector and technological changes can easily occur and modify the business. DCF methodology has been largely adopted and remains the most widely used methodology in the telecom industry. Because it is based on a long-term business plan, it appears to be the most accurate methodology for this sector compared to others.

In case of an operator's acquisition, **the value of the operator** includes:

- Its intrinsic value, called Enterprise Value - defined by the future cash flows to be created by the investment. The value of an asset is a "function of the expected cash flows on that asset" (Damodaran 2006).
- An acquisition premium, based on synergies created by the M&A.

In case of a license award, **the value of the license** theoretically includes only the future cash flows its will produce, as it is a *greenfield* investment. But its final price might also include a premium related to more or less rational factors (strategy of the investing MTC and other effects that will be detailed later in the document).
These future cash flows are calculated as from economic and financial hypotheses that are made based on real current value of assets of the investment.

The DCF method is based on the time value of money: an amount of money invested today will have more value later, including the interests. It assumes that the value of an asset is the present value of its expected future cash flows: the asset value equals the sum of its future Free Cash Flows (FCF) to be generated by the asset and discounted at an adequated rate that corresponds to the cost of capital. This method assumes that "every asset has an intrinsic value that can be estimated, based upon its characteristics in terms of cash flows, growth and risks" (Damodaran 2006).

The Enterprise Value (EV) is the metrics reflecting the market value of the whole asset; it is calculated as the sum of Discounted Cash Flows of the Enterprise for the whole period of the business plan. For each year, the Discounted Cash Flows are calculated by multiplying the discount factor (based on the WACC) by the Free Cash Flow of this year. The usual formula gives Enterprise Value (EV) or Present Value (PV) as:

$$EV = PV = \sum_{t=1}^{\infty} \frac{FCF_t}{(1+k)^t}$$

Where:
EV = Enterprise Value
PV = Present Value
FCF_t = Free Cash Flow in year t
t = period during which Free Cash Flows are created
k = discount rate (or Weighted Average Cost of Capital)

As FCF cannot be calculated on an infinite time period t, t is divided in two periods (an explicit horizon plus a terminal value). PV is calculated as the sum of FCF created in period n (n is a period on which FCF assessment seems to be reliable) plus a terminal value (TV) that is the sum of residual FCF to be created from n+1 to ∞.
Thus the formula becomes:

$$EV = PV = \sum_{t=1}^{n} \left(\frac{FCF_t}{(1+k)^t}\right) + \frac{TV}{(1+k)^n}$$

Where:
EV = Enterprise Value
PV = Present Value
FCF_t = Free Cash Flow in year t
t = period during which Free Cash Flows are created
k = discount rate (or Weighted Average Cost of Capital)
TV = terminal value
n = explicit horizon of the business plan. In the ICT sector, n is usually determined around 5 years, as it can reach 10 years in such sectors with a lower flexibility.

For an asset valuation in the case of an operator's acquisition or a license valuation, assumptions must be made on the life of the asset, on the cash flows during its life and on the discount rate that will be applied. The method involves three different steps:

1) Determining an adequate discount rate k (or WACC: Weighted Average Cost of Capital)
2) Projecting the operating Free Cash Flows (FCF) over the years of the project n and discounting them
3) Calculating the discounted terminal value (TV)

a. Discount rate

Estimating the discount rate is a critical step of valuation process, as it will strongly influence the results. When talking about cash flows to equity, the discount rate to be used is cost of equity. As we talk about cash flows to the firm, the discount rate to be used is cost of capital, also called WACC (Weighted Average Cost of Capital).
In practice, the investor will choose to invest in this asset if the return on investment (Internal Rate of Return) is higher than the cost of capital (WACC).

The cost of capital of a firm is based on the weighted average of the cost of debt (what interest rates operators borrow at, as well as taxation rates) and the cost of equity (risk-free rate + equity risk premium).

Cost of debt is the interest rate paid on debt (interest expense is tax deductible), thus:

$$\text{Cost of debt} = \text{yield to maturity of debt } (1-t)$$
$$= (\text{riskfree rate} + \text{default spread})\ (1-t)$$

With:
t = company's marginal tax rate

Cost of equity is calculated the following way:

$$\text{Cost of equity} = \text{risk free rate of return} + \text{beta} * \text{risk premium}$$
$$E = R_f + \beta\ (R_m - R_f)$$

With:
E: the expected return on a security
R_f: the expected risk-free return on this market (government bond yield)
β measures sensitivity to movements in the relevant market and depends on financial leverage, operating leverage and type of business.
R_m: historical return on the stock market or equity market
R_m-R_f is the risk premium for average risk investment and depends on base equity premium and country risk premium.

Note on β coefficient: β is a component of WACC and gives information on the company's risk profile compared to market. *Table 9* illustrates the betas of some multinational operators. The lower the risk, the lower the β. Beta of a stock varies according to different parameters:

- The higher the sensitivity of a sector to its economic context, the higher the beta of a company of this sector
- The higher the fixed costs of a company, the higher its beta
- The higher the debt of a company, the higher its beta

β is usually in a 0.5-1.5 range and between 0.75 and 1.0 in telecommunications: the sector is considered as slightly less risky than the overall market. "Additional risks are reflected by higher betas (and hence higher costs of capital) for operators in emerging markets." (Ernst & Young 2011).

Table 9. Comparison of beta between developing and developed markets
Source: Reuters brokers

Company	Country	Unlevered Beta (oct.2013)
MTN	South Africa	0,71
Millicom	Luxembourg	0,97
Sonatel	Senegal	1,01
Safaricom	Kenya	0,89
Hits Telecom	Kuwait	1,76
Vodacom	South Africa	0,74
Telkom SA	South Africa	0,55
Access Kenya	Kenya	1,50

Company	Country	Unlevered Beta (oct.2013)
Belgacom	Belgium	0,50
Deutsche Telekom	Germany	0,43
Orange	France	0,41
KPN	Netherlands	0,14
Swisscom	Switzerland	0,32
Telecom Italia	Italy	0,42
Telefonica	Spain	0,62
Telekom Austria	Austria	0,22
Telenor	Norway	0,62
TeliaSonera	Sweden	0,33
Vodafone	United Kingdom	0,69

Thus, the Weighted Average Cost of Capital is computed as follows:
WACC = cost of equity * equity / (debt + equity) + cost of debt * debt / (debt / equity)

Local factors (characteristics and risks of the host country and market) will impact WACC calculation, such as volatility of interest rates, currency, exchange rate, etc. Work on the cost of capital in emerging markets has developed in the past few years (Bancel 2004, Naumoski 2011) and underlines the necessity of taking into account the country risk in assessments of investments in emerging markets. European cash flows are typically discounted using a 8% WACC, whereas emerging market cash flows are usually discounted at a WACC over 10%. Also, Damodaran (2009) underlines that because of unliquidity of financial markets in many emerging markets, "usual measures of valuation of risk (beta, to assess cost of equity and corporate bond ratings; and interest rates, to assess the cost of debt)" are "less reliable".

b. Free Cash Flows

Cash Flows indicate how much money is flowing to the company at a point of time. As detailed in Part i. of this chapter "From P&L statement to Free Cash Flow", FCF can be calculated the following way:

$$FCF_t = EBITDA_t - Capex_t - (EBIT_t \text{ x corporate tax rate}_t) - WCM_t$$

With:
FCF_t = free cash flow
t = year t
EBITDA = Earnings Before Interests, Taxes, Depreciation & Amortization = revenues – Opex (Operational Expenditures)
Capex = Capital expenditures
EBIT = Earnings before Interests & Taxes = EBITDA – Depreciation & Amortization
WCM = Working Capital Movements = receivables + payables

Like the WACC, FCF will also be impacted by local factors, such as the characteristics and risks of the host country and market, at different levels (revenues, Opex, Capex, tax rate, etc.).

c. Terminal Value

Estimation of Terminal Value (TV) is a critical issue in valuation. TV is the value of the asset after the time horizon of the business plan. Telecom assets are usually valued over 10 years. Payback and change in technology generally occurs in 5 to 7 years. So the 3 to 5 last years of the business plan will be normalized in a TV. Terminal Growth Rate (TGR), also called Perpetual Growth Rate (PGR) represents the growth of cash flows beyond the forecast period and will be used to estimate the TV.

To conclude, the Enterprise Value gives the value of the asset. *Tables 10 and 11* gives examples of DCF valuations applied to Zain, made by the investment bank EFG Hermès.

Table 10. Example of DCF valuation
DCF valuation for Zain Nigeria (US$million), nov.2009

	2009e	2010e	2011e	2012e	2013e	2014e	2015e
EBITDA	473	506	578	601	623	657	685
FCF	147	151	223	266	325	365	375
WACC	15.6%						
TGR	6.0%						
EV	2,870						
Net Debt (Cash)	972						
Equity Value	**1,898**						
Zain Stake (65.7%)							
Value per Zain Share (KWD)	**0.089**						

Source: EFG-Hermes estimates

Table 11. Example of DCF valuation
DCF valuation for Zain Zambia (US$million), nov.2009

	2009e	2010e	2011e	2012e	2013e	2014e	2015e
EBITDA	133	153	180	197	206	209	208
FCF	42	75	83	89	91	99	100
WACC	18.7%						
TGR	2.0%						
EV	560						
Net Debt (Cash)	89						
Equity Value	**471**						
Zain Stake (78.88%)							
Value per Zain Share (KWD)	**0.028**						

Source: EFG-Hermes estimates

Also, to assess the attractiveness of a potential investment, the MTC looks at the Internal Rate of Return (IRR) and to the ROCE. The IRR is the discount rate at which the Enterprise Value of an investment is zero. In practice, to make an investment decision, value creation is needed. The MTC will be willing to invest in an asset in case the Internal Rate of Return (IRR) exceeds the WACC. The Return on Capital Employed (ROCE) equals EBIT/capital employed and is an indicator of investment profitability and efficiency: a ROCE superior to WACC means that value is created, so that the investment can be done.

iii. The case of license valuation

License is an intangible asset and its valuation requires specific considerations. Three main approaches can be listed to value a license (Ernst & Young, 2011):

- The ***greenfield*** **approach** (replacement cost method): "This approach values the license by calculating the value of a hypothetical start-up company that goes into business with no assets except the asset to be valued (the license)."
- The **market approach** "estimates the fair value by referring the purchase prices paid for licenses for similar technologies."
- The **cost approach** "estimates the license value on its historical or replacement cost."

Usually, in practice, a DCF valuation is conducted over the license duration, including costs of license renewal in the terminal value. This method is reinforced by a multiples & comparables methodology - that will be detailed in the next part - based on similar countries and markets. Multiples used for license valuation can be: price/inhabitant, price/GDP, price/GDP/inhabitant, price/MHz, price/MHz/inhabitant, etc.
It is important to note that during its life, the value of a license may vary (upward or downward) due to various factors on the markets (entry of a new operator, changes in customer preferences, availability of a new technology...).

Different types of license fees exist in theory. The one-shot fee can be determined based on market practices (comparisons with other licenses on the same market or on similar ones). In case of an auction, the regulatory body can decide to impose a minimum bid to auction participants. Recurring fees can also be required, either fixed or as a percentage of annual revenues.

iv. From valuation to final acquisition price

The **Discounted Cash Flow method** enables to calculate the value of the targeted asset, based on the sum of the Discounted Cash Flows over the period of the business plan: This is called the **Enterprise Value** or market price.
In practice, total deal prices do not strictly equal the Enterprise Value as such, as additional parameters come into play.

The **acquisition premium** is an additional amount the investing MTC is willing to pay over the Enterprise Value in order to ensure it will win the bid. It depends on the synergies the MTC plans to make with the acquired asset, on the externalities it expects to make with the investment, or on the competition intensity between potential investors on a common target.

When it comes to an **operator's** acquisition, the **control premium** is the additional amount the investor is willing to pay over the Enterprise Value of the target in order to acquire a controlling share of the target. This is the value attributed by the investing MTC to take a majority in the ownership structure that will give it some control over the decisions of the new structure.
When it comes to a **license**, the final price tends to be higher when the award method is an **auction**. On this subject, literature points out that, in case of an auction, there is a trend that the winner will finally overpay for the acquired asset, which is called the "winner's curse phenomena".

Value and price are different in practice, as the price includes some premiums related to the tender context and to the specifitices of the deal. To sum up, "price is what you pay and value is what you hope to get" (Weaver & al., 1991).

b) **Relative valuation: Multiples & comparables**

Another approach to valuation assumes that it is not possible to determine the intrinsic value of an asset and that "the value of an asset is whatever the market is willing to pay for it (based upon its characteristics)". Based on the idea that similar assets sell at similar prices, this value will thus be estimated on "how the market prices similar or comparable assets" (Damodaran 2006). A **comparables** approach is a technique according to which the value of an asset is determined by the value of a similar asset that has been sold recently.

Relative valuation implies to identify comparable assets and a common measure of value to compare assets. Comparable analyses can be done:

- By comparing the value of the targeted company to other similar companies. The main difficulty here is to identify a sample of peers, with similar industry, size, and geography.

- By comparing the concerned transaction to past transactions that have similar characteristics of target and buyer. The difficulty is also to find relevant samples to compare with.

A **multiple** measures some aspect of a company's financial well-being, determined by dividing one metric by another metric. Common multiples that are used as valuation criteria in telecommunications are the following ratios (Ernst & Young 2011): Enterprise Value / Sales; Enterprise Value / EBITDA; Price Earnings Ratio (P/E); Price-to-Book (P/B); Beta coefficient (β). Other ratios and key performance indicators are proper to the **telecom industry** such as the ARPU (Average Revenue Per User), the SAC (Subscriber Acquisition Costs), the SRC (Subscriber Retention Costs) and the Enterprise Value / number of subscribers ratio.

An **exposure to emerging markets** usually gives the asset higher multiples: there is a premium placed on growth perspectives of emerging countries (Ernst & Young 2011). A higher EV/EBITDA ratio shows that the asset has the ability to benefit from market growth prospects and from higher margins that are specific to emerging markets. A higher P/B shows that high growth perspectives of emerging markets and thus anticipated return on equity has been taken into account in their share price and has increased P/B.

c) **Contingent claim valuation: Real options methodology**

i. Real options theory

In financial theory, an option is the right (not an obligation) to buy ('call option') or to sell ('put option') an asset at a specific date (European option) or on a specific determined period (American option). In 1977, S. Myers has made the link between decisions of options holders on financial markets, and investment decisions of managers in companies: He has then applied the financial option theory to company investment choices.

Today, **real options theory** is the application of financial options to value 'real' (physical) assets, based on the fact that an investment opportunity can be compared to a financial option. Real option is the right to make or not an investment at a date or during a specific determined period. This methodology quantifies the risks and uncertainties (Roussel 1999),

and thus optimizes the strategic investment project. According to Damodaran, "Real options represents the first real attempt to bring in the potential profit of being exposed to risk". For example, an option gives the right to the investor to wait for better conditions to make the investment. Possible options can be 'defer the project', 'temporarily stop the project & wait for a better timing', 'abandon it', etc. *Table 12* describes some of these options.

Table 12. Description of options
Source: H.Suto & al. 2008

Option	Description
Defer	To wait to determine if a "good" state-of-nature obtains
Abandon	To obtain salvage value or opportunity cost of the asset
Shutdown & restart	To wait for a "good" state-of-nature and re-enter
Time e-to-build	To delay or default on project – a compound option
Contract	To reduce operations if state-of-nature is worse than expected
Switch	To use alternative technologies depending on input prices
Expand	To expand if state-of-nature is better than expected
Growth	To take advantage of future, interrelated opportunities

For instance, a project that currently has a negative NPV can be considered with a deferral option. This gives the opportunity to defer the project for one period of time and see whether its Expanded Present Value (ENPV) is worth making the investment. ENPV equals the NPV plus the Real Option Value (ROV), with ROV being the value of deferring this project for one period of time.

The literature has promoted, in the past few years, the usage of real options theory in telecom valuation, particularly for capital investment decisions. It is said to be a more appropriate method for long-term investment valuation (Mun, 2006) as - being a probabilistic method - it provides a value for future strategic options, which traditional valuation methods such as DCF do not. Dixit and Pindyck (1995) argue that options are a preferable methodology to classical ones as it deals with management's flexibility, offering more flexibility under uncertainty. Pindyck will add in 2005 that DCF analysis is not accurate as it only deals with two possibilities: invest or not invest, whereas real option theory includes other options like deferring the investment, which makes it more accurate regarding investment timing.

ii. Real options in the telecom sector

In her PhD thesis, C. Krychowski (2007) presents some case studies of real options applied to the telecommunication sector and underlines that the methodology is efficient to:

- **Better understand the value of an investment project in a context of uncertainty**, based on the example of deployment of an ADSL network in a low-density population area (which includes uncertainty on profitability of the project, despite public subsidies)
- To **determine an optimal date of an investment**, based on the example of deployment of a UMTS network. Timing issue is key in case of the launch of a new technology on a competitive market: If too early, the risk is to invest in a low return on investment project; if too late, competition might pre-empt the market.

Real options in the telecom sector have become a subject of research in the past few years (Athwal & al. 2005, Harmantzis 2007, Mkhize 2009, Mastroeni 2010). Sinha (2011) proposes an example of real option method applied to 3G spectrum valuation in India.
Today, in practice, real options theory is applied to various sectors such as utilities (electricity), oil and mining, real estate, pharmaceutical industry, regarding different types of projects including mergers and acquisitions. Nevertheless, it seems this method has not been adopted yet by telcos even if recommended (Alleman 2002). Athwal & al. (2005), quoted in Mkhize & Moja (2009), argue that it is because it has been quite a **new method** for the telecom industry. It seems there is a lack of empirical research on real options (C. Krychowski, 2007), which would give managers some tools to apply this methodology to their projects.

For the time being, in practice, it seems indeed that telecommunication companies widely use the DCF technique. Its result is binomial, depending on the Net Present Value result: Investment shall be profitable if NPV >0 and not if NPV<0. Thus this has appeared to be a 'basic tool', only providing managers with a go/no go decision. With DCF, risk and uncertainties are handled by sensitivity analyses (with probability-weighted scenarios) made on various parameters: financial (WACC, TGR...), regulation-related (ULL prices, termination rates...) or operational parameters (market shares, some costs...). To be effective, the use of the DCF method implies the complementary calculation of an IRR

(Internal Rate of Return) and of a ROCE (Return on Capital Employed) to support strategic decisions.

Our discussions with telecommunication professionals from operators and investment banks have confirmed that the real option methodology is not currently used in the sector as, being based on probabilisation of scenarios, it might dilute risk and artificially increase valuation result.

d) **Conclusion on valuation practices**

In the past few years, a growing body of the financial literature has promoted the usage of **real options theory** as an efficient asset valuation methodology in the telecom sector, particularly for capital investment decisions. Providing a value for future strategic options and dealing with flexibility, it is said to be a more appropriate method for long-term investment valuation. Nevertheless, the literature states that this method has not been widely adopted yet by telecom operators, which was confirmed by our discussions with telecom professionals.
To date, the **DCF method** is the most widely used method in the telecommunication sector. Its result is binomial. One of the disadvantages of DCF relates to uncertainties on these projections. A projection of Free Cash Flow involves assumptions on operating cash flow and capital expenditures, and the degree of uncertainty on them increases with the years. If their amount can be evaluated for the first years of the model, the difficulty to assess them for the following years can affect the results. Discount rate and growth rate can also be tricky assumptions to make.

The use of DCF method implies the calculation of NPV (Net Present Value), IRR (Internal Rate of Return) and ROCE (Return on Capital Employed) to support strategic decisions. It also makes necessary to supplement the DCF methodology with multiples and comparables analyses, as well as sensitivity analyses. Besides this, using benchmarks and historical data enables the investor to be more relevant on predicting cash flows.

We have consulted telecom professionals during our research: an M&A and a regulation experts at an MTC, as well as financial analysts of investment banks[41] specialised in the telecom sector.

They confirmed the **wide use of DCF method in the sector**, with emerging market cash flows normally discounted at a minimum of 10%.

Regarding the determinants of deal prices, **MTC experts** state they mainly take into account the following factors in their qualitative and quantitative studies: country growth potential, market growth potential (market size, maturity, ARPU evolution, ability to absorb additional services) and the value of the frequency band per capita per year. Governance as well as legal and regulatory vacuum are considered but as a second order issue.

Investment banking analysts, for their part, lay the emphasis on the following risks to take into account into their telecom valuations:

- Macroeconomic risks - both economic and political – as well as regulatory risks (constraints, difficult regulatory environment, aggressive liberalization such as introduction of too many licences in one market, etc.). are reflected in the discount rate in DCF calculation
- Currency risks in the forecast financial statements
- Operational risks (competition, etc.) in operational forecasts

The objective of the next part is to rationalise and classify these factors that potentially contribute to determine the price of a deal.

II. Classification of factors influencing the valuation

The objective of this part is to classify the factors that an MTC has to consider when planning to invest in a sub-Saharan country and valuating a targeted asset (operator or license) in a country.

These factors might be characteristics or risks. "Characteristics" mean here the known factors that might evolve quite slowly (e.g. population, GDP), whereas "risks" include the unknown – or difficult to assess – factors, which might suddenly change following, for example, a change in government (e.g. regulatory burden). Risks are generally accepted in any company and investment project, as they are inherent in business. It is understood that

[41] Sources: Orange, EFG Hermès, Bank of America Merrill Lynch

most of these risks can be considered as opportunities from the moment that they become an advantage for the investor. An investor will tend to mitigate risks and accept them, as long as its Return on Investment over a period of time is acceptable compared to the level and cost of risks.

The following classification has been based on Miller's classification (1992). Miller provides a categorization of uncertainties faced by firms that operate internationally: It is "a framework for categorizing the wide range of interrelated uncertainties relevant to managerial decision-making". These uncertainties are divided into 3 groups:

- **Exogenous uncertainties** are related to the environment (political, government policy, macroeconomy, social and natural uncertainties)
- **Endogenous uncertainties** are industry-related (input market, product market, competitive uncertainties)
- **Firm-related uncertainties** (operating, liability, R&D, credit, behavioral uncertainties).

The **exogenous (or macro-level) environment** represents all the country-related characteristics and risks, such as political, regulation and economic risks: It affects all organizations in a country. First, it includes factors linked to **institutions' decisions** such as the State as well as competition and regulation authorities. For example, restricting rules imposed by governments to foreign investors might have a strong impact on generated cash flows. A weak rule of law leads to low enforcement of law and contracts, which is also part of environmental uncertainties. **Macroeconomic uncertainties** (inflation, foreign exchange rates, etc.) are also part of the exogenous environment. For example, revenues and costs might strongly be impacted by a high inflation rate. Moreover, international projects of investments have a risk of currency change: some risky currencies can bring a fluctuation of cash flows. When fluctuations of currencies exchange rates (Foreign Exchange market or Forex) are particularly high, this will be reflected in the valuation through a higher WACC[42] (as seen in the valuation methods above).

The **endogenous (or micro-level) environment** represents the market-related characteristics and risks, such as risks coming from suppliers and customers: They are

[42] WACC: Weighted Average Cost of Capital

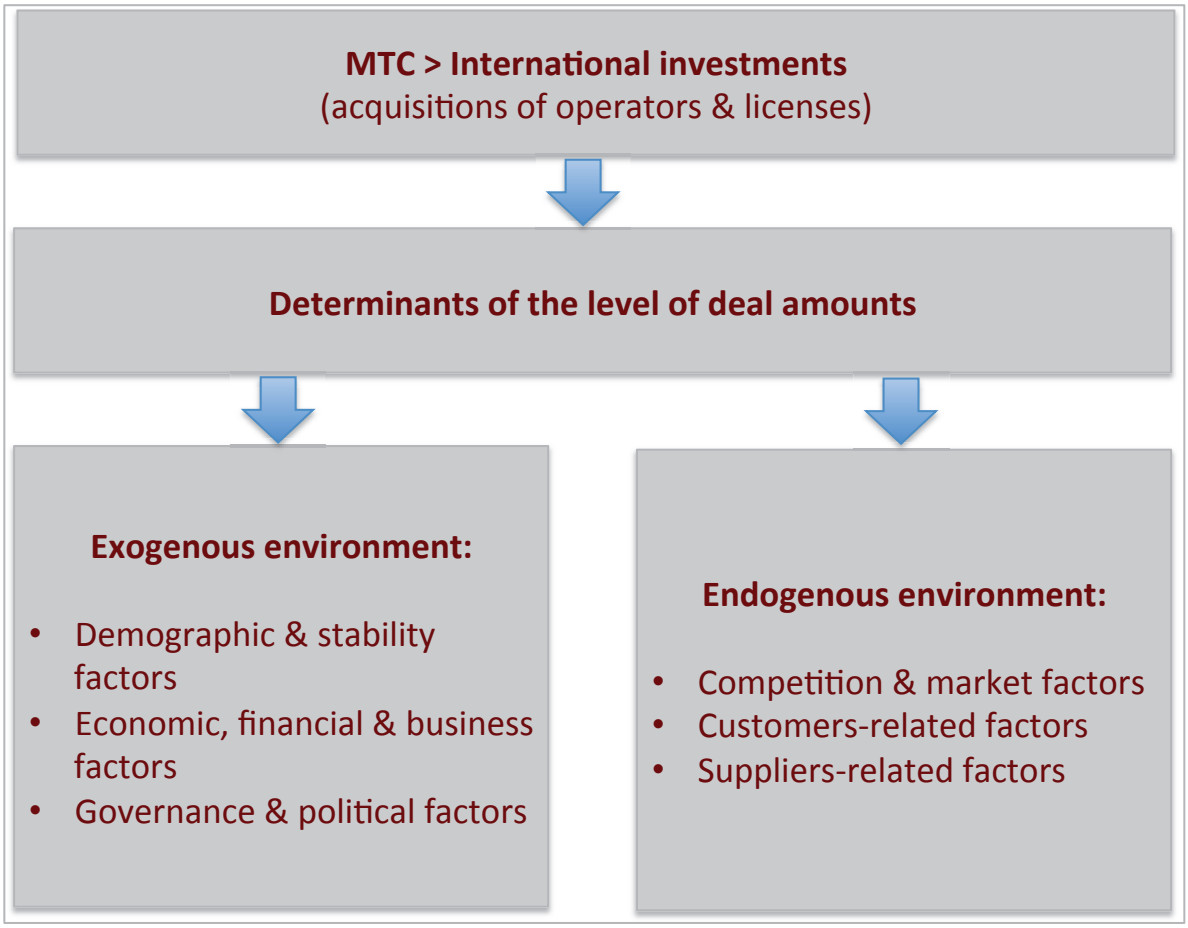
specific to the industry. Endogenous environment is thus related to the local telecom market, which includes for instance competitive uncertainties such as high churn[43] propensity of customers, market share and price volatility. Some market characteristics also impact revenues, such as the number of SIM (Subscriber Identity Module) cards, CAGR (Compound Annual Growth Rate) of mobile market, ARPU (Average Revenue Per User), country Internet capacity (sub-marine cable), etc.

Millers' classification also includes uncertainties specifically related to the firm, such as operational and financial risks: **Firm uncertainties**. If exogenous and endogenous environment are proper to each country, firm uncertainties have, for their part, to be studied on a case by case. Firm uncertainties will also be detailed in this part, but have not been considered for the quantitative analysis of the present thesis, as they are specific to each case and would entail a higher level of complexity in their systematization.

Both exogenous and endogenous environments interact and depend on each other. And firm-related risks must usually be studied in the light of both exogenous and endogenous environments in which it operates.

[43] Churn rate: proportion of subscribers who leave their service provider for a competitor during a given time period.

Box 7: Factors impacting telecom MTCs investments in Africa



The different parts below detail the components of exogenous, endogenous and firm environment and are illustrated by examples applied to telecom investments in sub-Saharan African countries. Exogenous and endogenous environment factors can all apply to the acquisition of an operator and to a license award *(Box 7)*. Firm environment factors only apply to operators' acquisitions, as a license award is a "greenfield" investment.

a) **The exogeneous environment: Country factors**

Country factors are basically the macroeconomic factors - including economic, financial, political, business and governance ones - that might logically affect operating profit and value of assets in the country. The attempt of classification of exogenous environment

factors that has been detailed below specifically applies to telecom investments in sub-Saharan African countries.

i. Demographic and stability factors

Demographic characteristics like **population density** and **population distribution** over the territory might impact usages of mobile and of Internet services. Low population density and rurality are both likely to impact revenue lines. Isolated and rural populations in Africa have specific needs. If their relatives live in the same village or area, their needs in telecommunications are nearly non-existent. If their relatives live in an urban region, they are likely to need to communicate with them. This need is constrained by their solvency that is lower than the one of urban populations. Usually, urban population call rural population, for solvency reasons. Also **rurality** - often associated with low **literacy rates** - might impact negatively the Internet usage and entail a lower need of populations for broadband[44] services and thus broadband revenues. Also, rurality and isolation of some populations make territory coverage requirements a great challenge for operators. Moreover, some isolated technical sites (such as BTS[45]) might be difficult for operators to reach and to feed with energy. This energy issue will be detailed in the next part about market factors (supplier-related factors).

Level of country security, social and political - current or future - instability can have a direct effect on revenues of a company and its ability to conduct business and operations. A stability period is more likely to increase mobile roaming revenues for operators, as country population will move more freely. On the other side, an instability period - like civil wars in Chad and Côte d'Ivoire - might positively increase prepaid, postpaid and fixed lines revenues of operators, as people might need to communicate more without moving (displaced people, separated families). Instability periods might also of course have negative impact on operators' revenues, as internal conflicts can entail network destructions or cuts in communications. On mid-January 2013 for instance, during the military offensive from Mali and France against jihadists, it was reported that Mujao jihadists had cut fixed and mobile communications (Malitel Sotelma and Orange networks) in Gao, Northern Mali, in order to prevent inhabitants to share information with Malian and French

[44] Broadband: High-speed internet access technology.
[45] BTS: Base Transceiver Stations

soldiers[46]. Telegeography has reported that: "On January 31st 2008, MIC Chad was forced to temporarily shut down its network by the Chadian government for two weeks, due to a rebel attack on the capital N'Djamena. While the network was reportedly undamaged, the company lost two weeks of revenue. » One can also mention the Internet line cut in Mogadishu, Somalia, in May 2011, in the fighting between insurgents and government troops[47]. In such periods of instability, illegal abuse of network usage by political forces can also happen: During the Arab Spring, in January 2011, Internet and communication services were blocked by the Egyptian government for five days, which direct costs for operators have been estimated to be around 90 millions USD[48]. MTCs might also have to repatriate their expatriate staff in insecurity and instability periods, leading to uncertainty on their own ability to conduct operations.

ii. Economic and financial factors

Economic factors might have an impact on asset valuation, acting as incentives or disincentives to foreign investment decisions. These factors relate to the **host country wealth** (GDP per capita, growth of GDP per capita, government budget balance, whether the country is oil-producing or not), to the **host country situation** (whether it is landlocked or maritime, whether it is islamic or not) and to the **host country openness** to international markets (level of Foreign Direct Investment inflows, balance of trade).

Financial factors also might impact valuation. **Volatility of interest rates** is an uncertainty factor when taking an investment decision in Africa. In sub-Saharan Africa, interest rate spread (lending rate minus deposit rate)[49] is volatile: It went from 6% in 1985 and 10,5% in 1995, to 13,7% in 2001 and then 8,1% in 2009. Risks related to interest rates generally arise on borrowings. As explained in Millicom Tigo's annual report 2011, "Borrowings issued at floating rates expose the Group to cash flow interest rate risk. Borrowings issued at fixed rates expose the Group to fair value interest rate risk. » To

[46] Source : Balancing Act, January 31st 2013, Issue n°199

[47] Source: http://www.irinnews.org/Report/92824/SOMALIA-Internet-lifeline-cut-in-Mogadishu

[48] Source: http://www.oecd.org/sti/interneteconomy/theeconomicimpactofshuttingdowninternetandmobilephoneservicesinegypt.htm

[49] Definition of interest rate spread: « Interest rate spread is the interest rate charged by banks on loans to private sector customers minus the interest rate paid by commercial or similar banks for demand, time, or savings deposits. », Source: World Bank data http://data.worldbank.org/indicator/FR.INR.LNDP?display=default

mitigate risks, MTCs can use a derivative financial product called « interest rate swap » (« IRS »), enabling them to exchange interest rate cash flows with another party. For instance, "in January 2010 Millicom entered into an interest rate swap to hedge the interest rate risk of the floating rate debt in […] Tanzania, DRC and Ghana. [It] was issued […] on a national amount of $100 million, with maturity in January 2013"[50].

Currency volatility is often a characteristic of emerging markets, both in terms of foreign exchange (impacting the **exchange rate**) and on an internal point of view (impacting **inflation**).

« **Foreign exchange risk** arises from future commercial transactions, recognized assets and liabilities and net investments in foreign operations. »[51] And volatility of exchange rates entails a volatility of company's earnings, cash flows and assets. For example, "Millicom seeks to reduce its foreign currency exposure through a policy of matching, as far as possible, assets and liabilities denominated in foreign currencies."[52] Some financial instruments exist to hedge the risk linked to currencies' volatility, but not in all countries nor in all currencies. For some risky or unstable currencies and some too long periods, risk associated with exchange rate cannot be insured. In March 2013, Telekom Networks Malawi announced that despite a 43% revenue increase in local currency between 2011 and 2012, net profit had dropped by 49% on the same period (some costs are in foreign currency), due to foreign exchange losses coming from devaluation of Malawi currency and its continued depreciation over 2012[53].

Inflation, particularly high in emerging economies, can impact some MTCs' costs (salaries and social contributions, sourcing commodities) as well as their revenues (by increasing market prices and thus ARPU). Some Capex are in US$ so they will not be inflating, some regulated costs will not be impacted by the inflation either. In a country with a low GDP per capita, inflation risk creates an uncertainty on the demand side: It makes operator's revenues particularly dependant on the customers' capacity to accept and absorb price increases in telecom services. Also, inflation of food prices might affect purchasing power of telecom customers: more money needed for basic needs might theoretically entail less money for telecom services consumption.

[50] Millicom Tigo, Annual Report 2011 (Appendix: Form 20F, page 112)
[51] Millicom Tigo, Annual Report 2011 (Appendix: Form 20F, page 112)
[52] Idem
[53] Telegeography, "TNM FY profit drops 49% on forex losses", March 26th 2013

iii. Governance and political factors

Before detailing governance and political factors, it is important to bear in mind the **strategic importance of the telecommunication sector** for a State – whatever the country. To cite a recent example, "Maroc Telecom is described a source of information for the French intelligence service in the Sahel, as it controls subsidiaries in Mali, Mauritania and Burkina Faso, and can monitor calls between suspected Jihadists. »[54]. This is the reason why French President Hollande would have asked Vivendi to delay the selling process of Maroc Telecom until the war in Mali is over. This example illustrates the constant relationship between institutions and the telecom sector, as it is a strategic sector in terms of country politics, economics and security.

In some sub-Saharan African countries, **complex and heavy regulatory burden** as well as the time dedicated to administrative and economic operations may discourage private projects and investments and even encourage firms to stay in an informal sector or to use forms of corruption (e.g. speed money).

General governance and rule of law may vary significantly between African countries:
Legal environment including labour law is often subject to uncertainty. Contract incompleteness (Hart 1999) and weak contract enforcement specifically strong in emerging markets often affect strongly corporate governance. Moreover, law is not always enforced (e.g. an anti-dumping law not enforced may lead to price volatility). A weak rule of law and low contract enforcement might lower the revenue line with unpaid consumptions (increasing receivables). Moreover, when other operators do not pay incoming calls to their competitors, leading to bad debts for the creditor, institutions do not always discipline this and telcos operating on the market might decide to apply their own rules. In DRC, in November 2012, Tigo, Vodacom and Airtel have decided to stop all interconnections with Africell, despite the national law making interconnections mandatory, because Africell was not paying them for the service [55].
Weak legal and regulatory regimes of some sub-Saharan African countries naturally lead to the **corruption** issue, which is a reason often cited by multinational companies for not investing in Africa (UNCTAD 2000). According to United Nations Global Compact, "Corruption can take many forms that vary in degree from the minor use of influence to

[54] http://www.balancingact-africa.com/news/en/issue-no-642/telecoms/france-asks-vivendi/en
[55] Balancing Act, n°195, November 15th 2012

institutionalized bribery. Transparency International's definition of corruption is "the abuse of entrusted power for private gain"[56]. This can mean not only financial gain but also non-financial advantages." It includes bribery, speed money, extortion, influence peddling, fraud, and nepotism. Corruption might happen at every level: At the executive branch (government, public telecom operator) and at the private level (managers, decision-makers)[57]. Africa is still considered as being "home to the majority of thoroughly corrupt countries in the world" (Persson & al. 2010). Potential investors might thus discover some irregularities in their due diligence processes (fake jobs, slush fund for undeclared commissions to favored distributors, etc.) Some acquisition projects did not finally take place, because of corruption. In 2003, the due diligence conducted by Lockheed Martin Corporation, a US company, to acquire Titan Corporation in Benin revealed that there might have some breaches of the Foreign Corrupt Practices Act (FCPA), the 1977 USA federal law. This led to an investigation of the SEC (Security Exchange Commission) and the US Department of Justice that concluded with the following charges against Titan: bribery under the FCPA, falsification of books and records under the FCPA and aiding or assisting in the filing of a false tax return. The acquisition of Titan Corporation was finally cancelled.

It must be emphasised however that if an operator takes advantage of a permissive regulation or of corruption, this may also increase its profits as well as it entails high risks. Thus a loose regulation might also be at the advantage of operators on the market.

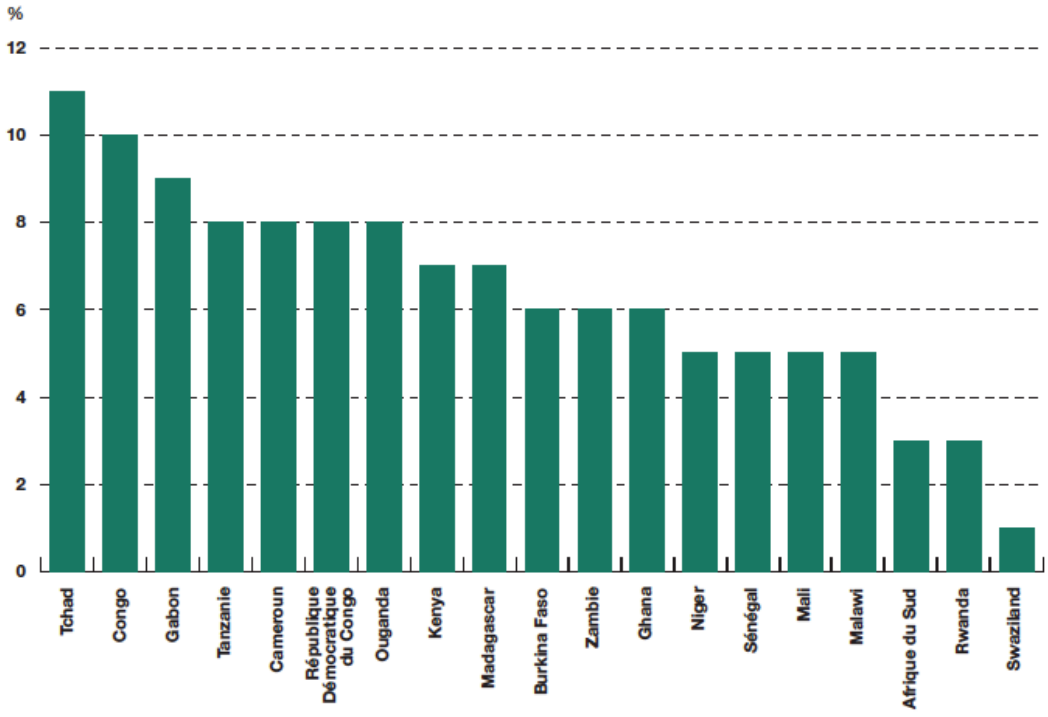
Regulation, laws and requirements specific to the telecommunications sector are not always favourable for operators. In this domain, a **change in political majority** can be a risk for an investor, because it might lead to changes in laws and rules of the sector, such as fiscal reforms. The new government may decide to reconsider past agreements (e.g. arbitrary revoking of licenses, new conditions imposed to the licensee) or make operators repay for an agreement that was already paid. This happened to Tigo in Senegal: "In 2008, the government of Senegal challenged the validity of our license when we refused to pay additional amounts for the license that we validly hold and that does not expire until 2018. We are currently in litigation relating to this dispute. »[58]

[56] www.UNglobalcompact.org
[57] On corruption in telecommunications, read: Sutherland E., 2012
[58] Millicom Tigo, Annual Report 2011 (Appendix: Form 20F, page 6)

Also, in some countries, there is a **strong tax pressure** on to telecom operators. Tax on telecommunications stands for a significant part of the State's revenues – more than 8% in some countries - as it is shown in the graph below[59] *(Chart 14)*. There are two main reasons to this tax pressure: First, in sub-Saharan African markets, the **informal sector** might represent up to 80% of the labor force[60]. This prominence reduces the income tax base of governments. Secondly, the telecom sector is a public service with potentially high returns on investment, making it a sector at risk in countries with a lack of political stability and transparency: This leads to some **political opportunism** in some cases: Different types of taxes (operating tax, revenue sharing, annual spectrum or license fees owed to the State, etc.) might be levied from telcos and can heavily weigh on their margin and put pressure on their investment projects. *Chart 15* illustrates the share of taxes in total operators' revenues. In Gabon and Tanzania, around 40% of telcos' turnover is charged by the State, according to the GSMA (2006 figures). This percentage jumps to 53% in Zambia.

[59] Source : BAfD/OCDE 2009 Perspectives économiques en Afrique
[60] Source : AfDB

Chart 14: Contribution of mobile operators to government revenues
Source: Perspectives économiques en Afrique, BAfD/OCDE 2009



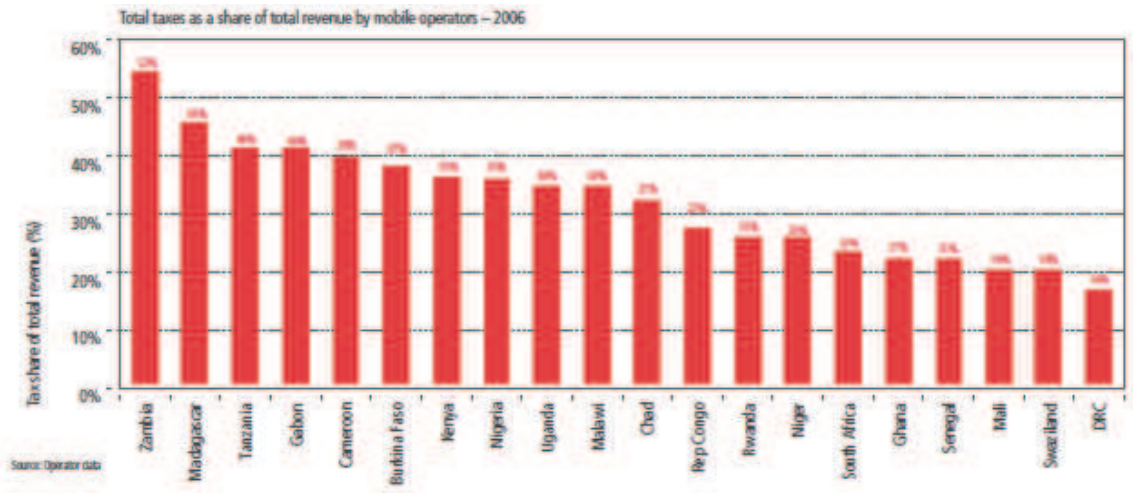
Source : GSM World (2006), "Taxation and Growth of Mobile Services in Sub-Saharan Africa". (« Fiscalité et croissance des services mobiles en Afrique subsaharienne »)

In Nigeria, operators must pay about 35% of their revenues, because each of the federal, the state and the local governments charge them. In Senegal, telecom sector is more charged than other sectors despite the fact that it represents a major contribution to country growth. For example, Sonatel (whom Orange is the main shareholder) reports to pay the following taxes to the State: VAT, corporate tax, fee on usage of telecom network, contribution to energy & telecom development (3% of turnover). In parallel, Orange Senegal reports to bring 10% of State revenues[61]. Another example is Ghana, about which Telegeography reported in July 2013: "Ghana's government has submitted a draft bill to its parliament seeking to impose an additional 6% interconnection fee on incoming international calls, Ventures Africa reports. According to the article, mobile operators currently pay 15% value

[61] Balancing Act, Issue n°177, February 23th 2012

added tax (VAT) and National Health Insurance Levy (NHIL) on international calls, and the hike in the Communication Service Tax (CST), also known as 'Talk Tax', will reportedly result in operators passing the new fee on to customers. Additionally, the draft bill proposes the re-introduction of 20% import taxes on mobile handsets to protect local manufactures of mobile phones, expecting to raise an estimated GHS49.8 million (USD24.14 million) for the treasury. The Ghana Chamber of Telecommunications, which represents all the country's wireless operators, said in a statement that it is dissatisfied with the CST amendment bill, as it would pose difficulties to operators and might hamper investment required for the expansion of infrastructure. »[62] Operators might even consider some taxes as "illegal". Ghanaian operators recently claimed to be double-taxed by the government on the Communications Service Tax, paying 6% tax on phone calls revenues and another 6% on interconnection fees.[63]

Chart 15: Total taxes as a share of total revenue by mobile operators, 2006
Source: GSMA[64]



[62] Telegeography, July 5th 2013, Ghana to impose additional 6% tax on mobile calls
[63] Telegeography 13 mars 2013, Ghana: Operators sue government over double taxation
[64] Source: Taxation and the growth of mobile services in sub-Saharan Africa, GSMA, 2008. www.gsmworld/africatax

Nevertheless, political opportunism might create a vicious circle to the detriment of quality of service, of the market, and finally of the final consumer: High taxes heavily impact operators' costs, putting pressure on investments projects (on coverage, on quality of service, etc.) and sometimes fines to pay by operators for not meeting (coverage or quality) requirements.

Another risk to take into account when an investor plans to acquire a license is the **level of requirements** (in terms of coverage, etc.) fixed by institutions that can be difficult to meet for telecom operators.

Lack of independence of regulatory bodies is still an issue in some sub-Saharan African countries (Berg 2002, Bodammer 2005, Minges & al. 2008). For instance, there have been cases where African governments have asked the regulator to inflate the price of license renewal in order to catch up on the price of initial licences, retrospectively considered as having been too low: This artificially increases the level of deal amounts. Thus processes of license awards are not always transparent and as some regulatory agencies are still connected to governments, the role of the regulator is still minor and dependant on government's decisions (L. Gille, 2010).

Frequent changes in regulation rules – as well as **unfair treatment of operators by regulatory bodies** - can strongly affect their profitability. Institutions' decisions (such as universal service obligation, functional separation, mandatory unbundling or network sharing, a mandatory price decrease, a reduction on tariffs of interconnection) are aimed to improve service access in the country, but might also erode operators' profits. In 2007, for instance, government of Benin « claimed that following a review of telecoms licensing it had uncovered discrepancies which necessitated cancellation of previous licences and the award of new concessions at a cost of CFAF30 billion. »[65] As MTN refused to pay this additional fee - considering license had already been paid -, its network was shut down for several weeks. Country institutions can also impose to foreign investors a **limit to repatriation of funds to their country of origin**. Repatriation of « cash from its operations in the form of dividends, royalties and management fees as well as repayment of shareholders' loans » is a risk that Millicom plans to test in all countries it operates, even if the MTC has « not experienced any issues in repatriating funds to date ».[66] **Nationalisation**

[65] Telegeography Globalcomms database, Benin, 2009.
[66] Millicom Tigo, Appendix of the Annual Report 2011 (Form 20F, page 111)

and (partial or total) expropriation might occur when the government wants to take control over national strategic industries, whose telecommunications are part of.

Most of these country factors (political, economical, financial, governance) are followed up by some organizations under the names of "country risk" or "economic freedom", depending on the definitions and methodologies used (This will be detailed in Chapter 4). The investing MTC can take an insurance against some of these risks with an Export Credit Agency (ECA). The Multilateral Investment Guarantee Agency (MIGA), part of the World Bank, is for instance a multilateral ECA, whereas COFACE (Compagnie Française d'Assurance pour le Commerce Extérieur) for France and ECGD (Export Credits Guarantee Department) for UK are examples of country ECA. MIGA will cover the investing MTC against:

- Expropriation (in case of withdrawal of the MTC's license or frequency)
- Breach of contract (in case the local State does not comply with its duties)
- Civil unrest and terrorism
- Risk of money transfer (dividend repatriation)

In some cases, it is not possible to take this type of insurance. Some governments refuse to include MIGA in foreign investments to their countries (Romania, Bulgaria, Algeria, India, etc.) in order to send the positive message to potential investors that investment is safe in their country and that MIGA insurance is not necessary[67].

These factors related to the exogenous environment might positively or negatively affect profits and thus valuation.

b) The endogenous environment: market-related factors

The telecom sector in Africa is very different from the one in developed countries: high growth, low ARPU, specific usages, etc. This part classifies the characteristics and risks related to the telecom sector in Africa that could impact the business model, in terms of costs or revenues, and valuation of a targeted asset by a potential investor.

[67] Source : Interview Y. Burtin, MIGA (World Bank)

i. Competition and market

The size of the host market (number of total mobile subscriptions in the country) might influence the investment decision and the level of valuation.

Growth opportunities are the main reason for MTCs to invest in emerging markets (The sector often experiences a negative growth in their home markets), so telecom sector's CAGR (Compound Annual Growth Rate) is a key indicator for investors. Some indicators may be taken into consideration to assess growth opportunities and risks related to the sector:

- **Market penetration** (number of subscribers or number of active SIM cards over the total country population) is a key indicator for market potential growth. Tigo[68] mentions here the relationship between market penetration according to areas and its growth potential: "Urban areas in the markets where we operate in Africa have a high penetration rate for mobile phones and opportunities for increasing the penetration rates in our African markets are largely in rural areas where ARPU (Average Revenue per User) is lower and costs are higher, which could threaten our future growth and profitability."
- **Competition intensity** is also an important factor: market concentration (number of operators on the market) and market balance (size of competitors and competitors' market shares) will definitely have consequences on volatility of market prices and an impact on future market shares of the investor.

The particularly **high entry barriers** of telecom sector (such as initial capital requirement for building a network or purchasing a licence, such as the incumbent defence of market shares, etc.) do lower – for established operators - the threat of new entrants on the market, but might increase the difficulty of an MTC to enter a market.

High exit barriers are also a potential risk to assess when investing in a country. They are based on power relationships between stakeholders and on the importance of finding a new shareholder, in the African context where the *intuitu personae* nature of the contractual relationship is key. Orange is said to be willing to sell its assets in Equatorial Guinea, but the situation seems to be blocked because of its relationship with the other shareholder: the State. Political and diplomatic pressure is put on France and the Orange Group by the local government to maintain their shares in the local operator.

[68] Millicom Tigo, Annual Report 2011 (Appendix: Form 20F, page 14)

Frequent **changes in technologies & networks** are characteristics of the fast-paced telecom environment. Operators have to adapt constantly, increasing their capital costs. This might be due to different reasons: because technology has evolved, because networks have a limited life (for instance, transmission systems must be replaced after two years) or have been damaged and must be replaced. This factor influences the valuation, whether the investment is made in Africa or somewhere else.

ii. Demand-related factors

Some consuming habits and usages are specific to telecommunications in Africa and might be a source of uncertainty for operators.

Prepaid usage (also called "pay-as-you-go", meaning credit is purchased before use of mobile service) is much more developed than Postpaid usage (contract with billing arrangement between a final customer and an operator): In Africa, 96% of mobile connections are prepaid (GSMA, 2011) versus 52% in Europe. This is mainly due to cultural and economic reasons: Living hand to mouth and based on his money available, the customer buys its prepaid refills. On a prepaid market, demand is more likely to be volatile than on a postpaid one. Prepaid usage, on the other hand, mitigates collection risk for operators.

Subscribers are traditionally **multi-SIM users**: On markets where the SIM card is free, users usually possess SIM cards of different operators, first because of lack of quality of networks interconnection, and then in order to have the choice between different tariff schemes (depending on the time of the day and the type of usage they make). This way, users can easily swap from one provider to another.

Also, in countries with high inflation risks, the **propensity of customers to accept potential price increases** in periods of inflation (and keep consuming telecommunications) might impact operator's revenues.

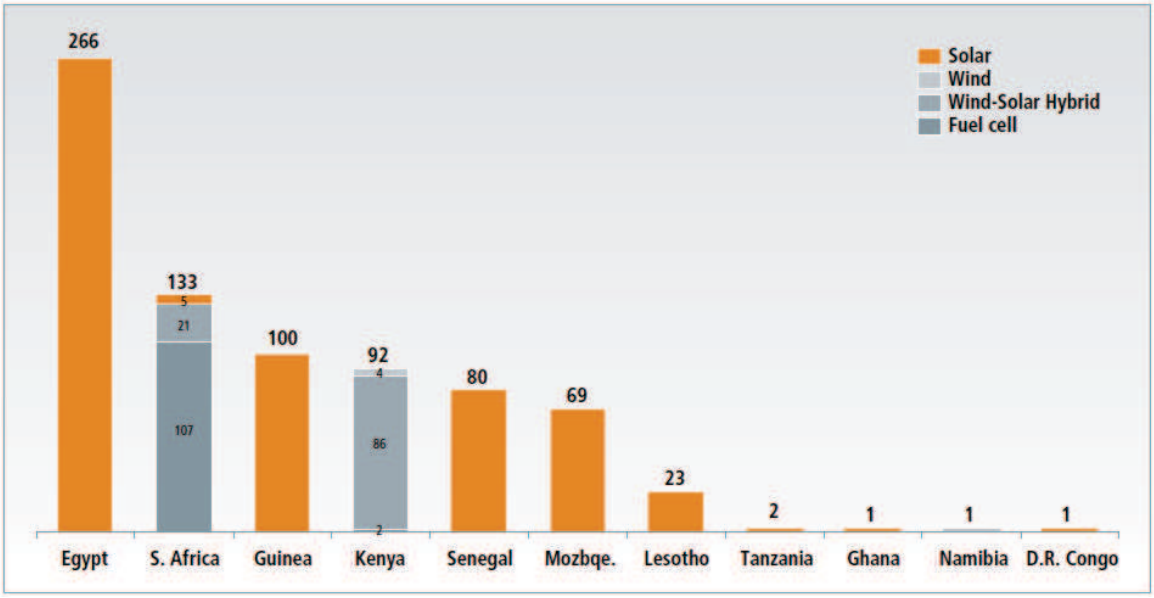
iii. Suppliers-related factors

Market power of telecom suppliers (for network infrastructures, hardware, software, mobile devices) represents a risk: The operator may depend on a small number of suppliers, who can raise prices or extend their delivery times. Uncertainty of supply is an indirect consequence of contract incompleteness, breach of contract terms, underdeveloped infrastructures or corruption.

Country service costs (for water supply, power supply, transportation) are high in sub-Saharan Africa, mainly because of lack and bad quality of network infrastructures, making both operating & capital expenditures higher for telcos. For example, **poor road infrastructures** can strongly increase the cost to develop a telecom network. Also operators must often equip their base stations with diesel power generators to offset the lack of electricity network that strongly impacts their costs. **Electricity networks** in sub-Saharan Africa are indeed mostly developed in capital cities and even when existing, they suffer power failures[69]. According to GSMA, 79% of sub-Saharan Africa base stations do not have a reliable electricity supply (GSMA 2011); meaning most of them are powered with diesel generators. Operators pay a particular attention to oil prices, as it might strongly impact their operational expenditures and erode their profitability. Operators have started to make investments in renewable energy sources – particularly in solar energy – in order to reduce this diesel dependency *(Chart 16)*. Existing **telecom infrastructure** and network development in the country (existing technologies GSM vs. 3G, broadband capacity, submarine cable…) are also factors to consider for a MTC investing in an asset on the continent.

[69] Source: Balancing Act, issue n°180, April 5th 2012

Chart 16: Base stations powered by renewable energy source
Source : African Mobile Observatory 2011, GSMA



Another type of uncertainty (which is quite unclassifiable) that impacts revenues and costs relates to **thefts**: As copper prices have strongly increased in the last ten years on the metal exchange markets, a new phenomenon has arisen: Copper cables are stolen in many countries and represent big losses for operators and major inconvenient for customers. In 2012, Togo Telecom evaluates repair, sourcing and installation of new cables at 1 billion CFA Francs (1,5 million €) over 6 months, which does not include loss of earnings for the operator[70]. The inconvenience caused to subscribers must be mentioned as well. There can also be some thefts of diesel on base stations, so security measures are taken by operators to avoid this inconvenient, such as the hiring of site security guards. This is unfortunately not always enough as thefts have happened to be done by the guards themselves in some cases.

[70] Balancing Act, n°191, September 20th 2012

c) **Firm-specific factors**

Both exogenous and endogenous environments interact on each other. In order to give the whole picture of factors that potentially affect a telecom investment in sub-Saharan Africa, this part is dedicated to the third pillar of Miller's classification of risks (1992) that relates to the firm itself. Nevertheless, these firm-related factors have not been considered for the quantitative analysis of the present work, as explained earlier.
These factors have been classified into operational and financial risks. They might impact revenues, costs and ability to conduct business.

i. **Operational risks**

Condition of assets of the acquired operator: The condition of **telecom networks** is a key issue for valuation, as well as the condition of **information systems** is a key issue for having access to company accounting and financial data.
Information asymmetry between the investor and the target can be an operational risk: According to Lee & Kwok (1988), in a foreign investment, watch over local management is difficult because of cultural gap and not adequate information systems. Moreover, it happens that fake data are communicated from the investment target to the potential investor, such as for the case of Telkom Kenya that announced to its potential acquirer Orange 5800 employees whereas it had only 1300 *(Box 2)*. Information gap might also come from accounting differences in standards between developing and developed economies, making comparison of results difficult between two companies from two countries.
Decision-making practices at company level are also important, such as the centralisation and the duration of management decisions (time notion is very important in high-velocity telecom industry), such as types of information and data used for decision-making (routine qualitative and quantitative measures needed for decisions).
Qualified staff is scarce in African telecommunication sector and there is a competition between operators to attract them. Thus expatriates are often hired at a higher cost for their technical expertise, in order to train local staff and make them operational.
Corporate governance of the local company might be a bigger source of risks than in developed economies. Damodaran (2009) underlines that even after having been publicly-traded, companies that were family-owned business keep on maintaining control by family members, making difficult or impossible for the investor any change in management. The

stake owned by the investor (whether it has a majority stake or not) will have an impact on its power over the target.

ii. Financial risks

By auditing the accounts, the potential investor may discover **some irregularities or issues**, such as undeclared commissions for favouritism towards some distributors, such as possible bad debts due for instance to incoming calls unpaid by other operators. **Branding costs** also need attention, as they can happen to be very high. Depending on its stake in the target, the investing operator will have more or less power on it, regarding its ability to **withdraw funds.**

All these risks, if they can be identified and measured, have to be taken into account in the target valuation and investment decision either in terms of probability or in terms of costs. Talking specifically about emerging markets companies, Damodaran (2009) proposes to consider as a *"bottomline (that) no matter how carefully we approach the valuation of these companies, our final estimates of value will be more volatile for these firms than for otherwise similar companies in developed markets"*.

III. Conclusion on Chapter 3 and research hypotheses

Chapter 3 details the main valuation methods and focuses on the Discounted Cash Flow method, as it is the leading method to valuate acquisitions of telecom assets. It then presents a classification of factors that might impact the valuation, whether they are related to the host country itself or to the local mobile market.

In the next chapter dedicated to quantitative analyses, the factors described in the classification have been translated into indicators.

Among **country factors**, the **demographic and stability factors** that will be used in the analyses are the population density, the urbanisation and the land area (representing the population distribution), the literacy rate and a governance indicator (representing social and political instability). The **economic and financial factors** analysed are the GDP per capita, the growth of GDP per capita, the FDI inflows, the government budget balance and the balance of trade, as well as the CPI (representing the inflation). Some macroeconomic indicators have not been included (interest rate and exchange rate), as they might be meaningless in the present analyses: MTC borrow on international markets rather than locally. Moreover, the World Bank underlines that 'the terms and conditions attached to

these rates differ by country, limiting their comparability'. This is why interest rates are not considered as a factor in the analyses. Also, manipulation of interest rates by central banks has an impact on exchange rates: a higher interest rate attracts foreign capital, which will increase the exchange rate. Choice has been made to keep inflation as representative of indicators of country economic health (under the form of the Consumer Price Index). All **governance and political factors** have been gathered into governance indicators in the analyses, such as the Worldwide Governance Indicator or the Index of Economic Freedom.
Regarding competition and market factors are represented by the indicators of market penetration, market size (number of subscriptions), number of operators on the market and market shares. Entry and exit barriers might be considered as captured by governance indicators. Changes in technology and network have not been considered in analyses, as simple indicators cannot easily capture them. This is also the case of the propensity of subscribers to accept price increases and of the suppliers' power. There is no historical quantitative data by country for prepaid usage, for multiSIM usage and for country service costs (road, electricity…).
As a reminder, firm-specific factors are not part of the analysis' scope. Nevertheless, some additional indicators that are not part of the classification will be tested in the analyses, such as the DJTTEL international market index.

Based on the knowledge we have of African telecom markets and on the literature, some **research hypotheses** have been made about the level of deal prices and they will be verified in the analyses.

As deal prices are based on a valuation calculation and as valuation is based on future profits, deal prices should incorporate the explosion of growth in the mobile industry in Africa over this period of time and thus be increasing **over the 2000-2010 decade**.
H0: Deal amounts per capita (license awards and operators' acquisitions) increase over the 2000-2010 decade.

Based on intuition and perception we have of what have been MTC investments in Africa over the decade, we expect that **a major part of the deal amounts** will be determined by factors related to the host **country** of investment, to its mobile **market** and to its political and **governance** context.
H1: A large share of deal amounts per capita is based on "local" factors (country, market and governance factors).

Among these "local" factors determining a large share of deal prices, based on the international business literature about the influence of governance and local institutions on foreign investments inflows, we expect governance factors (including political and stability factors) to be the main determinants for deal amounts. As a reminder, Musonera (2008) studies the impact of host country factors (economic, financial and political risks) over the FDI flows to sub-Saharan African countries. It states that the political risk has the highest influence on the level of FDI into the host country and that low levels of FDI to a country are due to a risky business and investment environment.
It might be interesting here to underline that contrary to main findings in the literature, according to which a good governance attracts higher foreign investments, governance seems to act ambivalently in investment choices of MTC: Some factors (loose regulation, lack of independence of regulatory bodies, civil crisis, corruption, etc.) do not foster welfare maximisation, but might foster operators' profits. These factors are not necessarily a risk for an MTC investing in a country and they may even act as positive externalities for the MTC, improving its potential profit. For example, the Ivorian crisis in 2010 was not a risk for operators who kept a stabilized ARPU, did not face any bid network damage and even increased their traffic. Another example is the comparison of MTN's EBITDA depending on countries, with their respective Worldwide Governance Indicators: In 2010, MTN South Africa had an EBITDA margin of 34% in a country that is rated 0,36 in Regulatory Quality and 0,39 in Government Effectiveness[71] and MTN Nigeria had a much higher EBITDA margin of 62,9% in a country rated -0,7 in Regulatory Quality and -1,15 in Government Effectiveness. Also the EBITDA margin of Orange Mali was 59% in 2010 despite the politically risky aspect of Mali. These examples illustrate the fact that political risk and loose governance might play a role in operators' profits, and this role might be positive or negative.

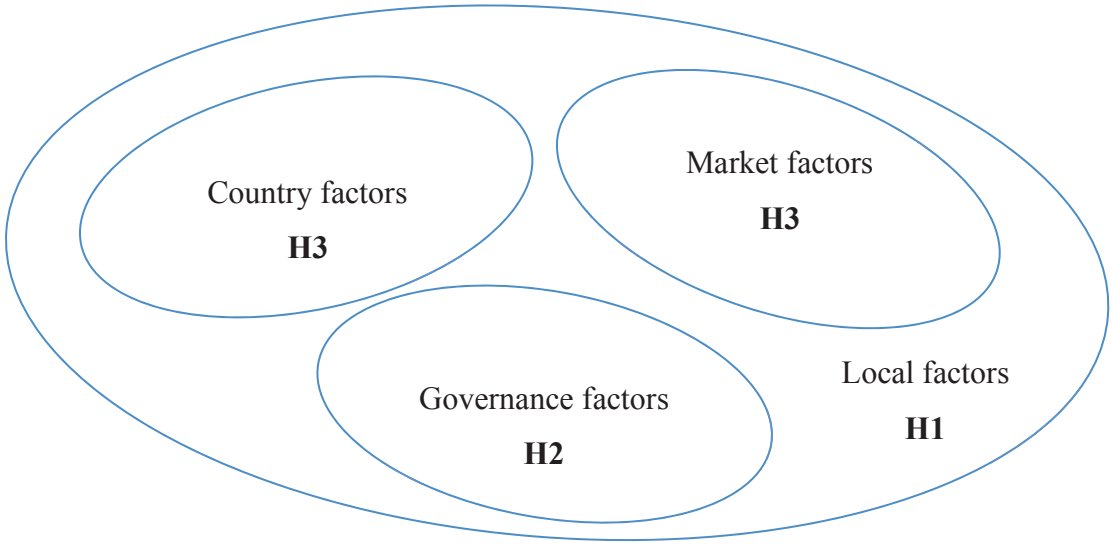
H2: Governance factors (including political and stability factors) are the main determinants for deal amounts, wether their impact is positive or negative.

Also Musonera (2008) states that other host country factors (economic and financial) have a lesser impact on the level of FDI into the host country.
H3: Country and market indicators have a secondary impact on deal amounts.

[71] Reminder : WGI scale is from -2,5 to 2,5.

Summed up here, the **hypotheses** capture the effects of local factors on the level of amounts of deals:
H0: Deal amounts per capita increase over the decade.
H1: A large share of deal amounts per capita is based on "local" factors (country, market and governance factors).
H2: Governance factors (including political and stability factors) are the main determinants for deal amounts.
H3: Country and market indicators have a secondary impact on deal amounts.

The following schema illustrates how our H1, H2 and H3 hypotheses are intermingled.



These research hypotheses about the level of deal prices will be tested in the different quantitative analyses made in Chapter 4.

CHAPTER 4

TELECOM ASSET VALUE IN SUB-SAHARAN AFRICA OVER 2000-2010: QUANTITATIVE ANALYSES

CHAPTER 4: TELECOM ASSET VALUE IN SUB-SAHARAN AFRICA OVER 2000-2010: QUANTITATIVE ANALYSES

In order to tackle the issue presented in the introduction chapter, quantitative and qualitative data have been collected to build a database. Data have been progressively collected from various sources. Some of them have finally not been used in the analyses, as the database has changed and evolved throughout the research process.

As a reminder, the research question is the following: "To what extent 'local' factors (characteristics and risks of the host country and of its telecom market) have an impact on the valuation of telecom investments in sub-Saharan Africa?" The relationship between deal amounts and different factors (deal-, country-, market- and governance-related) has been tested in three types of analyses that will be detailed in this chapter.

The first two analyses are descriptive. The first one has been made in two dimensions. It details the simple pair-wise correlations between deal amounts and the different factors. It results in weak correlations; no factor appears to be significant in this first type of analysis.

The second analysis, still descriptive, is in multidimensions (Principal Component Analysis or PCA). The PCA gives unexpected results; country size and economic dynamism appear as being more significant than governance factors in determining the level of deal amounts.

The last type of analysis is made of regressions. They highlight that around 30% of variance can be explained by the factors tested, meaning that the rest of variance is due to other factors.

This chapter presents the corpus and the different factors tested, and details the three types of analyses conducted.

I. Corpus presentation

An original database has been built that includes data on the investments made by 11 MTC in the period 2000-2010 in the 35 sub-Saharan countries included in the scope. The investments covered are licences awarded, licenses' renewals and acquisitions of local operators' stakes. The MTC included are: MTN, Orascom, Glo, Sudatel, Vodafone, France Télécom (Orange), Tigo (Millicom), Vivendi (Maroc Telecom), Bharti Airtel, Essar Communications and Etisalat. And the 35 countries covered are: Benin, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo Brazzaville, Côte d'Ivoire, Democratic Republic of Congo, Djibouti, Eritrea, Ethiopia, Gambia, Ghana, Guinea

Republic (Conakry), Guinea Bissau, Kenya, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, Sudan, Tanzania, Togo, Uganda, Zambia and Zimbabwe. Among these 35 countries, 6 of them have not got investments in mobile licenses or operators' acquisitions from these MTCs (Djibouti, Eritrea, Ethiopia, Gambia, Somalia and Zimbabwe), meaning that the database includes deals that have taken place in 29 countries (Detail on the scope of research was given in Chapter 1).

The database contains 176 deals (102 licences awarded and 74 operators' acquisitions). Among these 176 deals, 76% could be taken into account in the analysis as their amounts have been publicly disclosed: This concerns 70% of licences and 84% operators' acquisitions. Among the licences whose amounts have been stated, 66% are 2G licences, the rest are 3G and neutral ones.

P.Curwen (2010)[72] has worked on the changes in strategic stakes of MTC in a retrospective of mobile industry between January 1999 and December 2008. He has built some databases about 30 mobile operators that include their footprint and their strategic interests in stakes or license by continent[73], as well as their market value. His work was a first attempt for a 10 year-retrospective on the mobile industry in the world.

The present database of this thesis focuses on Africa as host continent for these strategic interests and brings a new approach by including the deal amounts for each acquisition of stakes or of licenses. Including detailed data on deal amounts and historical local data, this is a first attempt at gathering, in the same corpus, data on telecommunication deals on the African continent over a ten year-period.

As from this database, an inductive method has been applied: As from amounts of real deals and corresponding local factors (country & markets characteristics & risks), we will attempt to modelize the existing link between both. The Stata statistical software has been used for all econometric analyses of this research.

[72] Peter Curwen, Jason Whalley, (2010),"Mobile operators in the new millennium - retrospect and prospect", info, Vol. 12 Iss: 3 pp. 30 - 45

[73] Western Europe, Eastern Europe, Asia Pacific, Middle East, Africa, North America, Latin America

a) **Indicators included and excluded**

For each deal, the database contains the following quantitative and qualitative data. They will be detailed later on in the document.

- **General data for all deals:** MTC investing, country of investment, whether it is a license or an operator's stake, year and month of the deal, deal amount (US$)
- **Specific data for licenses:** licensee, license generation, award method, award date, end date, license duration, total license price (initial fee), total license price harmonized over 15 years, license price per capita, license price per capita harmonized over 15 years, license price per subscription, license price per subscription harmonized over 15 years
- **Specific data for operators:** operator acquired, % of stake acquired, implied 100% equity value, acquisition date, total deal amount, deal amount per capita, deal amount per subscription, other shareholders
- **Country data for all deals:** country population, population density, urbanisation rate, literacy rate, land area, maritime or landlocked country, oil country or not, islamic country or not, GDP, GDP growth, GDP per capita, GDP per capita growth, FDI amounts (US$), FDI inflows (% GDP) over 5 years, 'government budget' ratio = (government revenues + government expenditures)/GDP), 'trade' ratio = (imports + exports)/GDP), Consumer Price Index (base 100, 2005) yearly average, host country currency, common language or not between origin country of investment and host country of investment
- **Telecom market data for all deals:** mobile market penetration, mobile subscriptions (equals number of SIM cards), market competition (number of operators on the market at the date of the deal), market share, market maturity, whether the incumbent operator had been privatized or not at deal date, whether the operator concerned by the deal is mobile only or also includes fixed activities
- **International markets:** DJTTEL index at the date of the deal
- **Governance, regulation & risks data for all deals:**
  - The Index of Economic Freedom (overall score and its 4 components): Rule of Law (includes property rights and freedom from corruption), Limited Government (includes fiscal freedom and government spending), Regulatory Efficiency (includes business freedom, labor freedom and monetary freedom) and Open Markets (trade freedom, investment freedom and financial freedom)

- Worldwide Governance Indicators (6 components): Voice & accountability, Political stability, Government effectiveness, Regulatory quality, Rule of law, Control of Corruption

b) **Harmonization and allocation rules**

Year of the deal:
All the data included in the database and related to countries, telecom markets, governance and regulation correspond to the year of each deal. For instance, for the 2G license acquired by MTN in Cameroun in 2000, the corresponding GDP, population, etc. that have been used to make the analysis are those of the year 2000.

Multi-country acquisitions:
Regarding acquisitions of operators made by one MTC across several geographies, the amount publicly disclosed is for the whole geographic scope: the acquisition of Zain's African assets by Bharti in 2010 (10.7Bn$), the acquisition of Warid African assets by Essar in Uganda and Congo in 2009 (160m$), the acquisition of Atlantique Telecom African assets by Etisalat in Côte d'Ivoire, Benin, Burkina Faso, Niger, Togo and Central African Republic (50% in 2005 for 118m$, 20% in 2007 for 114m$, 12% in 2008 for 68m$ and 18% in 2010 for 75m$) and the acquisition of Investcom assets by MTN in 2006 for 5.5m$ in nine countries (Benin, Cyprus, Ghana, Guinea Bissau, Liberia, Sudan, Syria, Yemen, Afghanistan and Guinea) with different shares of ownership by country. In order to get the amounts of deals by country, an allocation has been made by revenues by country (for Bharti and Essar) or by number of subscribers by country (for Etisalat and MTN) - depending on the information available.

Licenses' duration and percentage of stakes:
Most of licenses of the database have a 15 year-duration. For harmonization and coherence in calculations, the amount of licenses that do not have this duration (some of them are 10

years for example) has been calculated as if the license was 15 years[74]. In this way, all license amounts are comparable as they are all corresponding to a 15 year-duration.
Following the same rationale, operators' acquisitions are not always for 100% of stake. When the acquisition is only a percentage of operator's stake, the amount of this acquisition has been 100% implied equity in order to get a harmonized view of valuations. For example, the acquisition made by MTN in Cameroun in 2000 cost 140m$ for 70% stake in Camtel Mobile, but is considered in the database as 200m$ for 100% implied equity value.

c) **Data sources and methodological issues**

The data sources used to develop this database are Telegeography, operators' annual reports, the World Bank databank, the International Monetary Fund, the GSMA, the Heritage Fundation (for the Index of Economic Freedom) and the World Bank (for the Worldwide Governance Indicators). These sources have been detailed in *Appendix 3.*

The main methodological issues that have arisen during the development of the database are related first to the complexity of the telecommunication industry, then to the geographical scope.
Since the 1990s, telecom operators had to adapt to massive changes in the market, in the demand, in technologies and thus, their strategies, their organizations and their regulations have evolved. This is why the database is subject to a tricky issue: the evolution of operators' names in the last two decades, as it is quite common to find different names relating to one company or one network.
Curwen (2010) details what can be the complexity of building a database in the area of telecom operators' stakes: *"These (names) may relate either to the majority owner of the network, to a minority owner whose name is nevertheless used because it is better known than that of the other owners, to the traditional name of the network itself or to the brand name of the main service(s). Operators themselves can be the source of added confusion by applying for licences using the names of existing or newly created subsidiaries or via joint ventures. Furthermore, for a variety of reasons, the preferred name of a network may*

[74] In order to take into account the time value of money, the formula used is the following: x+(x*1.1^15-x*1.1^t)/1.1^t (with a Weighted Average Cost of Capital equal to 10% and x the license price on a t duration with t≠15.

evolve over time without due recognition being taken of this by the media. (…) A number of operators built up international empires, and these empires became increasingly complicated." In order to overcome this issue and to rationalize the database, decision has been taken to consider that the deals have been made by the 11 MTC covered by the scope and not by the affiliates.
For instance, for a licensee called Zain in 2000, deal is considered as having been made by Bharti, as Bharti has acquired Zain's assets over the period 2000-2010.
The geographical scope has also been an issue when building the database: Data collection is a challenge when researching about Africa because there is still a limited amount of historical and reliable data on the continent.

II. Factors' definitions and data sources

This part describes all the variables used in the following analyses. It clarifies the way they were calculated, their units and their sources. It concerns:

- Deal-related factors
- Country-related factors
- Local mobile market factors
- Governance and regulation factors

The governance and regulation factors were subject to a particular consideration, as they were expected to have the largest impact on deal amounts. But results have shown this was not the case.

a) Deal-related factors

'Deal amount per capita'

- For licenses, the **amount per capita** (in US$) is the total license price harmonized over a 15 year-period (by a Net Present Value methodology) divided by country population at deal date. For instance, a 10-year license awarded for a price 'P_0' of 61m US$ is used as a 15-year license awarded for a price 'P1' of 98,2m US$, based on the following calculation: $P_1 = P_0+(P_0*1,1^{15}-P_0*1,1^{10})/1,1^{10}$ (with a WACC=10%).
- For operators' acquisitions, the **amount per capita** (in US$) is the total implied 100% equity value of the deal (by a simple cross product, which is a methodology used by investment banks for this) divided by country population at deal date. For

instance, 70% stake acquired in an operator for 140m$ is considered as a 100% stake of 200m$.

- Sources are Telegeography and operators' annual reports for deal amounts and World Bank databank for country population.
- For the descriptive analysis, the amount per capita has been kept in US$. For the Principal Component Analysis (PCA), it has been transformed into a standard normal distribution variable.

'Deal amount per subscription'

- The **deal amount per subscription** is computed as the deal amount per capita (in US$), except that instead of dividing the total amount by the country population at deal date, it is divided by the number of mobile subscriptions in the country at deal date.
- Source is WCIS - World Cellular Information Service (Informa UK).

'Award method'

- **'Award method'** (binary variable): This indicator is for licenses only. The award method is either auction or another award method (This includes beauty contests and granted licenses).

'Fixed/Not'

- **'Fixed/Not'** (binary variable) indicates – for operators' acquisitions - whether the operator acquired has fixed activities. This concerns the following operators: Onatel (Burkina Faso), Ghana Telecom (Ghana), Telkom Kenya (Kenya), Sotelma (Mali), Mauritel (Mauritania) and Zantel (Tanzania).

'Market shares'

- **Market share** is the percentage of the total sales volume in the local mobile market that is captured by the operator.
- Its unit is a percentage of total market volume.
- When the deal is an operator acquisition, market share is the one of the local operator acquired. In case of a license renewal, market share is the one of the operator that operates under this license. In case of a license award, market share has been considered as equal to 0%, as it is a totally new business. For the

regression analysis, this indicator has been used under logarithm: then it has been considered as equal to 0,01%, as log0 is not defined.

- Data filled in for this indicator are approximative and results to be considered with precaution. Sources are multiple: WCIS World Cellular Information Service (Informa UK), Business Monitor International, Crédit Suisse.

b) **Country factors**

'GDP per capita'

- The **GDP per capita** (in constant 2005 US$) is "gross domestic product divided by mid-year population". Source is World Bank databank.
- For the descriptive analysis, the GDP per capita is in constant US$. For the PCA, is has been transformed into a standard normal distribution variable.

'GDP per capita growth'

- This indicator is based on the country GDP (in constant 2005 US$). It is the change in the country GDP per capita over 5 years: between year y-2 before the deal and year y+2 after the deal. For example, 2004 growth of each country is the increase or decrease in GDP calculated between 2002 and 2006.
- World Bank databank is the source for country GDP per capita.

'FDI'

- FDI inflows are Foreign Direct Investment net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. This is in % of GDP. The indicator called **'FDI'** is the average over 5 years of these FDI inflows: For example, '2004 FDI' of each country is the average of FDI inflows calculated between 2002, 2003, 2004, 2005 and 2006.
- World Bank databank is the source for FDI inflows.

‘Trade’

- This indicator called **‘Trade’** is a ratio of country imports plus exports over GDP. This “commercial dynamism” indicator shows on what extent trade exchanges are strong or not compared to the country economic activity.
- Imports are imports of goods and services (in constant local currency) and exports are exports of goods and services (in constant local currency).
- Source for imports, exports and GDP (all in constant local currency) is World Bank databank.
- Unit is % of GDP.

‘Government budget’

- **‘Government budget’** is a ratio of government revenues minus government expenses over country GDP. This indicator shows the level of public finance crisis.
- General government revenue (in local currency) ‘consists of taxes, social contributions, grants receivable, and other revenue’. General government expenditure (in local currency) ‘consists of total expense and the net acquisition of nonfinancial assets’.
- A common source has been chosen for governement revenues, government expenditures and GDP: the International Monetary Fund Economic Outlook database.
- Unit is % of GDP.

‘Country population’

- Source of the indicator **’country total population’** is World Bank databank. It is ‘based on the de facto definition of population, which counts all residents regardless of legal status or citizenship - except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of their country of origin. The values shown are midyear estimates’.
- Country population is used for the deal amount per capita calculation. It has not been used in the descriptive analysis, but for the PCA, it has been transformed into a standard normal distribution variable.

‘Land area’

- Source of the indicator **‘land area’** is World Bank databank, that gives the following definition: ‘Land area is a country's total area, excluding area under inland water bodies, national claims to continental shelf, and exclusive economic zones. In most cases the definition of inland water bodies includes major rivers and lakes.’
- Its unit is square kilometers.

‘Population density’

- Source of the indicator **‘population density’** is World Bank databank that gives the following definition: ‘Population density is midyear population divided by land area in square kilometers.’
- Unit is the number of people per square kilometer of land area.

‘Urbanisation rate’

- This indicator is the **‘urban population’**: It ‘refers to people living in urban areas as defined by national statistical offices.’
- Its unit is % over total population.
- Source is the World Bank databank.

‘Literacy rate’

- **Literacy rate** is the ‘percentage of people ages 15 and above who can, with understanding, read and write a short, simple statement on their everyday life.’
- Its unit is % of people ages 15 and above.
- Source is the World Bank databank.

‘CPI’

- The **‘CPI’** indicator represents the average annual growth of CPI (Consumer Price Index) between 2000 and 2010.
- CPI ‘reflects changes in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly’ (base 100: 2005).
- Source of the Consumer Price Index is the World Bank databank.

'Maritime/landlocked'

- **'Maritime/landlocked'** (binary variable) indicates the geographical position of the host country of investment: maritime (country with sea borders) or landlocked (country entirely enclosed by land).

'Oil country/Not'

- **'Oil country/Not'** (binary variable): Have been considered as oil countries those with proved oil reserves in 2010 (Source: Ernst & Young, 2010[75]).

'Islamic country/Not'

- **'Islamic country/Not'**(binary variable): Have been considered as Muslim countries those in which at least 40% of total population was Muslim in 2010 (Source: Pew Research, 2010[76]).

'Currency'

- **'Currency'** (binary variable) indicates the currency of the host country of investment: Euro-pegged currency (local currency is CFA Francs) or other.

'Language'

- **'Language'** (binary variable) indicates whether the home country of investment (country of the investing MTC) and the host country of investment speak a common or a different language.

c) **Local market factors**

'Market size'

- **Market size** is the number of mobile subscriptions in the country (number of SIM cards).
- Source is WCIS World Cellular Information Service (Informa UK).

[75] http://www.ey.com/GL/en/Industries/Oil---Gas/Africa-oil-and-gas--a-continent-on-the-move---The-African-oil-and-gas-landscape (accessed 09June14)
[76] http://www.pewforum.org/2011/01/27/table-muslim-population-by-country/

‘Mobile market penetration’

- **Mobile market penetration** measures the adoption of mobile services in the country population. It is basically the number of subscriptions (SIM cards) divided by total population multiplied by 100.
- Its unit is % of total population.
- Source is WCIS World Cellular Information Service (Informa UK).

‘Competition’

- This **‘competition’** indicator gives the number of operators already competing on the market at the date of the deal.
- Its unit is the number of operators.
- Sources are Telegeography and GSMA.
- For the descriptive analysis, ‘competition’ is in number of operators. For the PCA, it has been transformed into a standard normal distribution variable.

‘Market maturity’

- **‘Market maturity’** is the ratio between the market penetration of the country at deal date and the multiSIM rate at deal date.
- The hypothesis has been made that a greater competitive pressure tends to increase the multiSIM rate: the more operators there are on the market, the higher the multiSIM rate, following a logarithmic curve. This has been based on the hypotheses made by F. Bresson and C. Bisson (2010). MultiSIM rate is 1 when there is only one operator on the market. For 2 operators, it is considered that every subscriber on the market has at least 1 SIM card and 1/3 of subscribers have a second SIM card. The multiSIM rate M has been computed this way, with x the total country subscriber base and n the number of operators on the market (Hypothesis has been made that all SIM cards in circulation are active SIM cards):

$$Mn = x + \sum_{n=1}^{N-1} \frac{x}{3^n}$$

This makes a multiSIM rate of 1 for 1 operator on the market, a rate of 1,33 for 2 operators, 1,44 for 3 operators, 1,48 for 4 operators, etc.

'Privatization'

- **'Privatization'** (ternary indicator) indicates whether the telecommunication incumbent operator has been privatized or not at the date of the deal. Its result can be: privatized incumbent, incumbent not privatized or privatization has been a failure.

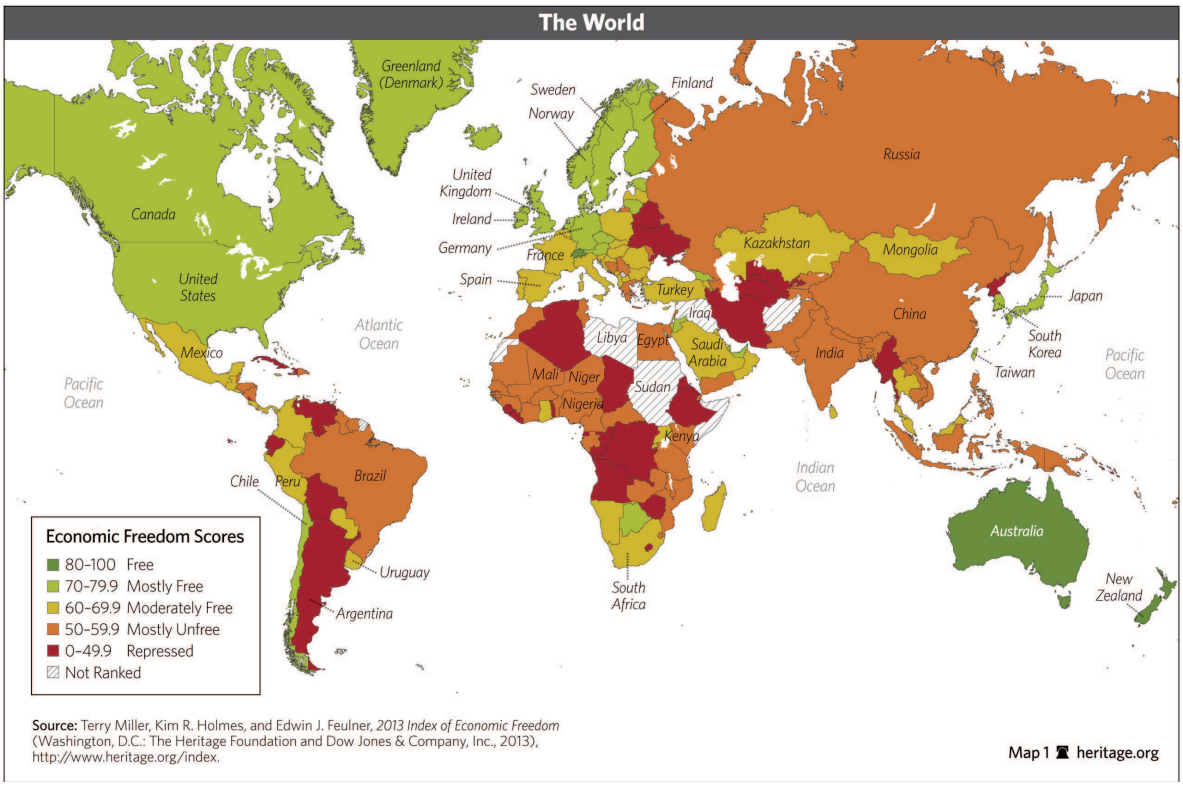
d) **Governance and regulation factors**

As explained earlier, governance and regulation factors were subject to a specific work, as their impact on deal amounts were expected to be high.

In the past few years, datasets of different indicators have been developed related to governance, regulation and country risk, due to the increasing demand from researchers and policymakers (Thomas, 2010). The importance of governance and country risk management is generally accepted and as Damodaran (2009) states, *'Even the best run companies in an emerging economy will find themselves hurt badly if that economy collapses, politically or economically.'* Nevertheless, these indicators have to be taken with due caution, mainly for methodological issues (Williams, 2008). Indicators provided by the World Bank (Doing Business, Worldwide Governance Indicators…), by PRS Group (International Country Risk Guide), the Heritage Fundation (Index of Economic Development) and Transparency International are among the most known (Knoll, 2011). These indicators refer to the risk of investing in a particular country, based on the political, economical, financial and regulatory environment. They are named 'country risk' or 'economic freedom', depending on the definitions and methodologies used.

As shown on the map below, risks are higher in emerging economies than in developed economies.

Map 4: 2013 World Economic Freedom map
Source: heritage.org



Several organizations follow up and rate evolution of country risk. One of them is the PRS Group that publishes the ICRG (International Country Risk Guide)[77]. This rating has been made since 1980 on a monthly basis over 140 countries. They are based on three pillars: political, economic and financial risks. Political risks components included are government stability, socio-economic conditions, investment profile, internal conflict, external conflict, corruption, military in politics, religious tensions, law and order, ethnic tensions, democratic accountability and bureaucracy quality. Each of these components is measured according to sub-components: Socio-economic conditions are for instance based on unemployment, consumer confidence and poverty. The second pillar, the economic risk rating, is based on GDP per head, real GDP growth, annual inflation rate, budget balance as

[77] https://www.prsgroup.com/about-us/our-two-methodologies/icrg

a percentage of GDP and current account as a percentage of GDP. The third and last pillar - financial risk - is made of foreign debt as a percentage of GDP, foreign debt service as a percentage of exports of goods and services, current account as a percentage of exports of goods and services, net international liquidity as months of import cover and exchange rate stability. The weighted average of these three indicators (political, financial and economic) gives a composite risk rating that classifies countries into very low, low, moderate, high, very high risk. ICRG has been used in academic research on country risk (Erb & al. 1996, Musonera 2008).

Another way to assess the exogenous environment that shall impact an investment is to look at the country economic freedom. Economic freedom is a "composite that attempts to characterize the degree to which an economy is a market economy – that is the degree to which it entails the possibility of entering into voluntary contracts within the framework of a stable and predictable rule of law that upholds contracts and protect private property, with a limited degree of interventionism in the form of government ownership, regulations and taxes." (Berggren 2003)

The Index of Economic Freedom[78] (named EFI here after) has been created in 1995 jointly by the American think tank "The Heritage Foundation" and the Wall Street Journal. It aims at measuring the economic freedom in the world every year since 1995 over 185 countries, based on ten criteria classified into four main pillars: rule of law (property rights, freedom from corruption), limited government (fiscal freedom, government spending), regulatory efficiency (business freedom, labour freedom, monetary freedom) and open markets (trade freedom, investment freedom, financial freedom). *Appendix 4* gives the definitions of the ten criteria.
Another dataset of economic freedom is the Economic Freedom of the World Index that is published every year by the Fraser Institute[79]. This index has covered 141 countries with historical data since the 1970s. It has been used more extensively in scholarly research than the Index of Economic Freedom of Heritage Foundation, as it is considered to use less subjective indicators. But both indexes (by the Fraser Institute and by the Heritage

[78] http://www.heritage.org/index/
[79] http://www.freetheworld.com

Foundation) have demonstrated to be similar (Caudill & al. 2000, Haan & Sturm 2000), showing up to 85% of correlation between their rankings (Hanke & Walters 1997).

The Worldwide Governance Indicators (named WGI here after)[80] are another way to track governance indicators. This dataset has been produced by Daniel Kaufmann (Revenue Watch and Brookings Institution), Aart Kraay (World Bank Development Research Group) and Massimo Mastruzzi (World Bank Institute), reporting 'aggregate and individual governance indicators for 215 economies over the period 1996–2012' (Kaufmann & al. 2009, 2010). Six indicators are aggregated based on 31 different sources, such as think tanks, survey institutes, NGOs, private sector firms, etc.:

- Voice & accountability (VA)
- Political Stability and Absence of Violence/Terrorism (PV)
- Government effectiveness (GE)
- Regulatory quality (RQ)
- Rule of law (RL)
- Corruption (CC)

Appendix 5 gives the definitions of these 6 pillars. Their measures are in units of a standard normal distribution, with mean zero, standard deviation of one, and running from approximately -2.5 to 2.5, with higher values corresponding to better governance.

Choice of governance and regulation indicators for the present research

Williams & Siddique (2008) give the pros and cons of several indicators, with a review of methodological issues in governance research. All governance and risk indicators have been challenged and criticized in the literature, mainly for methodological reasons (Arndt & Oman 2008, Thomas 2009, Langbein & Knack 2010).

The ICRG dataset is payable and choice has been made to go for a free dataset for this research.

[80] http://info.worldbank.org/governance/wgi/index.aspx#home

Among free datasets, the **Worldwide Governance Indicators** (WGI) have been preferred for this research, as they are the most widely used governance indicators (Knoll and Zloczysti, 2011), they are in free access and cover a large number of countries including historical data that fit to the present work. The WGI have been used in the three types of analyses.

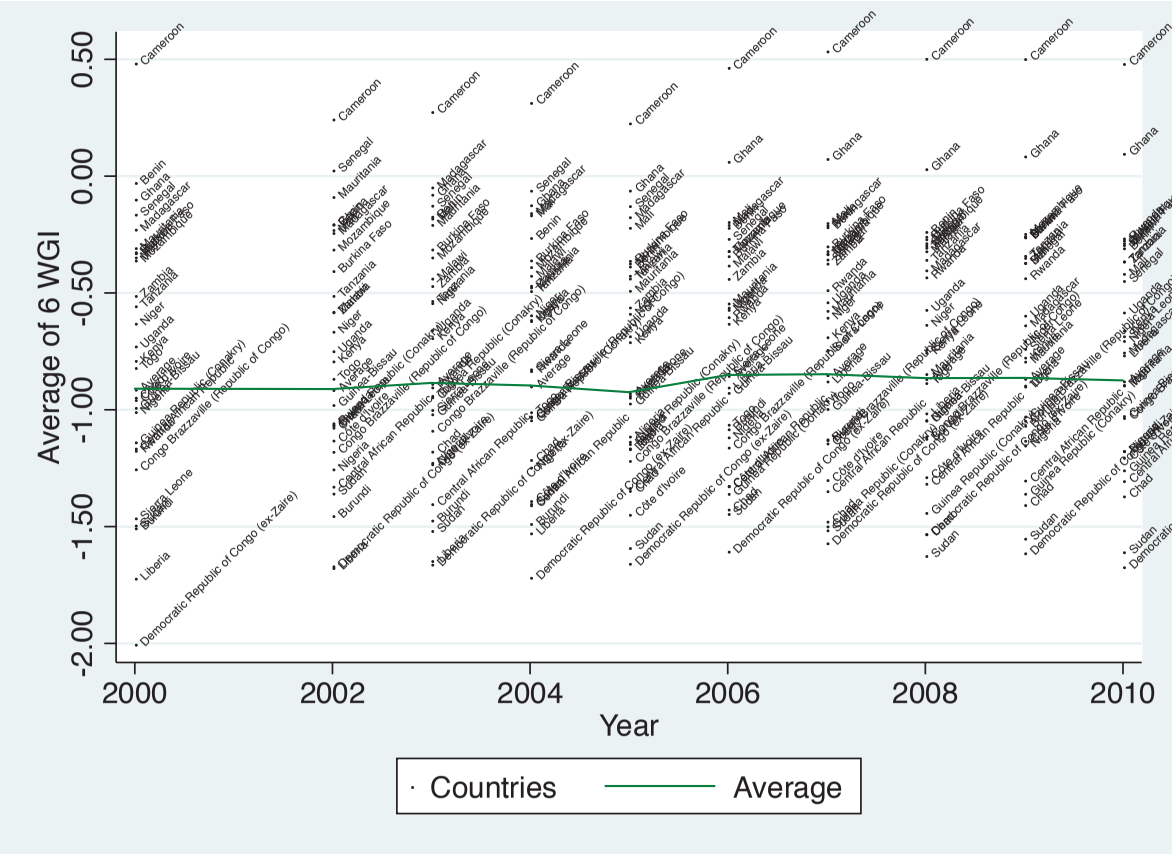
The **Index of Economic Freedom** (EFI) by the Heritage Fundation has also been used in the present research, in regression analyses, in order to confirm that governance factors do not appear as significant variables. The EFI by the Heritage Fundation has been preferred in the present research to the index by the Fraser Institute, as the latest has some missing historical data on our needed geographical scope (Burkina Faso, Mauritania, Niger, Nigeria, etc.).

Choice of a relevant WGI among the 6 WGI

Objective of this part is to show the existing correlations between the six WGI on our sample and to select the most representative one to be included in the analysis of MTC deal amounts. This correlation has been analysed in previous works (Lahimer, 2009).

A descriptive analysis of WGI has been conducted. It covers the 29 sub-Saharan African countries of our database (countries of research scope in which licenses' or operators' acquisitions have been made by MTCs): Benin, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Democratic Republic of Congo, Congo Brazzaville (Republic of Congo), Côre d'Ivoire, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Sudan, Tanzania, Togo, Uganda and Zambia. Total number of observations is thus 29.
A first step is to look at how each WGI behaves over a 10 year-period. 2001 data are missing, as they haven't been reported in the index. The graphs below show the evolution of the average WGI of the different countries over the decade *(Graph 1)*. Graphs of the average of each of the 6 WGI components are in *Appendix 5*.

Graph 1: WGI - Evolution of average of the 6 WGI over 2000-2010



The 6 WGI, as well as the WGI average show quite a stable trend over ten years on our sample of countries. Most of countries have a low variance over the decade: 96% of them have a variance lower than 10% for indicators RQ and RL, 93% for GE, 86% for VA and CC and 58% for PV.

For most of the indicators, Cameroon appears to be higher than other countries, followed by Ghana, Senegal and Benin: It has an average of 0.41 on the 6 WGI whereas Ghana is at -0.02, Senegal at -0,22 and Benin -0.23. This gap has to be put into perspective, as it is mainly due to the choice of countries in our sample: If we look at all the sub-Saharan African countries - between the score of Cameroon and the one of Ghana - we can find South Africa (0.35), Namibia (0.28) and Seychelles (0.13). Lowest averages are DRC (-1.67), Sudan (-1.51) and Central African Republic (-1.32).

Principal Component Analysis was then conducted on the 6 WGI in the 29 countries of our sample, with the following results:

Principal components/correlation — Number of obs = 29; Number of comp. = 6; Trace = 6; Rho = 1.0000

Rotation: (unrotated = principal)

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	5.04473	4.63376	0.8408	0.8408
Comp2	.410966	.150978	0.0685	0.9093
Comp3	.259988	.0839943	0.0433	0.9526
Comp4	.175994	.118058	0.0293	0.9819
Comp5	.0579356	.00754726	0.0097	0.9916
Comp6	.0503884	.	0.0084	1.0000

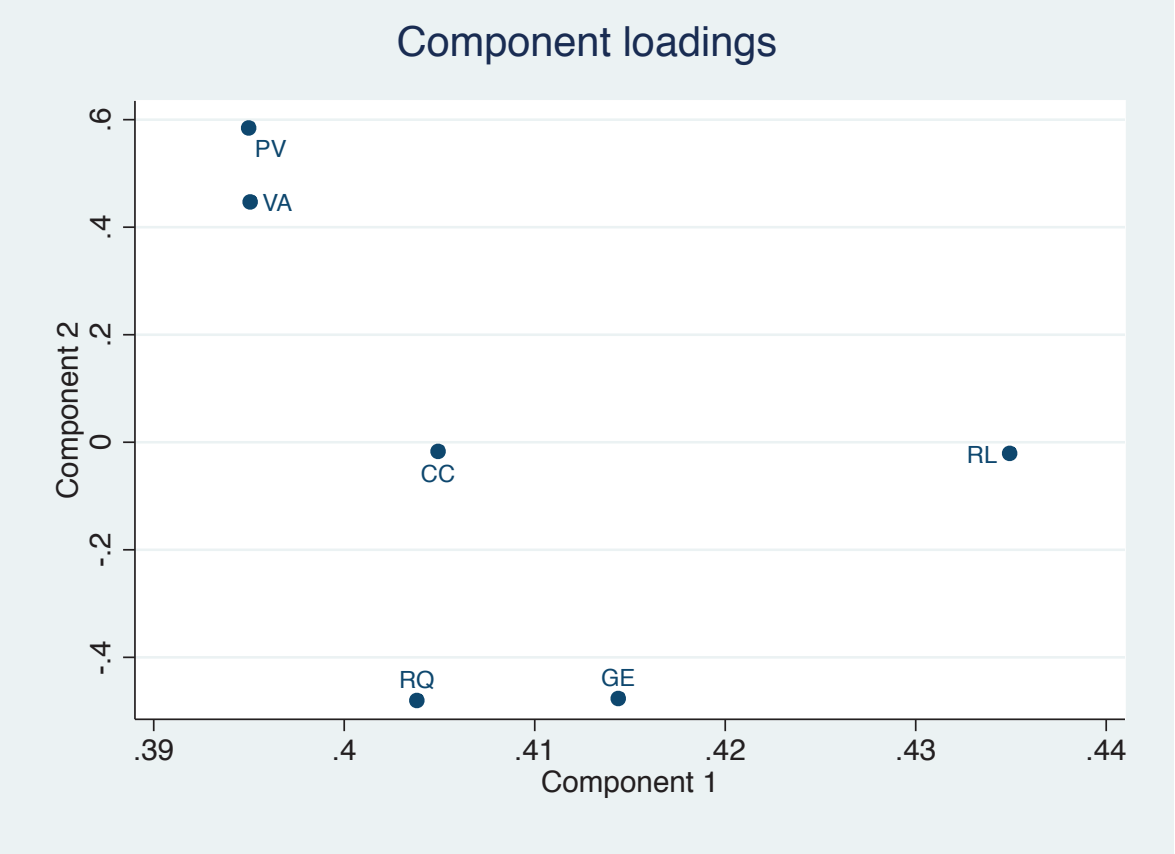
Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Unexplained
VA	0.3951	0.4469	0.5209	-0.5729	-0.0337	0.2088	0
PV	0.3950	0.5845	-0.0870	0.5964	0.3628	-0.0866	0
GE	0.4144	-0.4767	0.0413	-0.2340	0.6136	-0.4100	0
RQ	0.4038	-0.4803	0.3677	0.4323	-0.1676	0.5060	0
RL	0.4349	-0.0208	-0.0659	0.0501	-0.6781	-0.5863	0
CC	0.4049	-0.0171	-0.7615	-0.2683	-0.0534	0.4255	0

One component could be derived from these 6 items (Kaiser criteria of eigenvalue superior to 1). This component represents 84% of variance among items. This one-component model appropriate for the whole country sample confirms the dimensionality issue of WGI that has been raised in several research papers (Langbein and Knack, 2010; Knoll and Zloczysti, 2011).

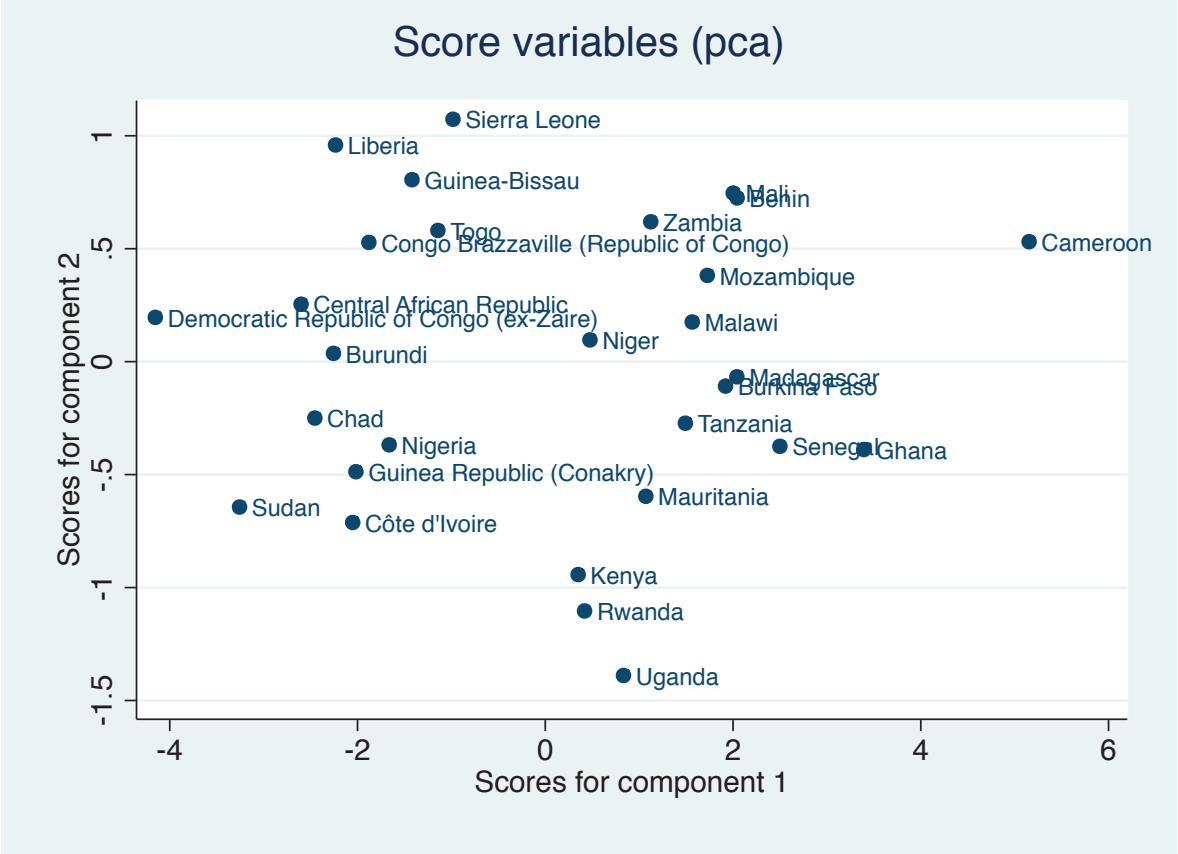
The “component loadings” graph *(Graph 2)* shows how the 6 variables are correlated to the 2 first components (90.9% of variance). All component loadings are between 0.39 and 0.44.

Graph 2: WGI component loadings



The score variable graph below (*Graph 3)* shows how each country is correlated to components 1 and 2. We will only look at Component 1 (Axis x), as it is the only component with eigenvalue superior to 1. The graph shows an overall discrimination between countries with an apparent stability on the right (Cameroon, Ghana, Senegal, Mali, Benin) and unstable countries with frequent changes in politics on the left (DRC, Chad, Liberia, Sudan, Burundi, Central African Republic). The apparent stability of countries on the right of the graph has to be put into perspective, as most of these countries have had the same government for several years or decades now.

Graph 3: WGI score variables



A similar PCA has been conducted with the indicators WGI-0 (average of the 6 WGI), WGI-1 (average of VA and PV) and WGI-2 (average of GE and RL) and gives the same country pattern as a result.

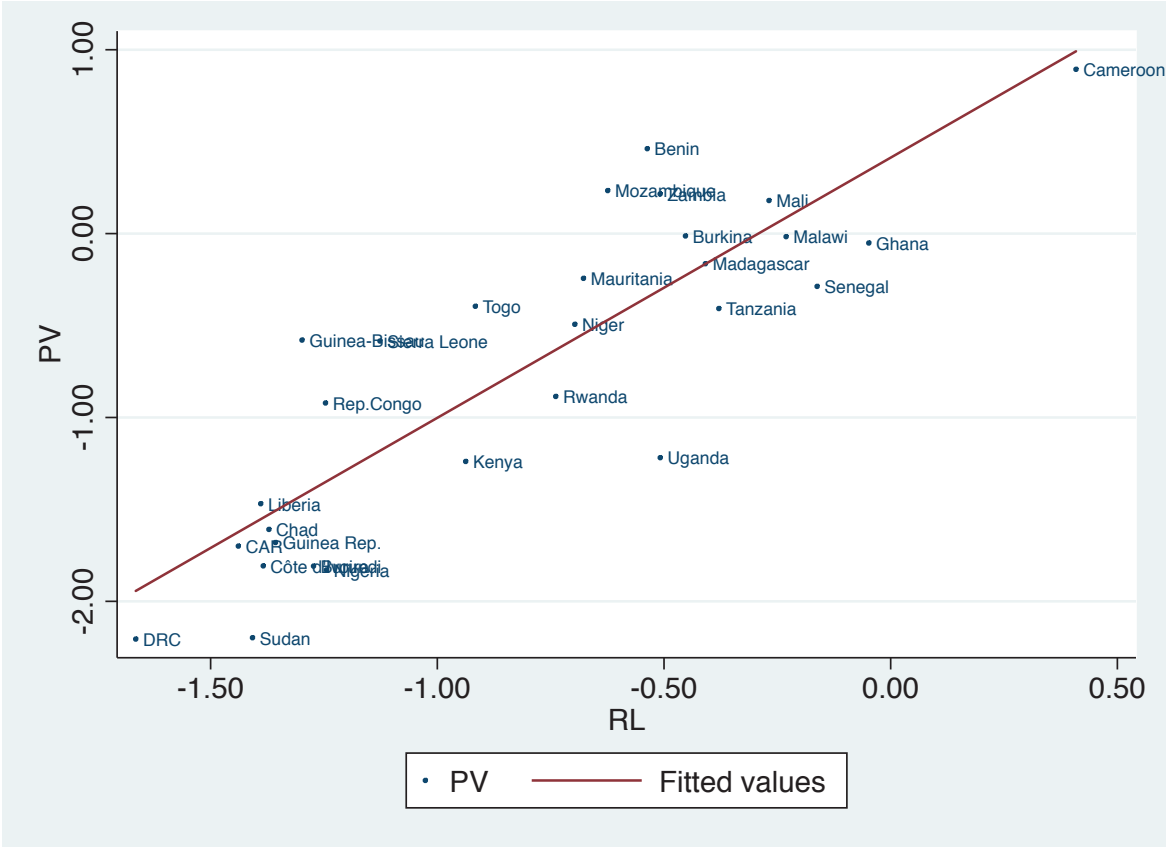
Correlation analysis by pairs of WGI has then been checked: The following table displays pairwise correlation coefficients.

```
pwcorr VA PV GE RQ RL CC
```

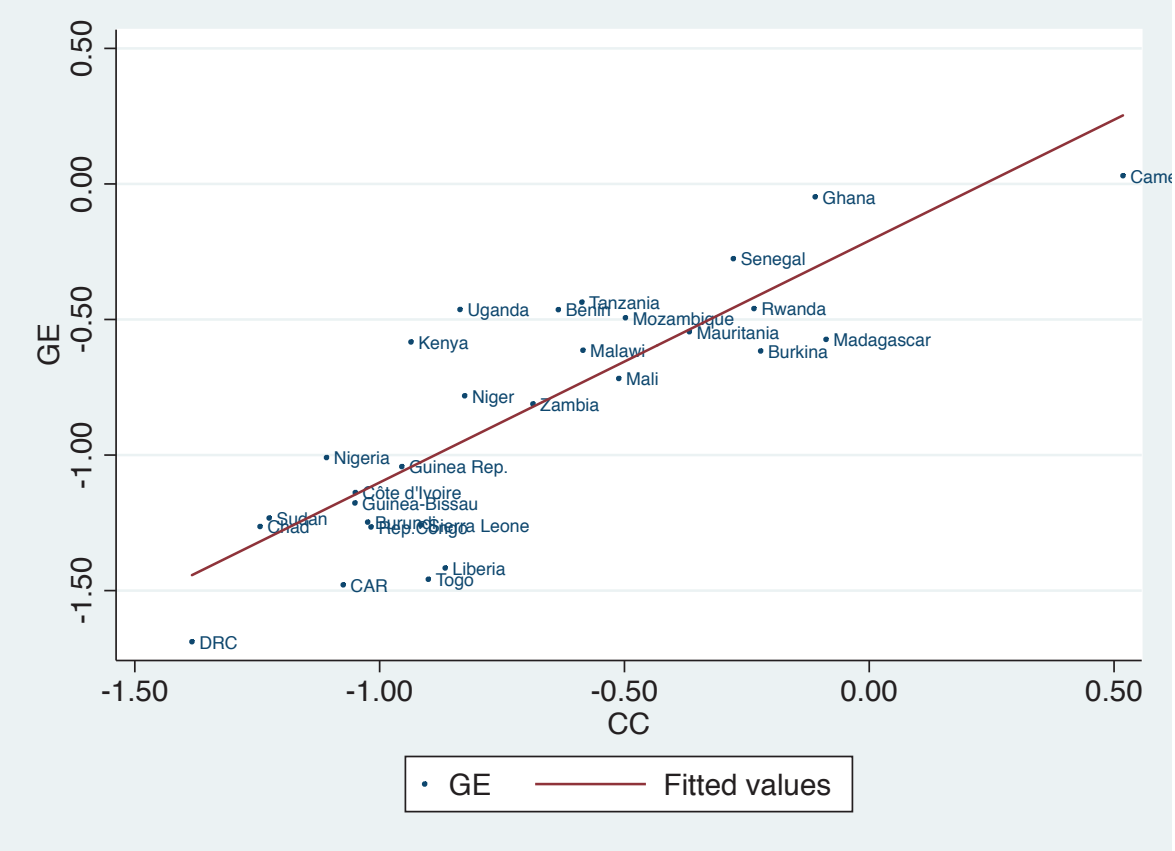
	VA	PV	GE	RQ	RL	CC
VA	1.0000					
PV	0.8210	1.0000				
GE	0.7620	0.7004	1.0000			
RQ	0.7284	0.7206	0.9080	1.0000		
RL	0.8442	0.8567	0.8985	0.8793	1.0000	
CC	0.7324	0.7888	0.8420	0.7464	0.8888	1.0000

All pairs of WGI show a strong correlation, between 0,70 (between PV and GE) and 0,90 (between RQ and GE). *Graphs 4 and 5* below are illustrations of some of these correlations (The other graphs have been included in *Appendix 5*).

Graph 4: WGI - Bivariate correlation between PV and RL



Graph 5: WGI - Bivariate correlation between CC and GE



Finally, a regression analysis has been conducted on every WGI, resulting in both examples of results below:

```
. regress RL VA PV GE RQ CC

      Source |       SS       df       MS              Number of obs =      29
-------------+------------------------------           F(  5,    23) =   63.61
       Model |  7.11892935     5  1.42378587            Prob > F      =  0.0000
    Residual |   .51482664    23  .022383767           R-squared     =  0.9326
-------------+------------------------------           Adj R-squared =  0.9179
       Total |  7.63375599    28  .272634143           Root MSE      =  .14961

------------------------------------------------------------------------------
          RL |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          VA |   .1371594   .0943923     1.45   0.160     -.058106    .3324248
          PV |   .1242255   .0711286     1.75   0.094    -.0229153    .2713663
          GE |   .1889864   .2009757     0.94   0.357    -.2267636    .6047363
          RQ |   .3111319   .1691376     1.84   0.079    -.0387559    .6610197
          CC |   .3440098   .1500794     2.29   0.031     .0335468    .6544727
       _cons |  -.0225931   .0647248    -0.35   0.730    -.1564866    .1113004
------------------------------------------------------------------------------

. regress  CC VA PV GE RQ RL

      Source |       SS       df       MS              Number of obs =      29
-------------+------------------------------           F(  5,    23) =   24.45
       Model |  4.29923195     5   .85984639            Prob > F      =  0.0000
    Residual |   .80897865    23  .035172985           R-squared     =  0.8416
-------------+------------------------------           Adj R-squared =  0.8072
       Total |   5.1082106    28  .182436093           Root MSE      =  .18754

------------------------------------------------------------------------------
          CC |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          VA |  -.131219   .1205709    -1.09   0.288    -.3806389     .118201
          PV |   .1342826   .0906658     1.48   0.152    -.0532738    .3218391
          GE |   .5590697   .2287352     2.44   0.023     .0858948    1.032245
          RQ |  -.4273686   .2088667    -2.05   0.052    -.8594424    .0047052
          RL |   .5405636    .235829     2.29   0.031     .0527142    1.028413
       _cons |  -.074496   .0798529    -0.93   0.361    -.2396843    .0906924
------------------------------------------------------------------------------
```

P-values equal zero, so the model is statistically significant. Results show for example that 93% of variability of RL and 84% of variability of CC come from the other variables. This percentage is 76% for the indicator VA, 81% for PV, 88% for GE and 87% for RQ.

Every pair of WGI shows a strong correlation on our sample, which confirms the findings of Langbein & Knack (2010), according to which the six indicators would measure the same concept without differentiating from each other.
Given the fact that even the less correlated pair of WGI (PV and GE) has a strong correlation coefficient of 0,70, only one WGI has been selected for analysis with deal amounts. The indicator with the highest R-squared (93%) is the indicator RL (Rule of Law): As it shows to be the most representative indicator of the six WGI, it has been selected as governance indicator for our research analysis.

Reconstitution of missing EFI

The EFI (Heritage Fundation) has been selected as a relevant index for some analyses. But some missing data in the EFI had to be reconstituted.
These missing data concern 9 deals[81] (4 licences and 5 operators' acquisitions) that have been made in 3 countries (Democratic Republic of Congo, Liberia and Sudan) on 6 different years (2000, 2004, 2005, 2006, 2007 and 2008).
Choice has been made to calculate them, based on a regression of EFI over the 6 WGI. This method has been chosen as being the best to assess the missing dots, even if EFI and WGI have only a 50%-correlation in our sample. The missing data concern countries with very low EFI: Democratic Republic of Congo, Liberia and Sudan are unstable countries.

[81] Out of 133 deals analysed

Results given below show the example of 2005 analysis.

```
. regress  EFI WGI_Voice2005 WGI_Polit2005 WGI_Govt2005 WGI_Reg2005 WGI_Law2005 WGI_Corr2005

      Source |       SS       df       MS              Number of obs =      38
-------------+------------------------------           F(  6,    31) =   11.06
       Model |  1032.46424     6  172.077373            Prob > F      =  0.0000
    Residual |  482.165565    31  15.5537279            R-squared     =  0.6817
-------------+------------------------------           Adj R-squared =  0.6200
       Total |   1514.6298    37  40.9359406            Root MSE      =  3.9438

------------------------------------------------------------------------------
         EFI |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
WGI_Voice2005 |  -2.588456   1.866294    -1.39   0.175    -6.394787    1.217875
WGI_Polit2005 |  -.9073677   1.320569    -0.69   0.497    -3.600687    1.785951
 WGI_Govt2005 |   .3155528   3.133895     0.10   0.920    -6.076067    6.707173
  WGI_Reg2005 |   9.815121   2.512642     3.91   0.000     4.690555    14.93969
  WGI_Law2005 |   1.096407   3.170531     0.35   0.732    -5.369934    7.562747
 WGI_Corr2005 |   .3442715   2.535622     0.14   0.893    -4.827165    5.515708
        _cons |   60.60218   1.063436    56.99   0.000     58.43329    62.77108


        regress  EFI WGI_Reg2005

      Source |       SS       df       MS              Number of obs =      38
-------------+------------------------------           F(  1,    36) =   66.35
       Model |  981.90779     1  981.90779              Prob > F      =  0.0000
    Residual |  532.722013    36  14.7978337            R-squared     =  0.6483
-------------+------------------------------           Adj R-squared =  0.6385
       Total |   1514.6298    37  40.9359406            Root MSE      =  3.8468

------------------------------------------------------------------------------
         EFI |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 WGI_Reg2005 |   8.222685   1.009433     8.15   0.000     6.175461    10.26991
       _cons |   60.24796   .8971573    67.15   0.000     58.42844    62.06748
------------------------------------------------------------------------------
```

As for the other years, around 70% of the EFI is explained by the independent variables and the only significant variable is WGI Regulation (WGI_ Reg2005). The 2005 EFI has then been calculated using the regression equation:
EFI = 8,222685*WGI_Reg2005+60,24796.
This gives a 2005 EFI of 0,47 for DRC and 0,49 for Sudan.

Conclusion on governance and risks factors

To conclude on governance and risks factors, the selected indicators for the present analyses are the WGI Rule of Law and the Index of Economic Feedom (EFI).

'WGI RL'

- **WGI RL** means World Governance Indicator / Rule of Law.
- Its definition is "perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence"
- WGIs are provided by the World Bank.
- They are standard normal distribution variable, ranked between -2.5 and +2.5. In regression analyses, nevertheless, WGI have been used under logarithm: they have thus been ranked between 1 and 5, in order to avoid log0 that is not defined.
- More details on WGIs are given in *Appendix 5*

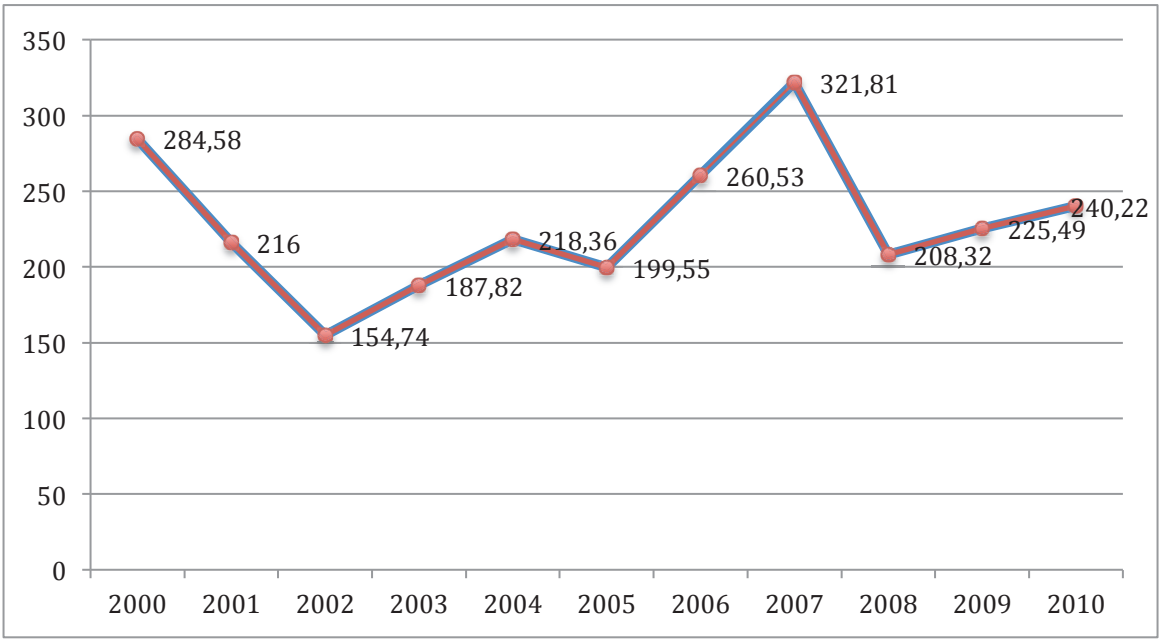
'EFI overall'

- **'EFI overall'** represents the overall Index of Economic Freedom for each country and each year.
- Its unit is a percentage (the higher the percentage the higher the economic freedom).
- Source is the Heritage Fundation.
- EFI are ranked as a percentage from 0 to 100.
- More details on the Index of Economic Freedom and on the reconstitution of missing data are given in *Appendix 4*

e) **International market factor**

DJTTEL index means Dow Jones Telecommunications Titans 30 Index and measures the performance of the largest stocks within the telecommunications sector, including the world largest telecommunications companies. *Chart 16* shows DJTTEL evolution over the decade 2000-2010. The 2002 dip in the curve is the consequence of the bursting of the Internet bubble; the 2008 dip reflects the world economic crisis.

Chart 17: Evolution of DJTTEL Index over 2000-2010



For the analyses, the DJTTEL Index has been transformed into a standard normal distribution variable. It has then been included as an independent variable, in order to test the impact of international financial markets towards the telecom sector.

All the factors presented in this part – deal-related, country, local, international markets and governance factors - have been used for the three following types of analyses: the descriptive analysis in 2 dimensions, the descriptive analysis in multidimensions (Principal Component Analysis) and the regression analyses.

III. Descriptive statistical analysis in two dimensions

The purpose of this part is to present the main features and trends of the data included in the database. In terms of statistics:

- 74 acquisitions of operators' stakes over 2000-2010 have been identified and collected, and the corresponding deal amount is available for 62 of them (84% of acquisitions of operators' stakes are analysable)

- 102 licenses acquisitions over 2000-2010 have been identified and collected, and the corresponding deal amount is available for 71 of them (70% of licenses are analysable)
- In total, 133 deals are analysable (amounts of deals were available) out of a total of 176 deals (76%).

The **highest deals in operators' acquisitions** are the acquisition of Zain's African assets by Bharti in 2010 for 10.7Bn$. By chosing revenues of each of the 15 Zain's markets as allocation key, the deal artificially represents 5.8Bn$ in Nigeria (in fact 3.8Bn$ for 66% of assets), 1.3Bn$ in Tanzania (in fact 794M$ for 60% of assets), 1.1Bn$ in Zambia (in fact 876M$ for 79% of assets) and 948M$ in Democratic Republic of Congo. Other major operators' acquisitions in sub-Saharan Africa over 2000-2010 are the acquisition of 70% of Ghana Telecom in 2008 by Vodafone (900m$, so 1.3Bn$ for a 100% implied equity value) and the acquisition of 51% of Telkom Kenya in 2007 by France Telecom (571m$, so 1.1Bn$ for 100% implied equity value). **Lowest deals** are the acquisition by MTN of Investcom's assets in 2006 for 5.5Bn$, which – allocated[82] – makes for instance 74.7m$ for the 100% of Guinea Bissau Investcom assets (Spacetel Guinea Bissau) and 99.7m$ for 60% Liberia Investcom (Lonestar Communications) assets (representing 166m$ for 100% implied equity value).

Regarding **acquisitions of licenses, the highest amounts** have been paid on the Nigerian market: 285m$ by MTN and by Econet Wireless (Bharti now) in 2001 and 200m$ by Globacom in 2002 for 2G licenses and 400m$ by EMTS (Etisalat) in 2007 for a neutral license. Sudan has also awarded licenses for high amounts: in 2004, MTN (now Bashair Telecom) has bought a neutral license for 177m$ and Sudatel has spent 230m$ for a 2G license in 2006. Still in terms of total amounts, **lowest license prices** have been awarded in Rwanda in 2008 (MTN's 2G license renewal for 605k$) and in Mauritania where 3G licenses were awarded to Sudatel and Maroc Telecom in 2006 for 1,14m$.

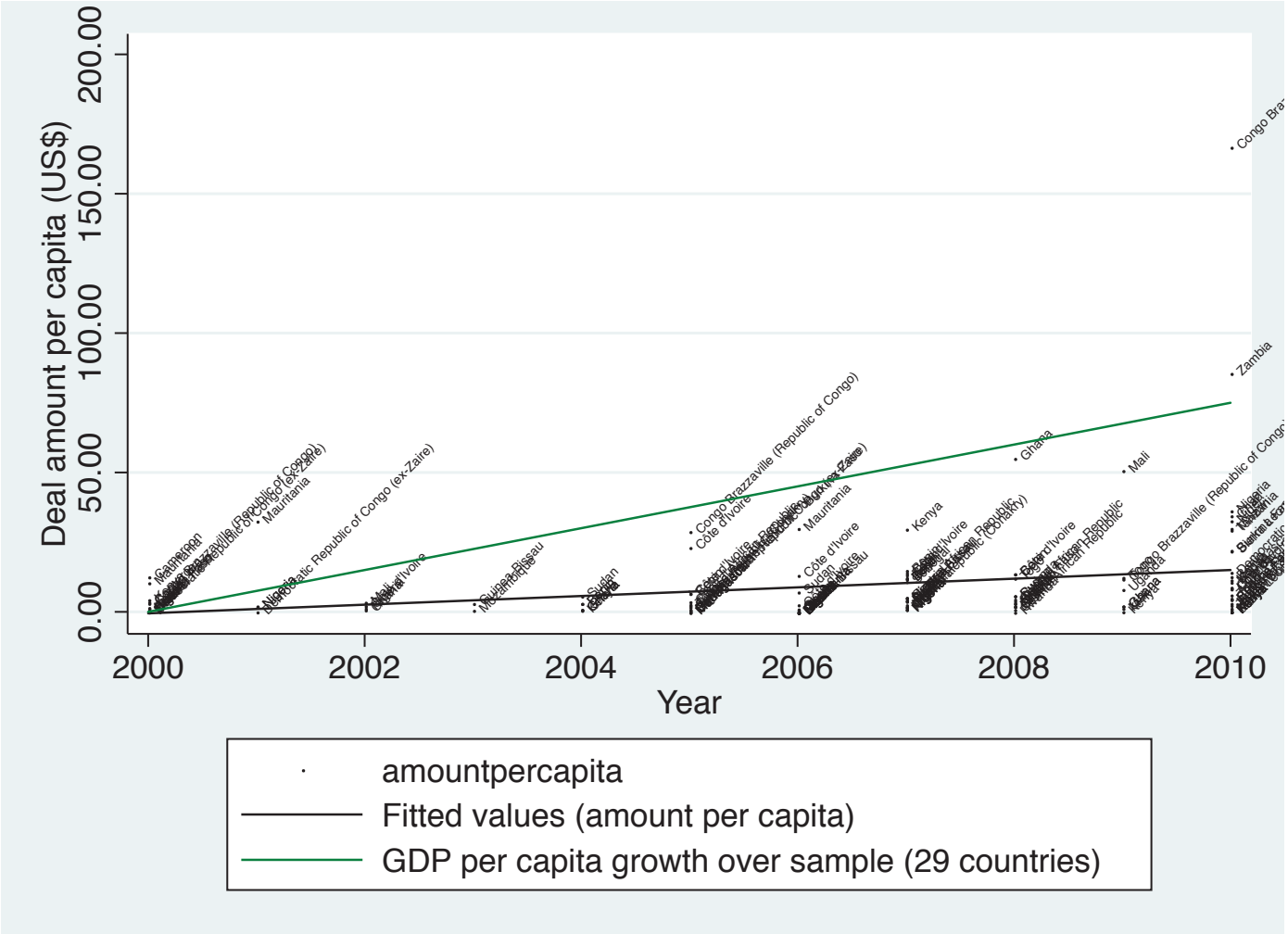
In the two-dimension analysis below, most of the following graphs use the amounts per capita in order to cancel the scale effect (each deal amount has been divided by the country population on the year of the deal).

[82] Revenues not available, so allocation made by number of subscriptions (Source: MTN 2006 annual report).

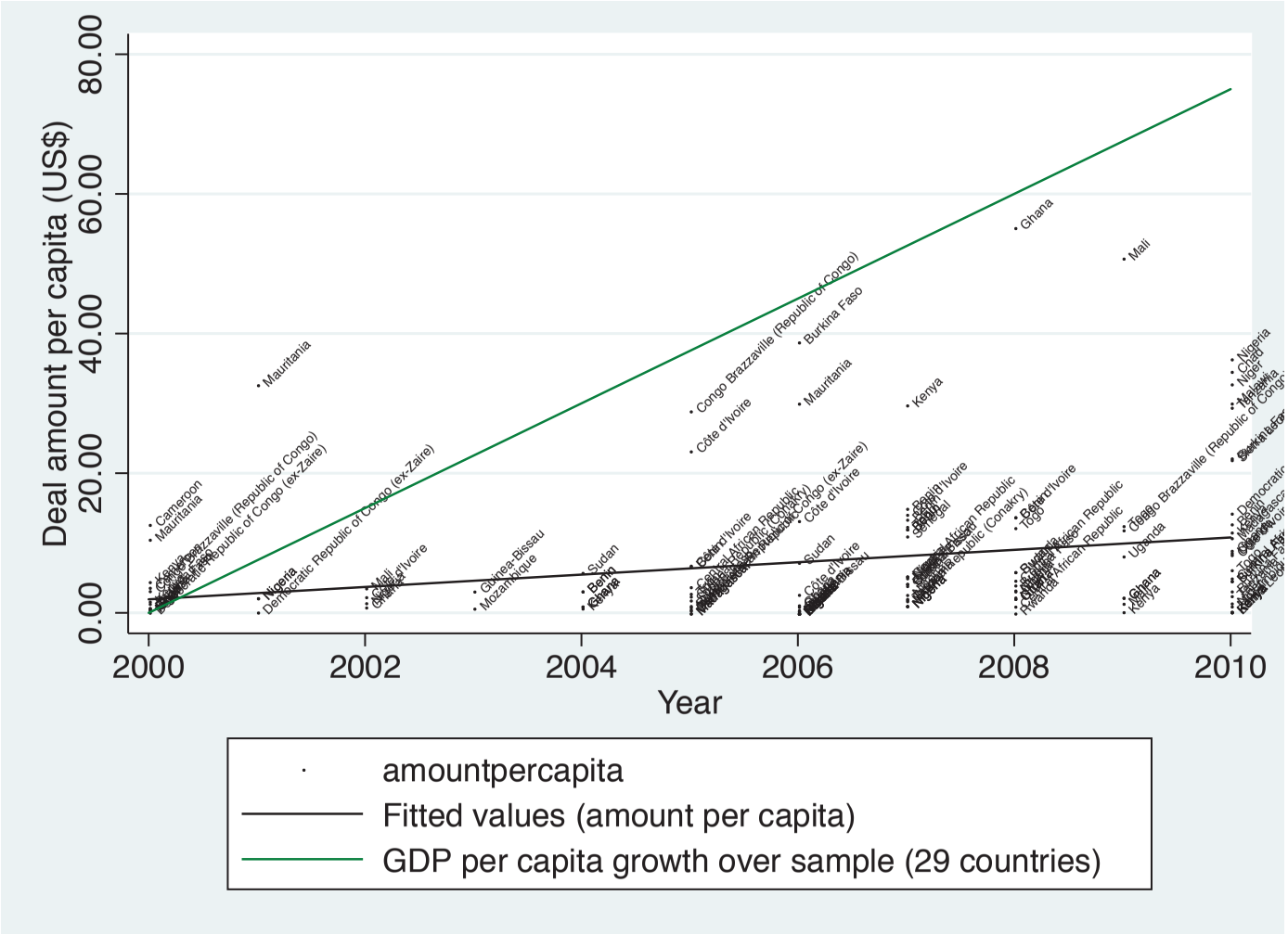
a) **General information about deal amounts evolution over the decade**

First set of graphs show the deals by country and their amount per capita across the decade. *Graphs 6 and 7* present the level of amount per capita of the 133 deals over time compared to the evolution of GDP per capita (in constant US$) over our sample (29 countries) between 2000 and 2010.
Graph 7 excludes Bharti's deal in Congo Brazzaville and Zambia that have much higher deal amount per capita than the trend (respectively 166.9$/capita and 85.8$/capita: This is due to the fact that both countries represent a substantial share of Zain's revenues as well as a low share of population of the 15 countries of investment). In this whole descriptive analysis, most of the graphs will also be presented without these two deals.
In *Graphs 6 and 7*, the green line on both graphs represents the growth of the average GDP per capita (in constant US$) in all 29 countries between 2000 and 2010. The average GDP per capita was 312,99$ in 2000 and 387,99$ in 2010 (about 24% increase over ten years and 2.2% annual increase). Slope of the curve p is the ratio of the difference between 387,99 and 312,99 over the difference between 2010 and 2000, which makes a slope of p=7,5. As GDP per capita curve starts around 0 on the y axis (on x=2000), it ends on y=75 where x=2010, based on the following calculation: $y_{2010}=y_{2000}+p*(x_{2010}-x_{2000})$, which makes $y_{2010}=0+7,5*(2010-2000)$.

Graph 6: Deals amounts per capita vs. years (all deals) & GDP/capita growth between 2000 and 2010



Graph 7: Deals amounts per capita vs. years (all deals) & GDP/capita growth between 2000 and 2010 (excluding Congo & Zambia deals)

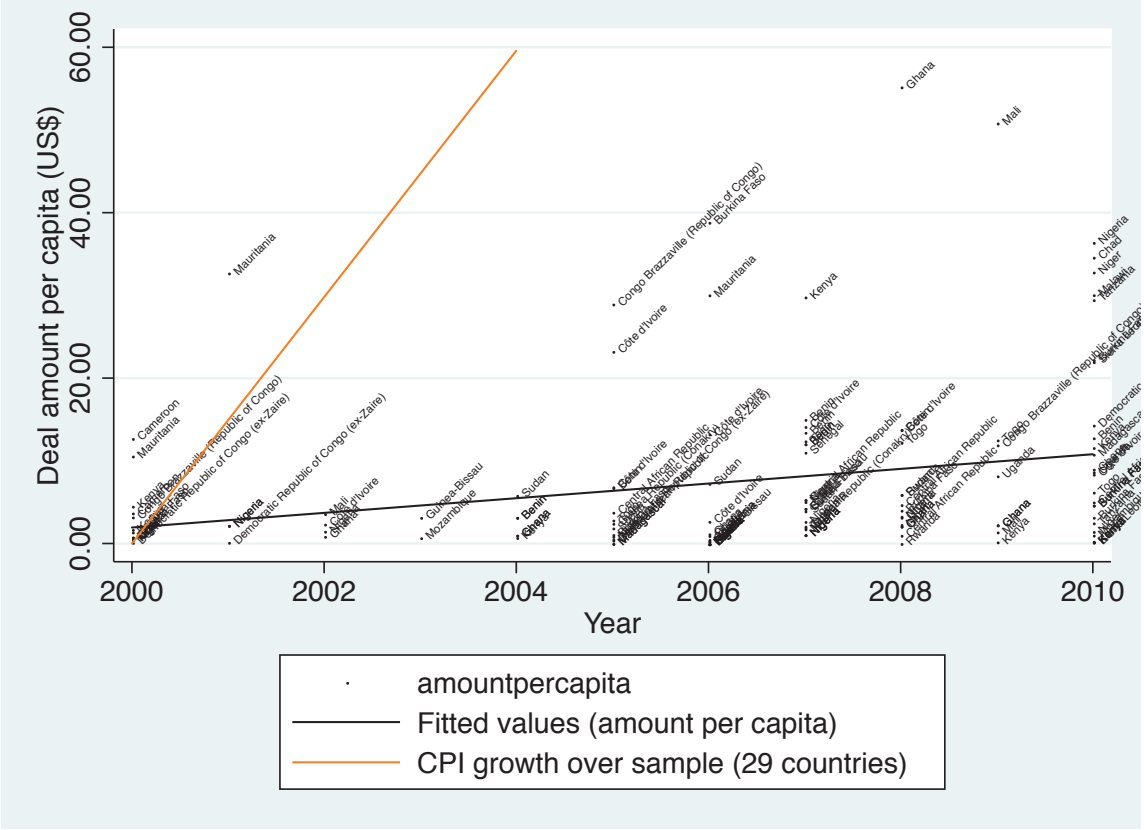


On *Graphs 6 and 7,* the amplitude increases between lowest deal amounts per capita and highest ones over the years, reflecting an uncertainty in investments in Africa in the early 2000s as well as an increase in the general value given by investors to investments in Africa.
The increase in deals' prices per capita is almost flat and much lower than the increase in GDP per capita in constant value, showing that deals' prices do not follow the general economic dynamism of countries. Different hypotheses could explain this: The potential of the telecom sector might have been captured over the decade by factors such as the opening to competition of the telecommunication sector in African countries, its increasing market penetration or the high level of taxes that is applied to operators in most countries.

For the rest of the descriptive analysis, most of the graphs will be presented excluding the two extreme dots of Bharti's deal in Congo Brazzaville and Zambia.

Graphs 8 is the same representation but includes - in orange - the evolution of the Consumer Price Index (CPI) between 2000 and 2010. The same methodology as for the green line on Graphs 6 and 7 has been used for the CPI orange curve. The average CPI on the 29 countries goes from 73,4 in 2000 to 222,34 in 2010 (slope of the curve p' is 14,9). As CPI curve starts around 0 on the y axis (on x=2000), it ends on y=149 where x=2010, based on the following calculation: $y_{2010}=y_{2000}+p'*(x_{2010}-x_{2000})$, which makes $y_{2010}=0+14,9*(2010-2000)$.

Graph 8: Deals amounts per capita vs. years (all deals) & Consumer Price Index growth between 2000 and 2010 (excl. Congo & Zambia)

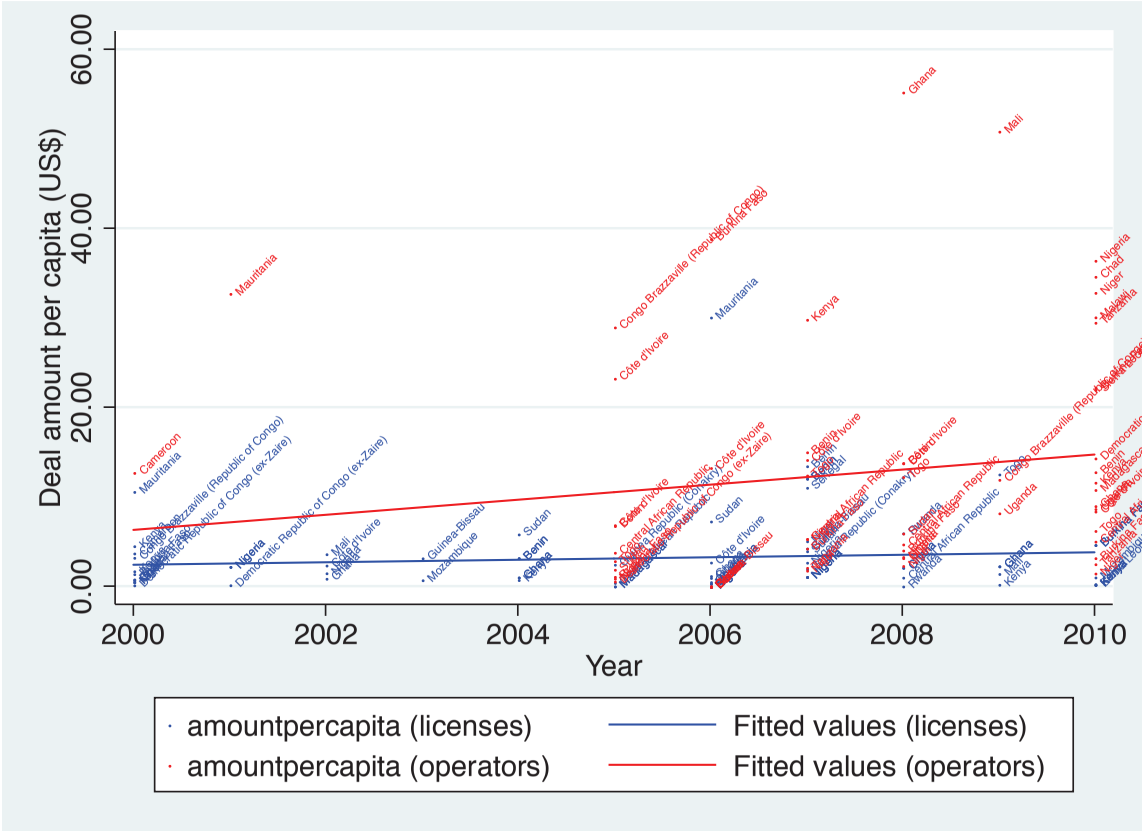


It is important to note that follow up of inflation indexes in developing countries must be taken with caution, as they might include significant biases. Price indexes in developing countries reflect only a part of the local economy, as in most countries the informal sector represents a large share of the economy. General observation on *Graph 8* is that the increase in deals' prices per capita is much lower than the inflation in the area and thus does not follow inflation: If deal amounts per capita were considered in constant prices (thus including inflation), they would probably be flat (or decreasing) over the decade.

The observation of *Graphs 6 to 8* confirms **H0** according to which deal amounts per capita increase over the decade, but this trend is much lower than expected, given the growth potential of the market.

Graph 9 is the same representations as Graphs 6 to 8: They present the 133 deals over the decade in terms of deal amount per capita, but they make a difference between awards of licenses (in blue) and operators' acquisitions (in red).

Graph 9: Deals amounts per capita vs. years (split operators & licenses)
(excl. Congo Brazzaville & Zambia)



The deal amount per capita for operators' acquisitions increases, showing that MTC have assigned an increasing value to future profits of their acquisitions over the decade.
Differently, licences' amounts per capita remain quite flat over the decade. This might be due to a bad assessment of market evolution by governments and by the bidding MCT (in case of auctions) and wrong criteria chosen for valuation.

Operators' acquisitions have accelerated as from 2005 in sub-Saharan Africa (there are more red dots as from 2005). This might be due to the increasing confidence in African markets that has progressively developed throughout the decade.
Operators' acquisitions reach higher amounts per capita than licenses' acquisitions (red curve over blue curve). One explanation could be that investing in an operator's stakes usually means buying existing infrastructures, but *Graphs 15 to 17* will show that network seems not to be given any value in itself. Another explanation for this gap is that acquiring an operator is acquiring its existing customer base - so market shares - which will be confirmed by some coming graphs.
Also, getting a license shall require higher additional investments for launch of operations, which could explain the lower level of value attributed to licenses.

On *Graph 9*, the acquisition of 70% of Ghana Telecom by Vodafone in 2008 appears to be the highest price per capita (55,3$ per capita), followed by the acquisition of 51% of Sotelma (Malian incumbent) by Vivendi Maroc Telecom (50,9$ per capita). 38,9$ per capita is the acquisition by Vivendi Maroc Telecom of 51% Onatel in Burkina Faso (2006), 32,8$ per capita is the acquisiton by Vivendi Maroc Telecom of 54% of Mauritel, the Mauritanian incumbent (2001), 29,9$ per capita is the acquisition by France Telecom of 51% of Telkom Kenya (2007) and 29$ per capita is the acquisition by MTN of 100% Libertis Congo in Congo Brazzaville (2005). Most of these deals (Ghana Telecom, Sotelma, Onatel, Mauritel, Telkom Kenya) concern country fixed-line telecommunication wireline incumbents: their high level of price might be explained by the profit expectation made on their monopoly on the fixed telephony market.

2010 red plots at the right of the graph represent acquisition of Zain's assets by Bharti in Burkina Faso, Chad, Congo Brazzaville, DRC, Ghana, Kenya, Madgascar, Malawi, Niger, Nigeria, Sierra Leone, Tanzania, Uganda and Zambia (Bharti also acquired Zain's assets in Gabon, but this country is not part of the scope).
On *Graph 9*, the only license over 20$ per capita was paid by Sudatel (Chinguitel): 30,1$ per capita for the Mauritanian 2G license in 2006 (Total deal was 94,3m$ after auction). The case study in *Box 1* details the context of award of this license.

Box 8 Licenses in Mauritania[83]

Mauritania is a large country (over one million km^2, twice France's area) with only 3.5 million inhabitants (in 2010). It has among the lowest population density in Africa: 3.4 inhabitants/km^2.

In the early 2000s, two operators shared the mobile market (largely prepaid):

- Mattel - Mauritano-tunisienne des télécommunications (Tunisie Telecom and Mauritanian private stakeholders) had around 40% of market share.
- Mauritel Mobile, the mobile subsidiary of the telecommunication incumbent Mauritel had around 60% of market share.

Mattel and Mauritel obtained their 2G licenses for 28.1 million US$.

The regulation body – Autorité de Régulation (ARE) de la République Islamique de Mauritanie (in charge of regulating telecommunications, posts, water and power), created in 1999, implements policies against anti-competitive practices, but it is only in 2013 that the Mauritanian law did give it a power of competitive regulatory authority per se. In the mid-2000s, the ARE informs both competitors that a third license will be awarded, in order to increase competition and prevent collusion on the market. Both Mattel and Mauritel then improve quality of service and prices.

In 2006 nevertheless, a bidding process is launched including several lots, with Lot 1 containing 2G/2.5G license and Lot 4 containing 3G/3.5G license. The purposes of this bidding process are the following ones: "introducing competition in the different fixed services, awarding a third mobile license, enable operators to diversify their services offer […], encourage Mauritanian investors to consider the telecommunications sector […]"(Press release, Aug. 11th 2006). This auction takes place in a specific context: on one hand, the ARE and operators in place are in a conflict period, on the other hand, Mauritania is benefiting from a new economic image and its economic progress is being compared to Nigeria's.

A pre-selection of operators is made in July 2006 based on technical and financial criteria: Orange, Wataniya Telecom and Sudatel (Chinguitel) have sent proposals for a 2G license (Lot 1) and have been qualified. Then the envelopes containing the financial

[83] Sources: Autorité de Régulation de Mauritanie, World Bank databank, Balancing Act Africa Issue 324

proposals have been opened: Sudatel (Chinguitel) proposed 94.3 million US$ (26.6 million MRO) for the 2G license, three times the Orange's proposal – 32.1 million US$ (9.07 million MRO) - and Wataniya's proposal – 28.8 million US$ (8.15 million MRO). Thus, the third 2G license has been awarded to Sudatel (Chinguitel), who bet on a spectacular economic growth "with the impact of oil (which has recently started pumping from offshore fields) and a newly opened copper mine." (Source: Balancing Act Africa)

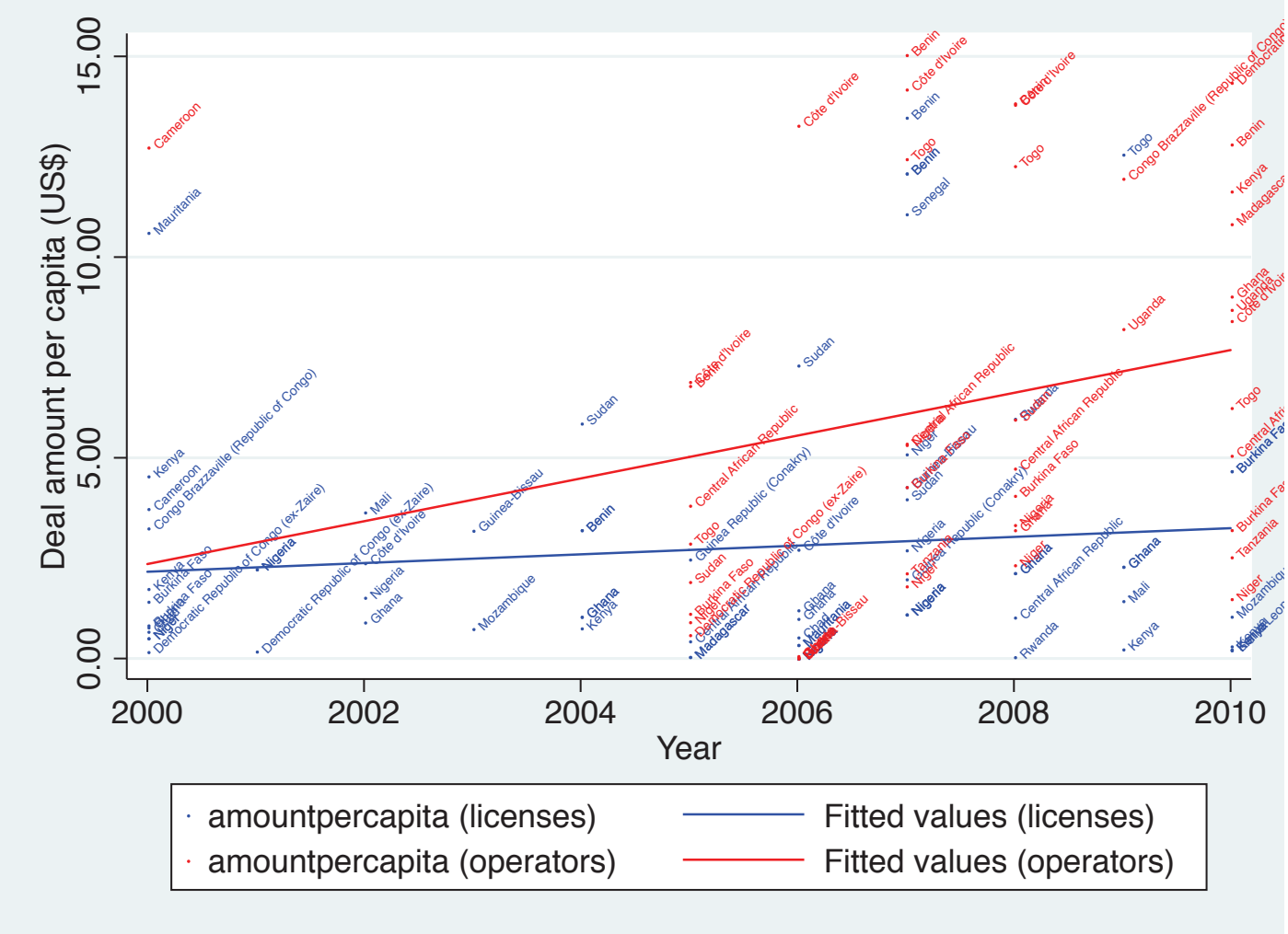
For Lot 4 (3G/3.5G licenses), Mauritel proposes 1.1 million US$ (300 million MRO) and Chinguitel proposes 380k US$ (100 million MRO): Both are awarded a 3G/3.5G, provided that Chinguitel aligns its contribution on Mauritel's.

Three years later, in 2009, Mattel has been awarded a 3G/3.5G license for 3.4 million US$ (900 million MRO), three times the price granted to Mauritel and Chinguitel in 2006.

Graph 10 focuses on deals below 20$ per capita, still with a split between licenses awards and operators' acquisitions.

It confirms observation of *Graph 9*: Operators' acquisitions reach higher amounts per capita and show a higher increase over the decade than licenses' acquisitions.

Graph 10: Deals amounts per capita under 20$/capita vs. years (split operators & licenses)

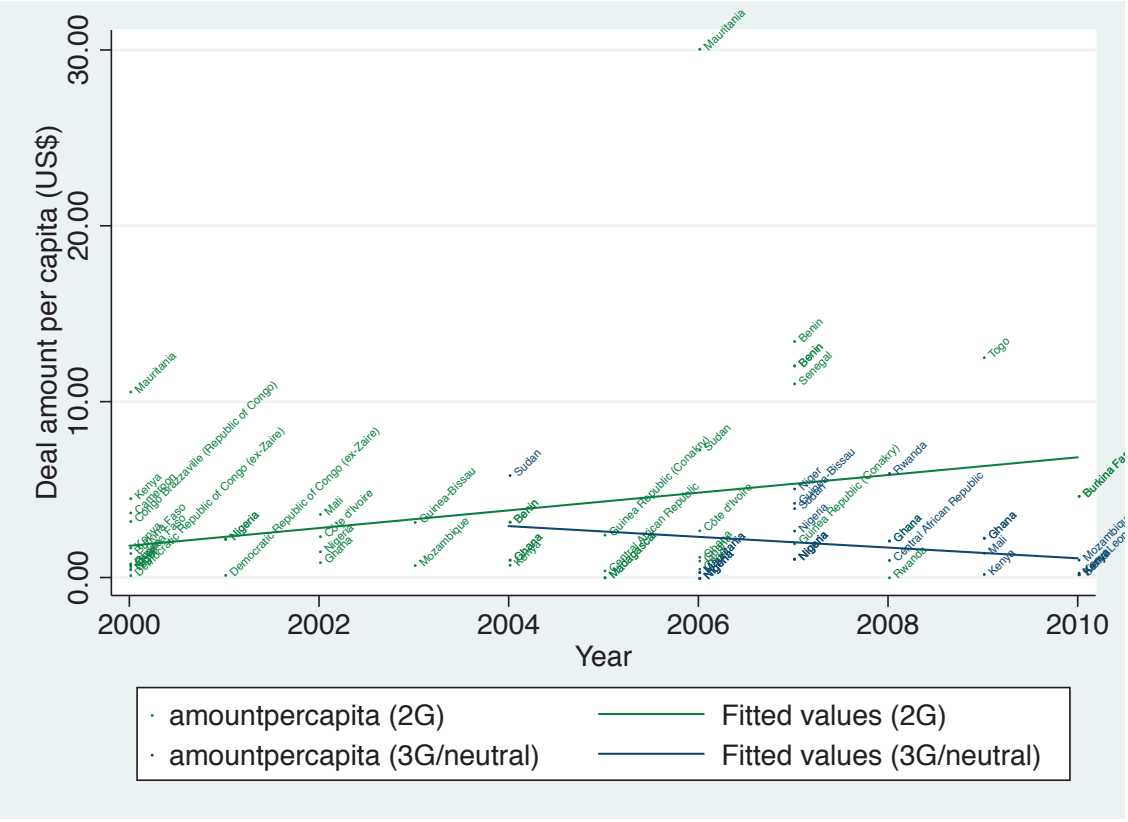


Graph 11 focuses on licenses only, with a differenciation between 2G and 3G/Neutral licenses. Neutral means here 'technology neutral': According to the GSMA, they 'allow any technology to be used in the specified band' and leave 'operators free to evolve their services as the technology advances'. But neutral licences are not widespread in Africa over the decade.

Deal amount per capita has kept increasing slightly over the decade for 2G licenses. First, in the early 2000s, 2G was quite a new technology and there were modest expectations about its future value. During the decade, its value has increased, mainly due to the growing awareness of the value of this public good.

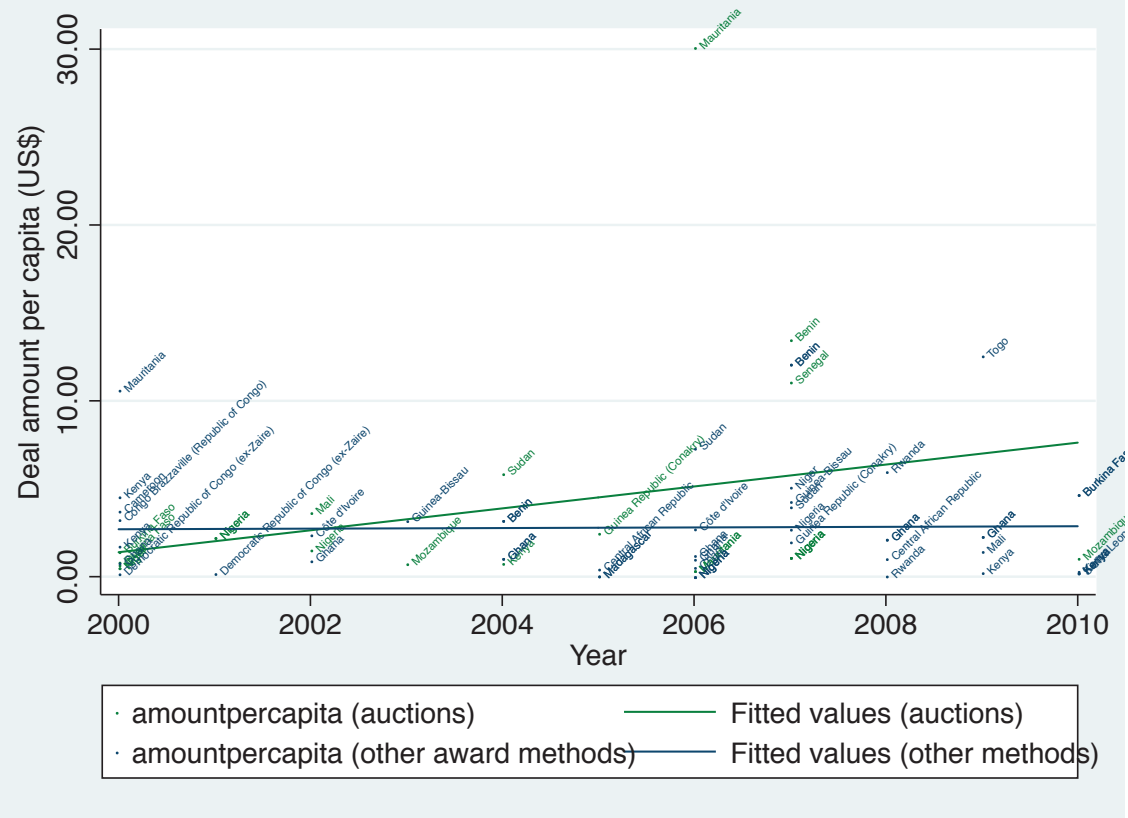
According to *Graph 11,* 3G/neutral licenses have started to be awarded by the mid-2000s in our sample and their deal amount per capita is lower than for 2G licences. 3G operates in higher frequency bands than 2G, thus with a smaller transmission range, which requires more network investments and thus higher Capex. Based on this trade-off between license price and future Capex, this is why 3G licences generally have a lower value than 2G licences. The decrease of deal amount per capita on 3G over the decade is also due to a better knowledge of the technology and of this necessary trade-off.

Graph 11: Deals amounts per capita vs. years (split 2G licenses & 3G/neutral licenses)



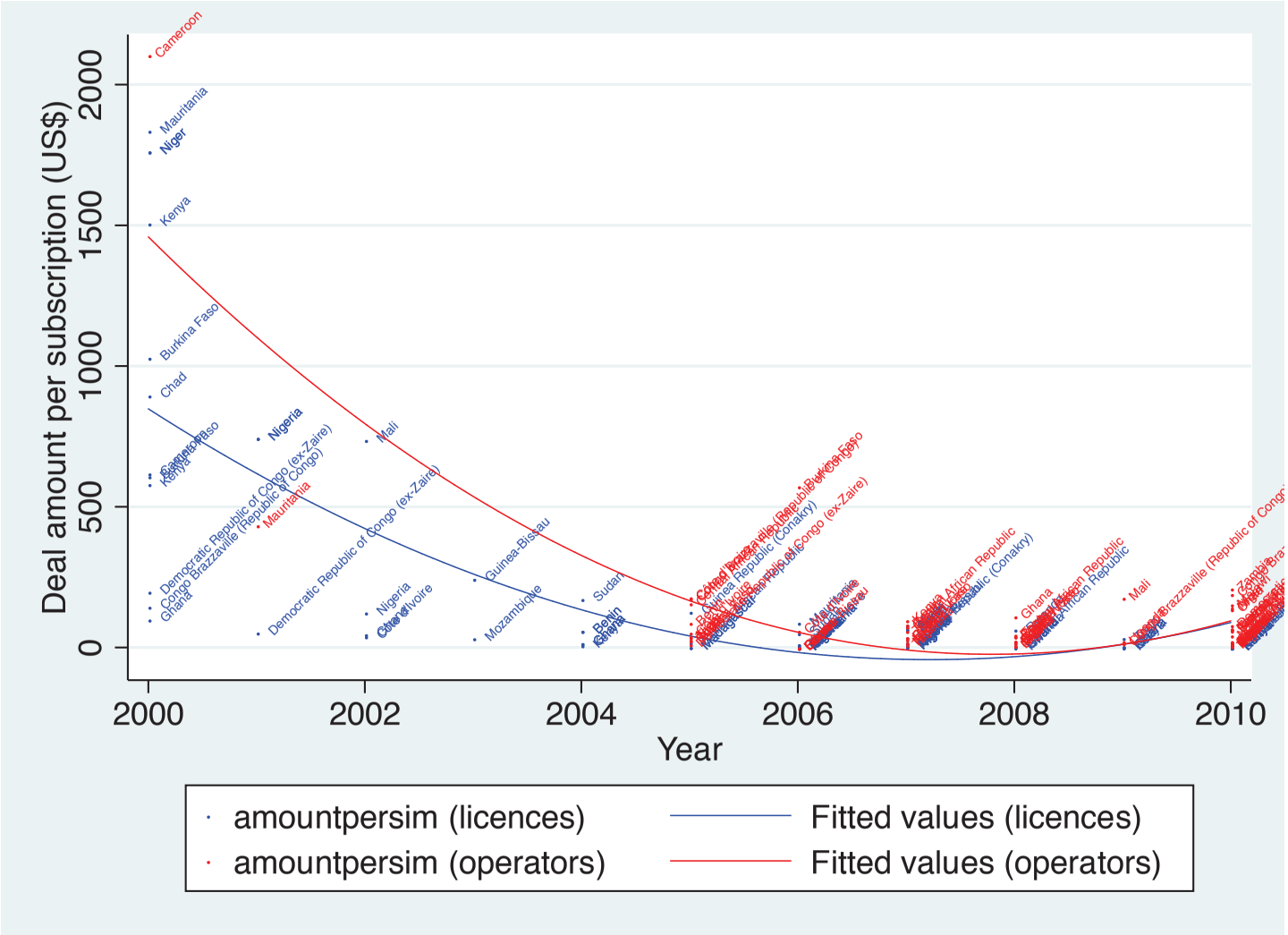
Graph 12 also focuses on licenses only over the decade and shows the potential link of license award methods with the level of deal amounts. Confirming what the auction literature states, licenses awarded by auctions have higher final prices than other award methods. Moreover, prices of licenses awarded by auctions have kept increasing whereas other award methods show a flat trend over the decade.

Graph 12: Deals amounts per capita vs. years
(split auction vs. other award methods)

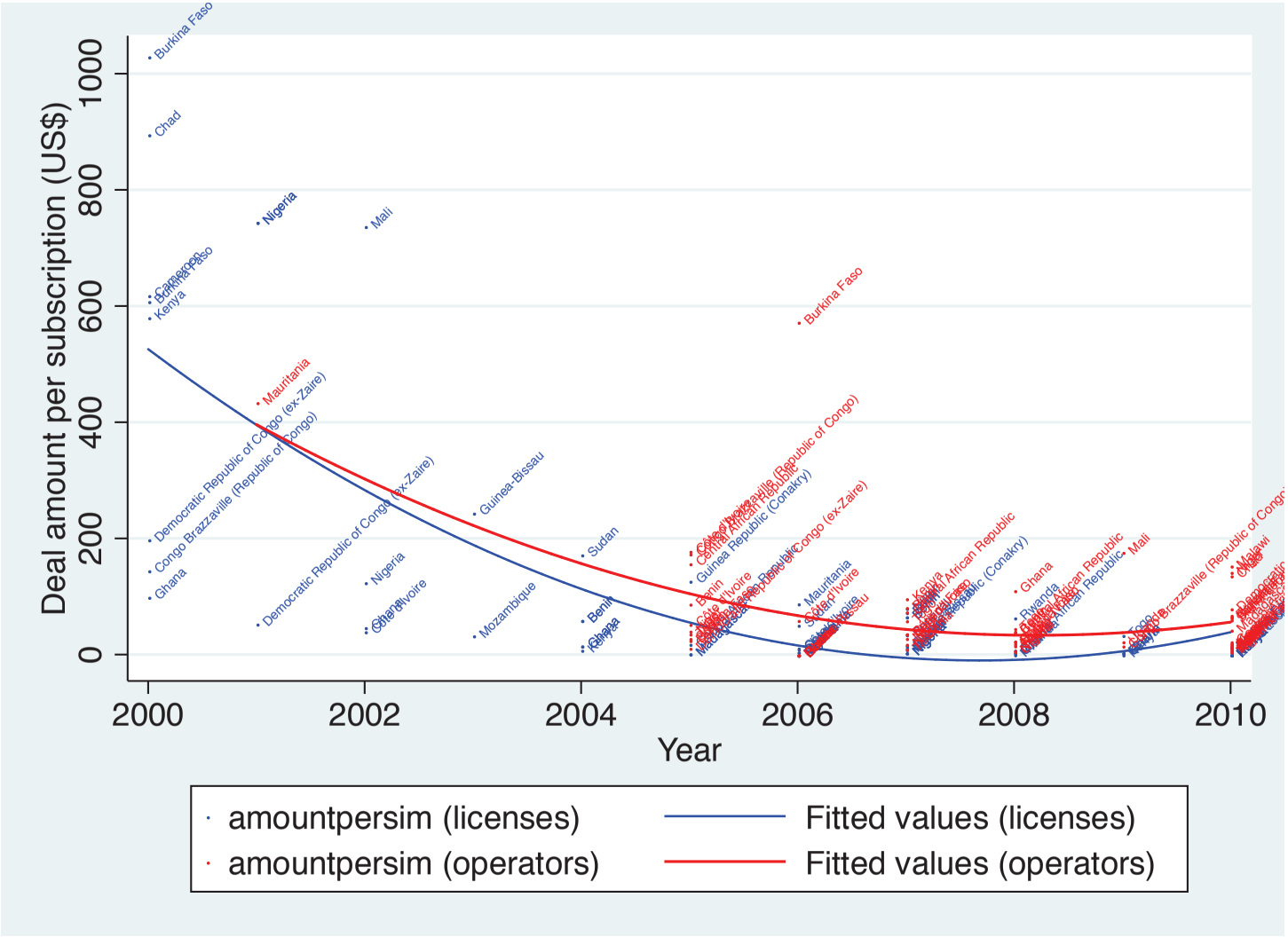


The following graphs *(Graphs 13 and 14)* also present the 133 deals along the decade. But contrary to the graphs above, deal amounts have been calculated per subscription (and not per capita): This means that instead of dividing the total amount by the country population at deal date, it is divided by the number of mobile subscriptions in the country at deal date.

Graph 13: Deals amounts per subscription (all deals) vs. years (split operators & licenses)



Graph 14: Deals amounts per subscription (below 1100$/deal) vs. years (split operators & licenses)



Fitted values have been represented by a quadratic curve (instead of a linear one, as in other graphs). This appears as a more representative way to picture the dynamism of subscriber base (compared to country population in other graphs): the evolution of market penetration is represented by a S curve and sub-Saharan African markets were in the left part of this S curve on the period 2000-2010.

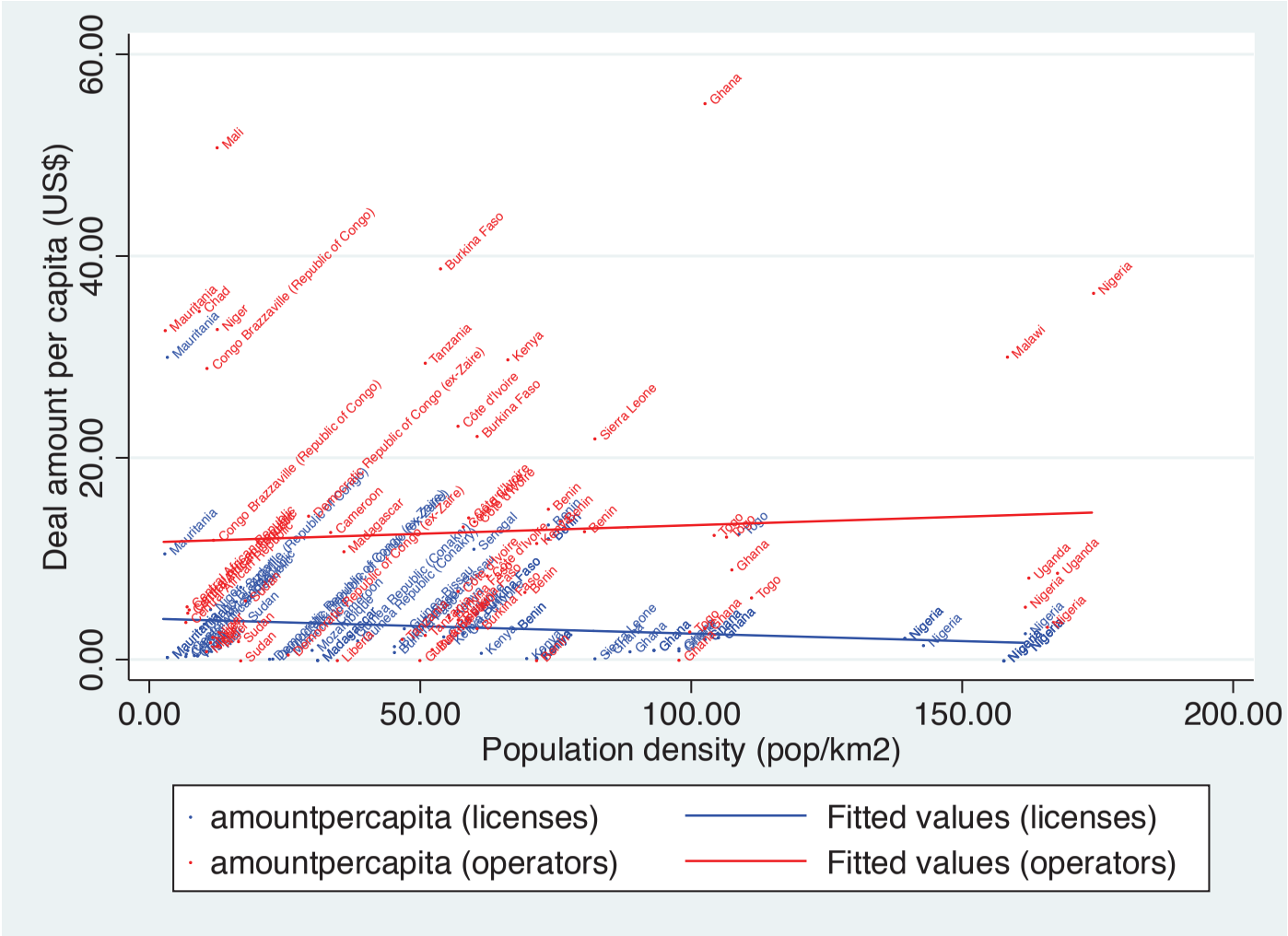
Graphs 13 and 14 show a general decrease of deal amounts per subscription between 2000 and 2010, for licenses as well as for operators' acquisitions. This might reflect the fact that African mobile markets have matured over the decade: After a strong increase of customer acquisitions, markets have experienced a slowdown of these acquisitions with a lower ARPU (Average Revenues Per User). The hypothesis can be made that this slowdown might have been anticipated by the different stakeholders and been reflected in the deal amount per subscription.
Both license and operator curves join over the decade and the gap between them in 2000 might be due to very small (and/or underestimated) country customer bases.
Graphs 13 and 14 show the 133 deals. All deals above 1000$ per capita have been made in year 2000, mainly because low mobile market penetration at that time makes high deal amounts per subscription. The Cameroon dot in red corresponds to the acquisition of Camtel Mobile (Cameroonian incumbent) by MTN, with a deal of 140 million US$ for 70% of stake. The dots in blue that are above 1000$ per capita correspond to 2G license awards made in 2000 to Zain (Niger, Kenya and Burkina Faso), to Mauritel (Mauritania) and to Telecel (Niger).
Graph 14 focuses on deals below 1000$ per capita.

b) **Deal amounts and country-related factors**

This set of graphs describes how the variable "deal amount per capita" behaves when crossed with variables related to the host country specificities.

Graph 15 crosses deal amounts per capita with population density of countries at deal date. In our sample, two 2008-deals in Rwanda appear at the very right of the graph - population density was 405/km^2 then - so they have been removed from the graph for readability reasons.

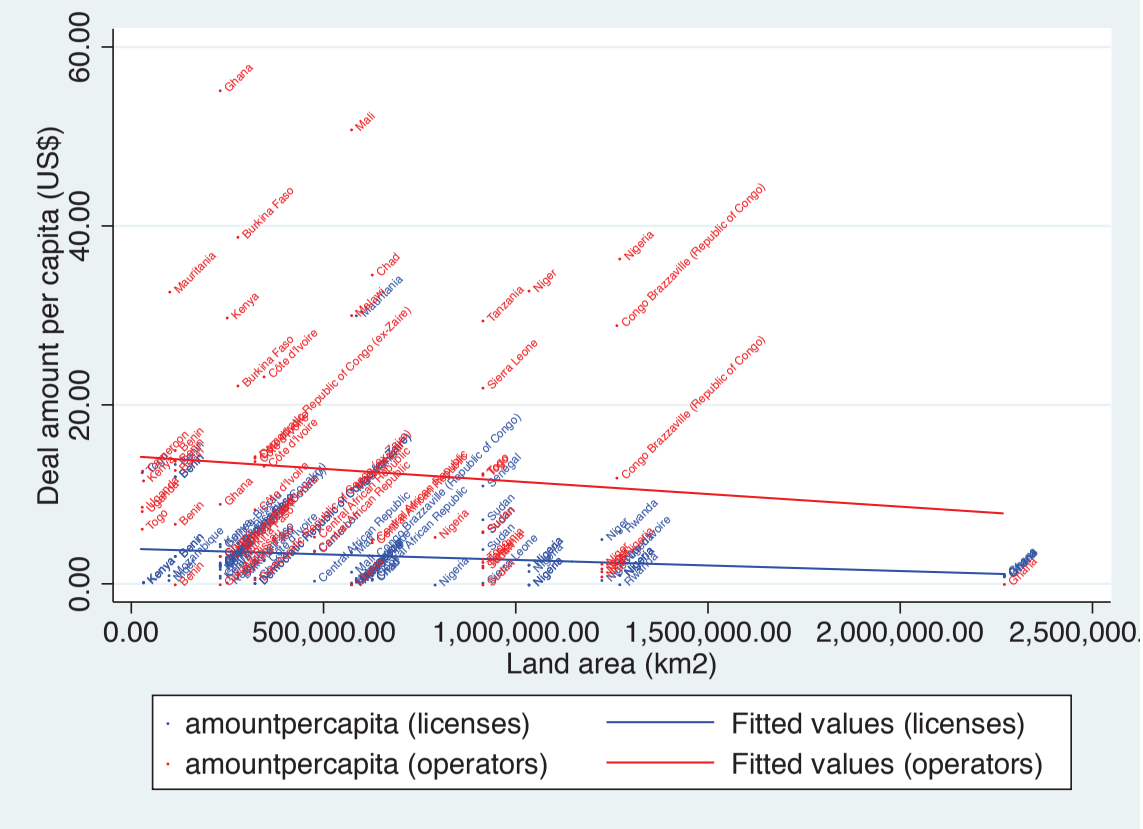
Graph 15: Deals amounts per capita vs. population density (split operators & licenses)
(excl. Congo Brazzaville and Zambia)



Regarding acquisitions of operators, the trend is slightly increasing, which would mean that higher population densities correspond to higher deal amount per capita. This can be explained by the fact that the necessary effort in coverage investment will be less in countries with a higher population density, hence a higher value attributed to the asset acquired: In summary, the higher the population density, the easier-to-serve the territory, the lower the costs, the higher the profitability, the higher the deal price. On the contrary, the trend for licenses is slightly downward: a higher population density corresponds to a lower amount per capita, which is quite a counter-intuitive result and might be explained by the features of our sample.

Graph 16 crosses the deal amounts per capita with land areas in km^2 (and excludes both Bharti's deals in Congo Brazzaville and Zambia).

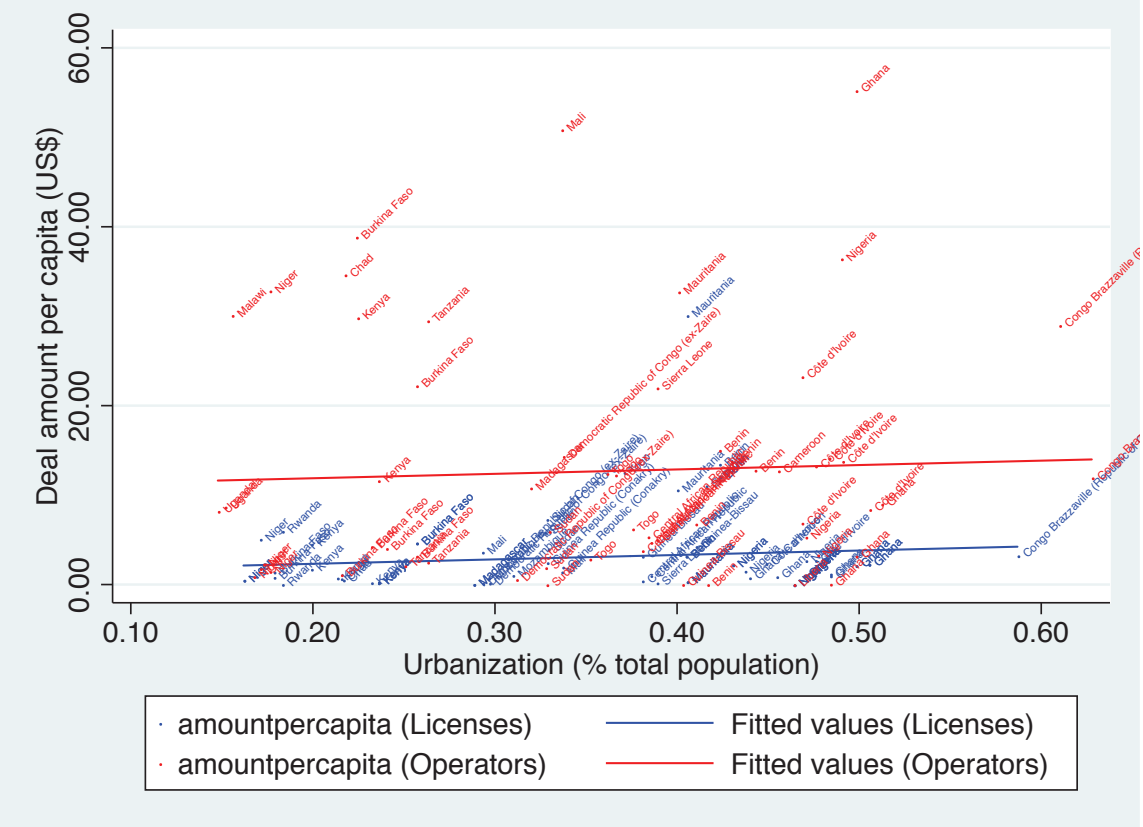
Graph 16: Deals amounts per capita vs. land area (split operators & licenses)
(excl. Congo Brazzaville and Zambia)



Both for licenses and operators, there is a slight downward trend: larger countries are associated to lower deal amounts. A larger country might mean bigger challenges in terms of coverage and costs, which would be reflected in a lower value given to the initial asset invested.

Same representation has been made in *Graph 17,* but with urbanization (and also excluding both Bharti's deals in Congo Brazzaville and Zambia).

Graph 17: Deal amounts per capita vs. country urbanization (split operators and licenses)
Excluding Congo Brazza & Zambia

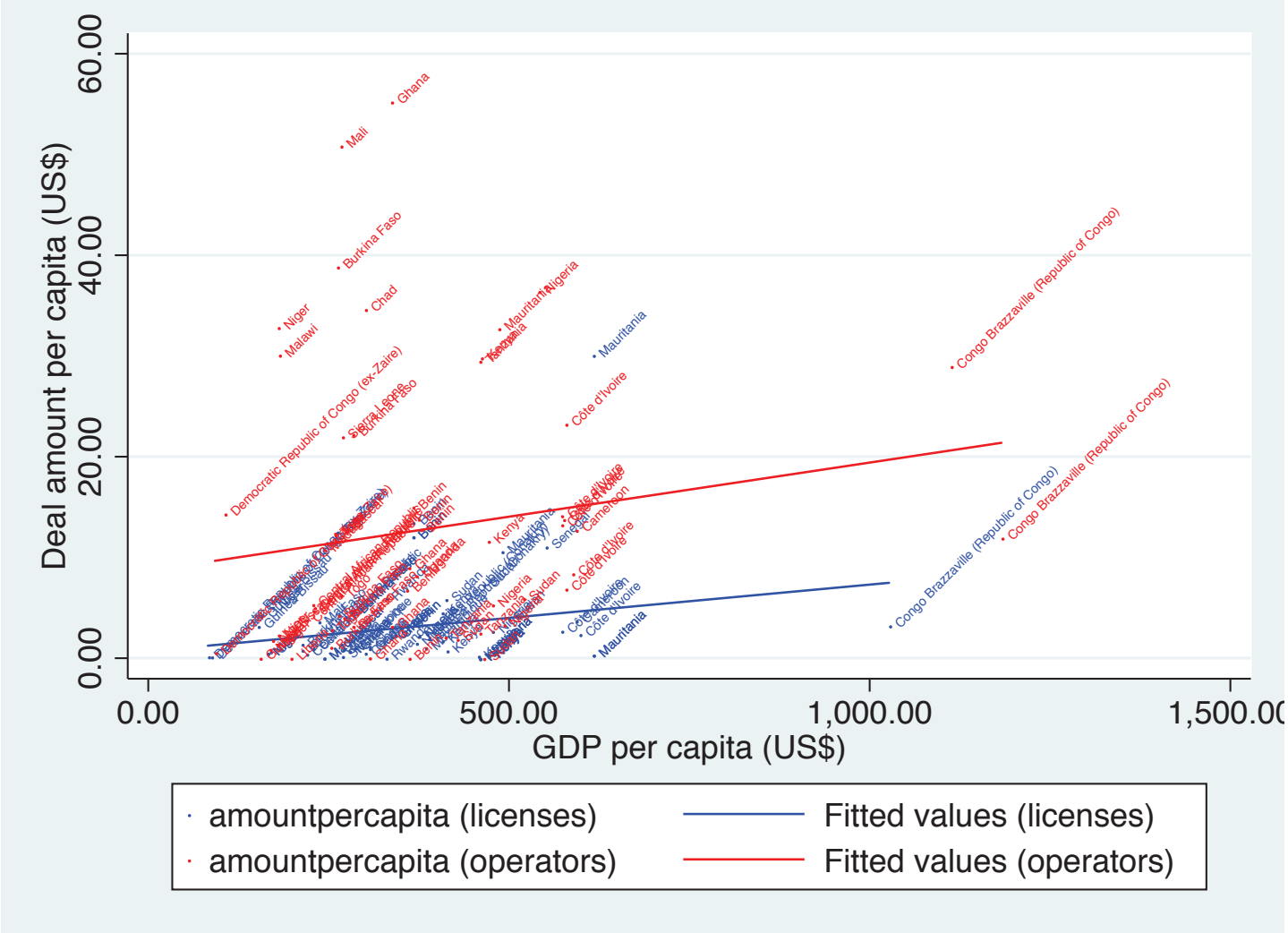


Graph 17 shows no clear correlation between deal amounts per capita and urbanization of the country.

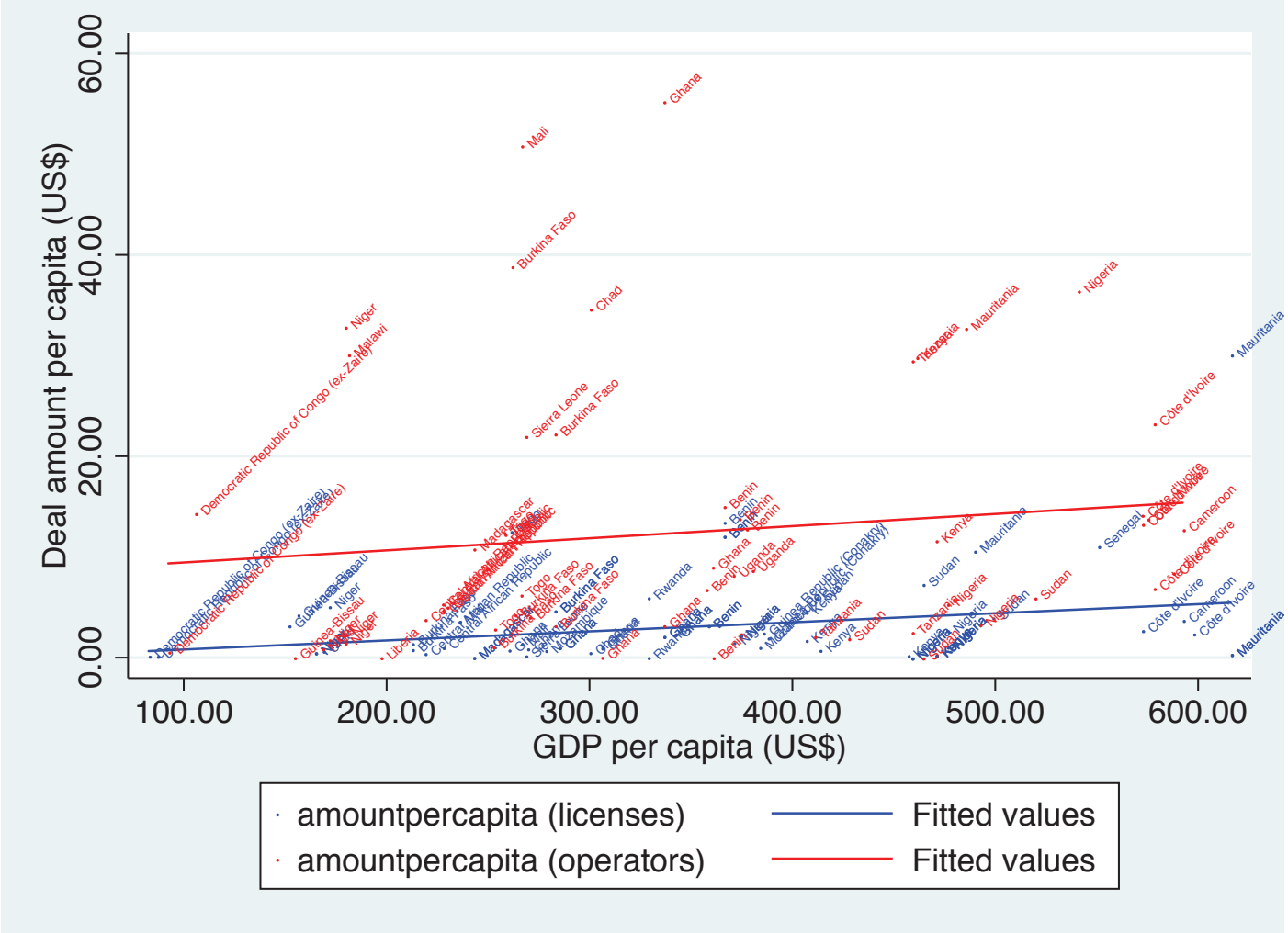
The relative stability of licenses' amounts (and of operators' amounts, on a smaller extent) - in *Graphs 15 (population density), 16 (land area) and 17 (urbanization)* - show that network costs (in terms of capital as well as of operational expenditures) have not really been considered in the MTC's profit expectation. This could be interpreted as follows: The regulatory pressure related to coverage requirement is not strong enough to consider a potential profit loss that would occur because of universal service obligations.

On an economic point of view, *Graphs 18 and 19* cross the amounts per capita with the country GDP per capita (at deal date). All of them exclude Bharti's deals in Congo Brazzaville and Zambia. *Graph 19* exclude three deals made in Congo Brazzaville, which is a country with a very high GDP per capita (over 1000US$) compared to the rest of the sample (then come Cameroon, Côte d'Ivoire and Mauritania around 600US$). The trend of fitted values is upward: A higher GDP per capita is correlated with a higher amount per capita, which means that higher deals have been made in richer countries. Investors might anticipate on the purchasing power of local populations, attributing a higher value to a country with a higher GDP per capita.

Graph 18: Deal amounts per capita vs. country GDP per capita (split operators and licenses)



Graph 19: Deal amounts per capita vs. country GDP per capita (split operators and licenses)
– Focus on GDP/capita < 600US$ -



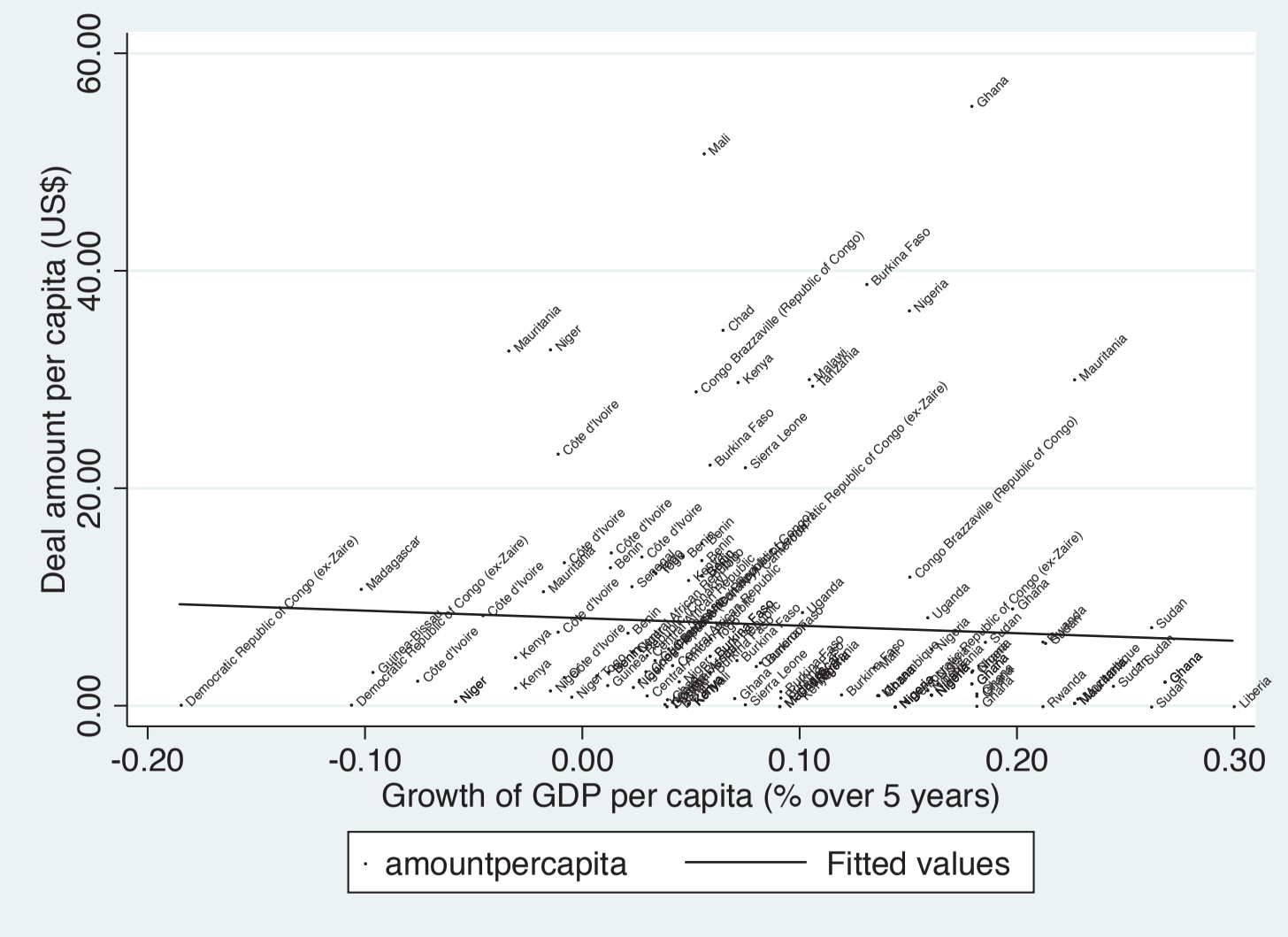
Nevertheless, it seems there is no apparent anticipation by stakeholders of the GDP trend in the country they invest in. When looking at growth of GDP per capita over 5 years (from 2 years before to 2 years after the deal) on *Graphs 20 and 21*, trend is flat for licences and downward for operators' acquisitions: higher growth of GDP per capita is associated to lower deal amounts, which is quite a counter-intuitive result.

The dynamics of GDP per capita do not intervene in the value given to assets: Because of uncertainties and situational factors, investors do not trust the GDP dynamics. For instance, Mali has good economic forecastings until the armed conflict in 2012. Another example is the revised expectations of GDP growth in the countries affected by Ebola Virus Disease in 2014 *(Table 13).* These uncertainties are probably the reason why growth of GDP per capita is not correlated to deal amounts per capita.

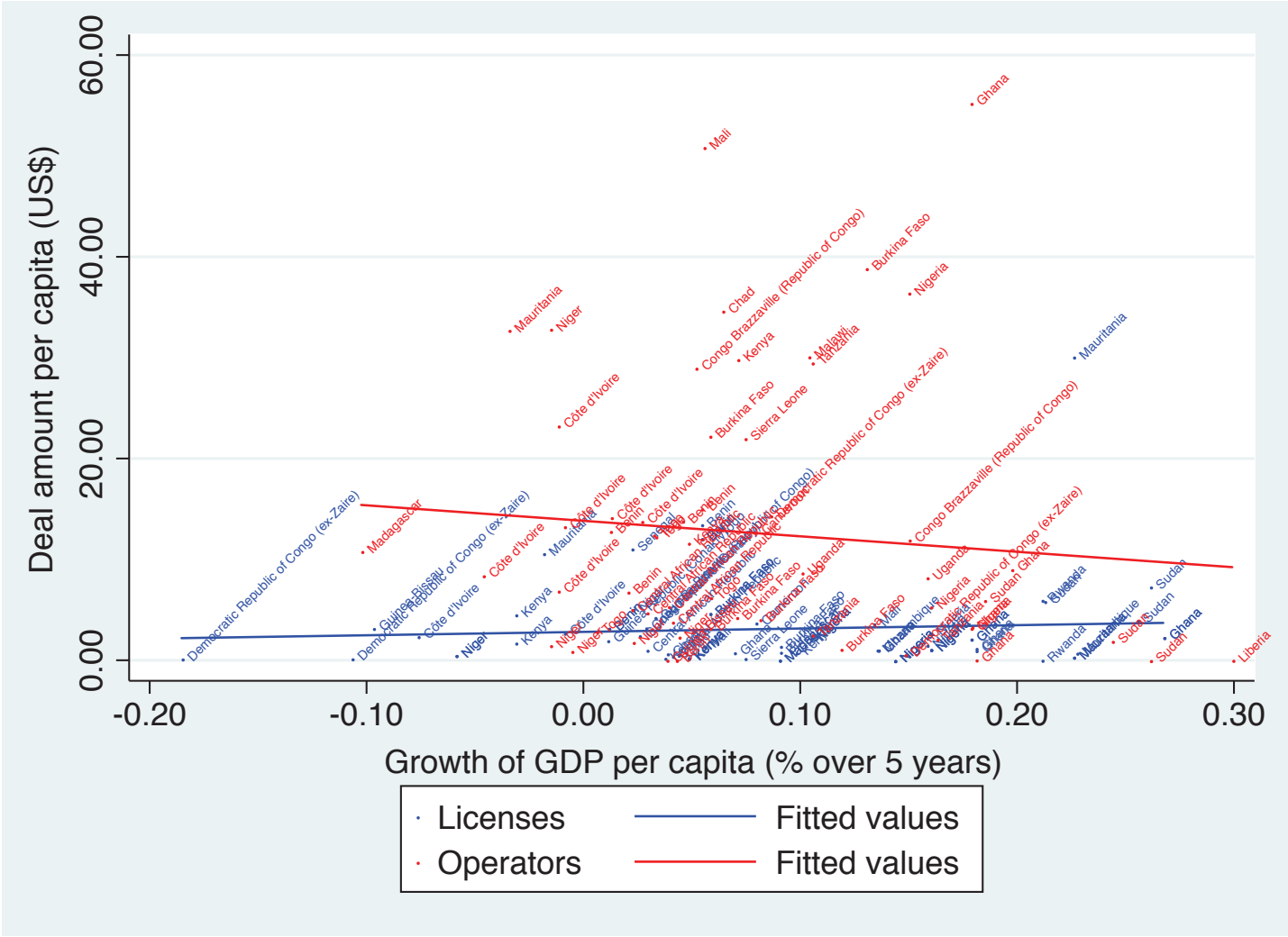
Table 13. Estimated GDP impact of Ebola (2014)
Source: World Bank / IMF staff estimates

Real growth in GDP (%)	Initial projection	Revised projection
Liberia	5,9 (June 2014)	2,5
Sierra Leone	11,3 (June 2014)	8,3
Guinea	4,5 (January 2014)	2,4

Graph 20: Deal amounts per capita vs. growth of country GDP per capita (all deals)

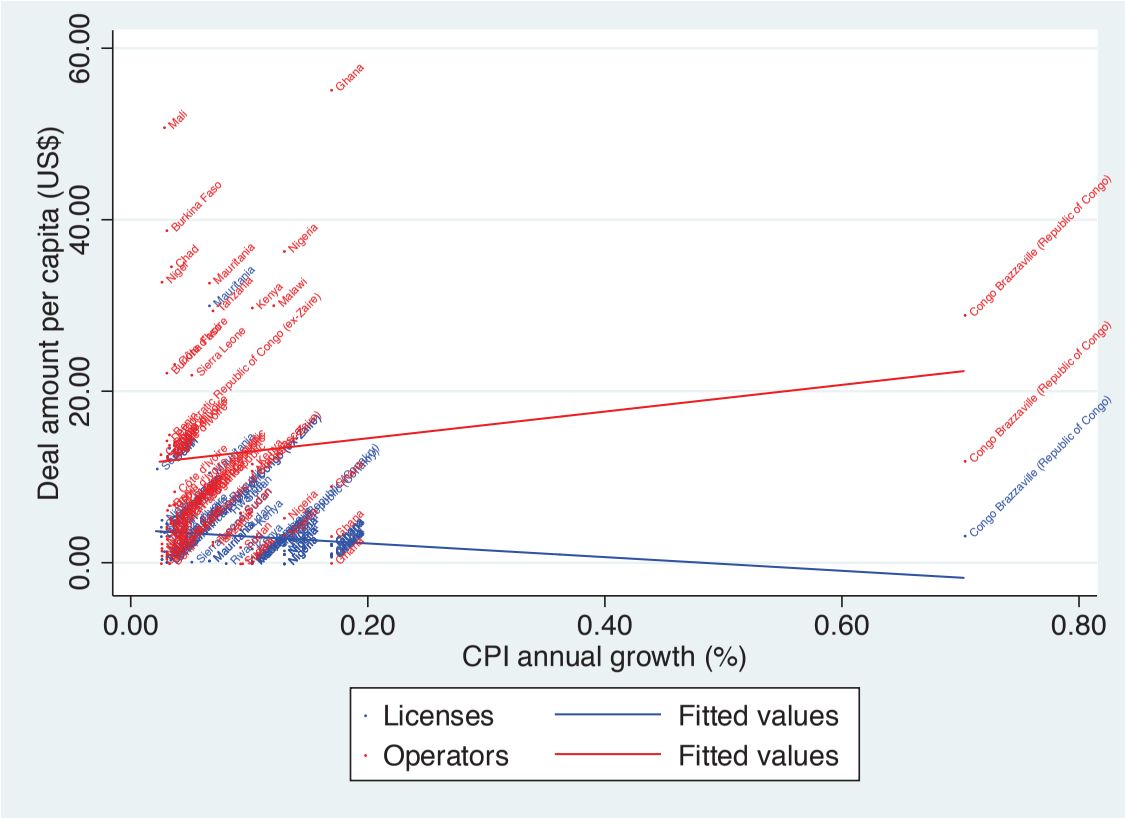


Graph 21: Deal amounts per capita vs. growth of country GDP per capita (split operators & licenses)

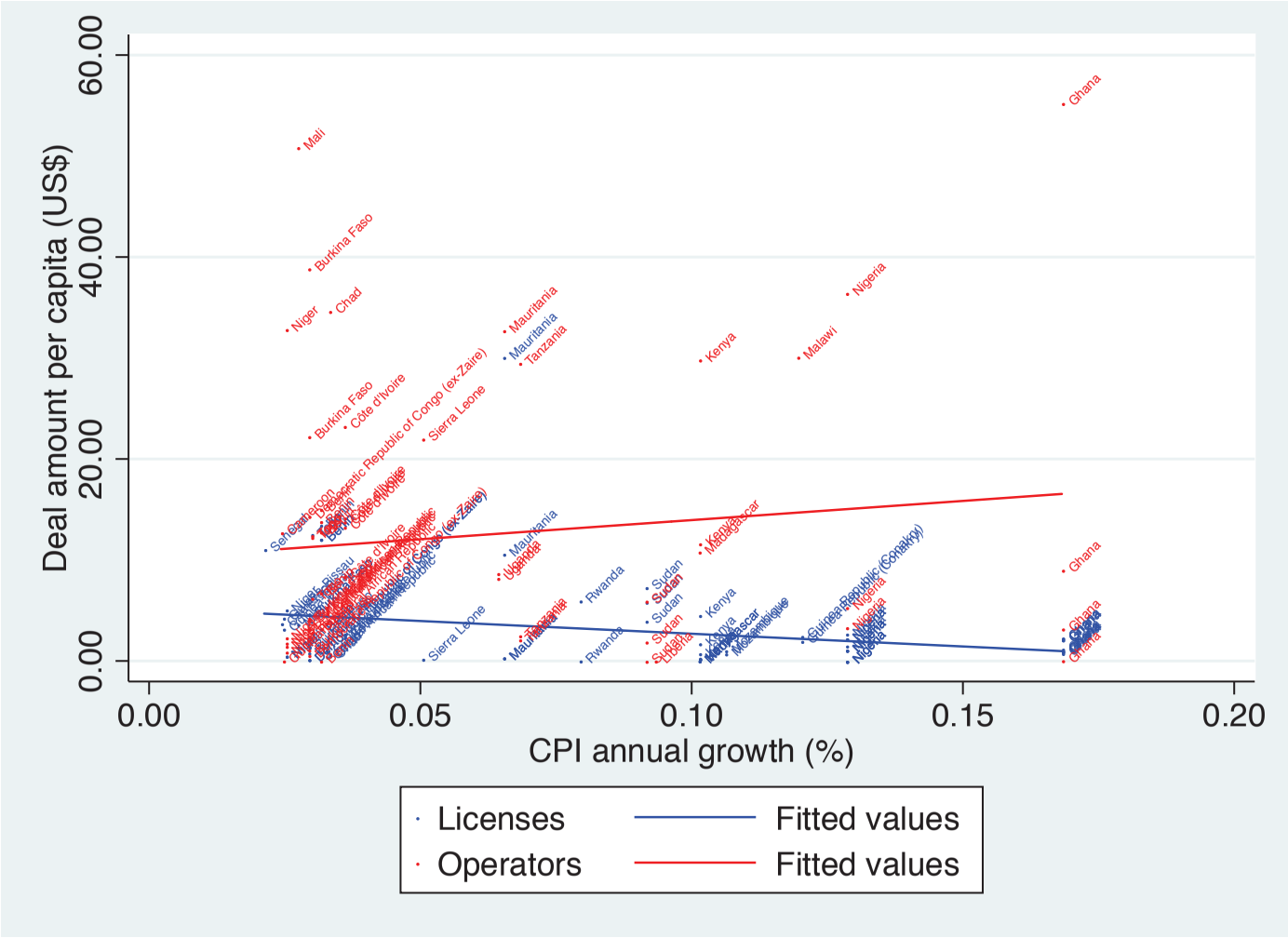


Graphs 22 and 23 relate to the potential correlation between amounts per capita and country inflation (CPI for Consumer Price Index). It is important to underline here that price indexes in developing countries must be taken with caution - as their value reflects only partially the local economy – and are often overestimated. Results look more intuitive for licenses than for operators: higher inflation is associated with lower deal amounts per capita, translating the MTCs' willingness to less value licenses in countries with higher inflation.

Graph 22: Deal amounts per capita vs. CPI annual growth

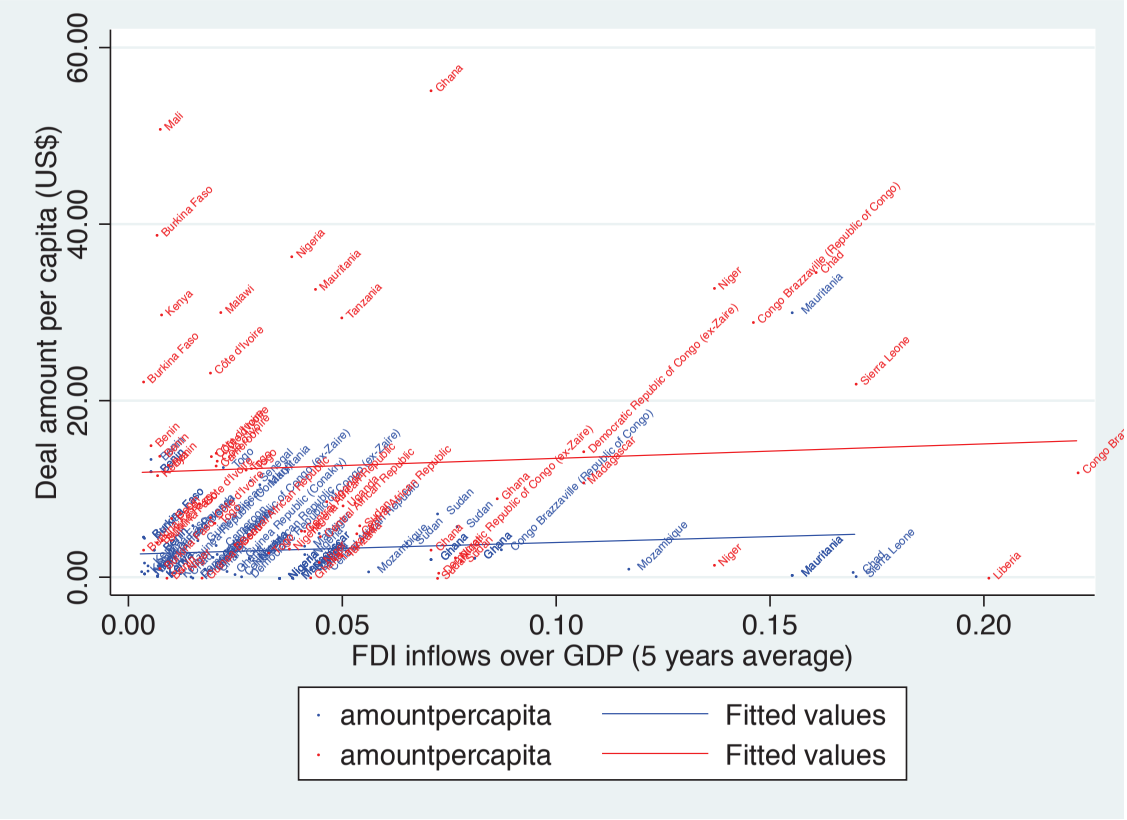


Graph 23: Deal amounts per capita vs. CPI annual growth
– Focus on CPI < 0.2 -



Graph 24 presents the level of deal amounts depending on the level of FDI inflows to the host country at deal date. The FDI indicator is basically the average over 5 years of FDI inflows over GDP.

Graph 24: Deal amounts per capita vs. FDI inflows (split operators and licenses)
Excl. Congo Brazza & Zambia

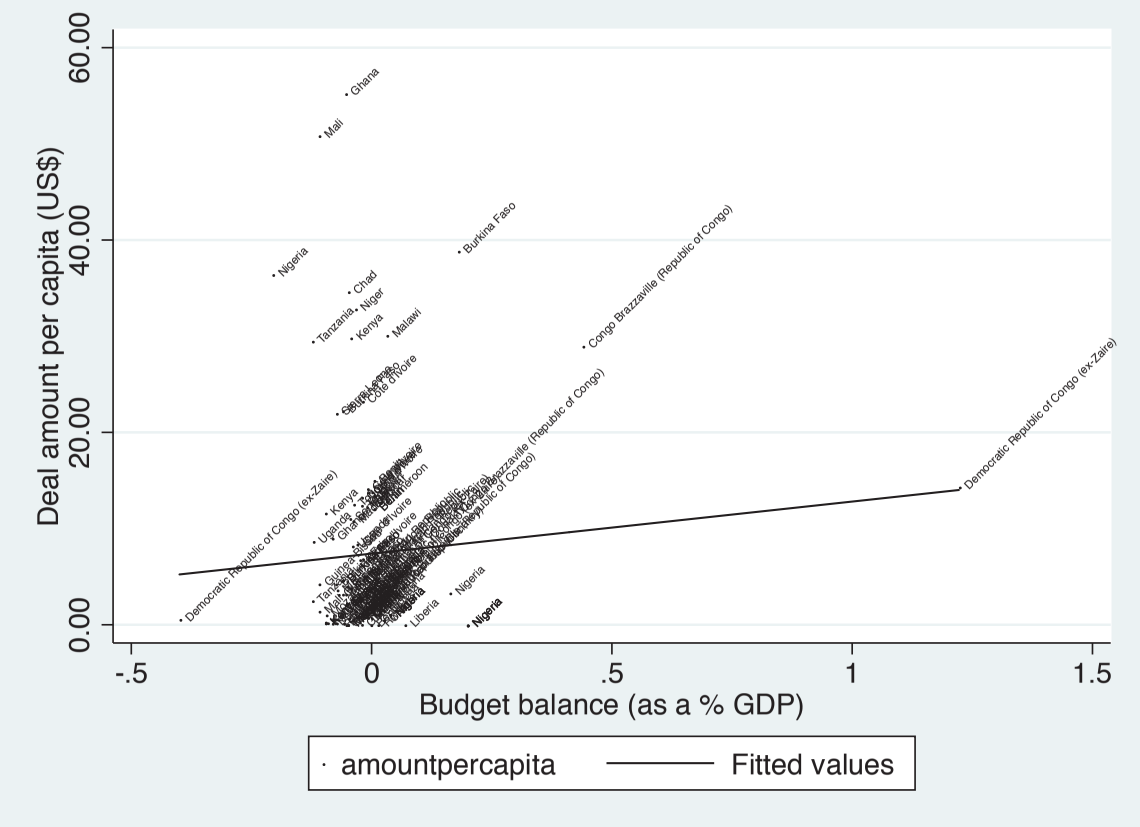


Trend looks flat, meaning no relationship can be made between deal amounts and FDI inflows.

Graph 25 is about government budget, which is the ratio of government revenues minus government expenses over country GDP. This indicator shows the level of public finance crisis. A high level of public finance crisis could potentially have an impact on taxation that is applied to the telecommunication sector. On the graphs, government budget variable is the value of the standardized normal distribution. The dot at the extreme right of the graphs

relate to 2010 Bharti's deal in Democratic Republic of Congo: the budget balance ratio was then 122%, corresponding to large revenues and expenses compared to a low GDP.

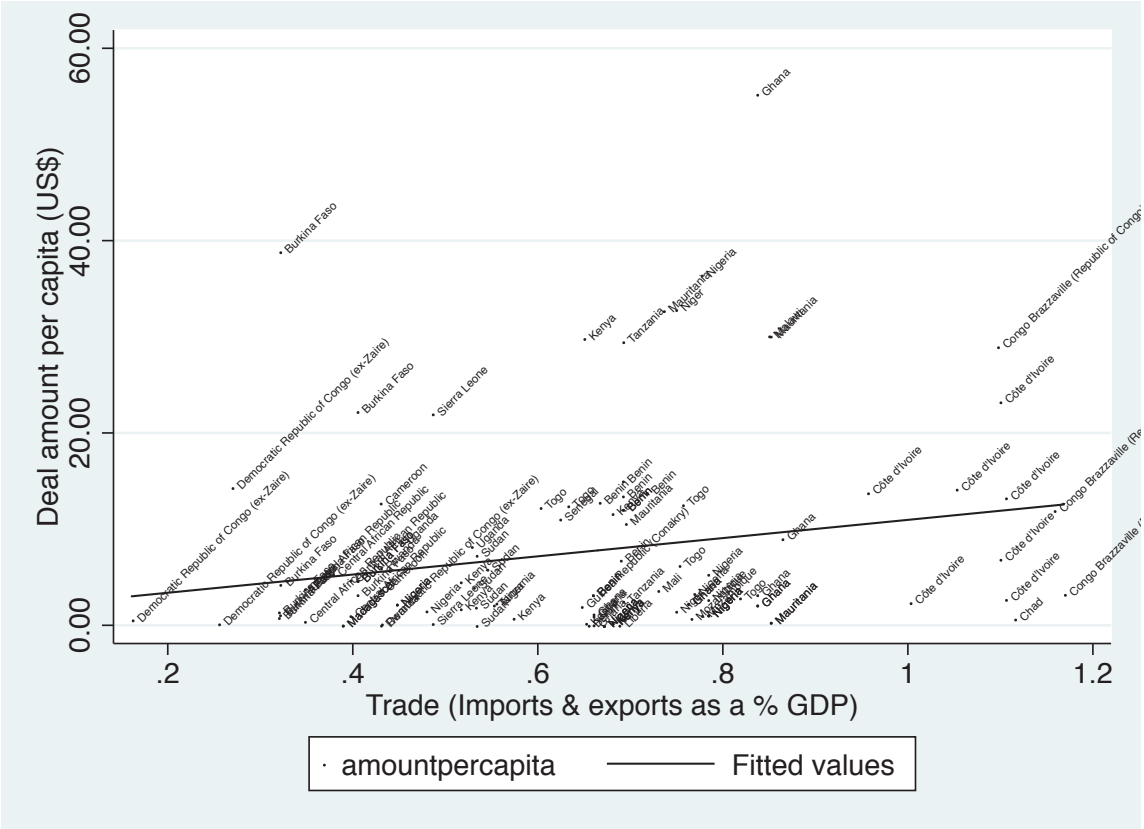
Graph 25: Deal amounts per capita vs. budget balance (as a % of GDP) (all deals)
Excl. Congo Brazza & Zambia



Higher deal amounts are made in countries where the budget balance as a percentage of GDP is higher. Better public finance would be associated with higher levels of deals.

In *Graph 26,* as a reminder, trade is the ratio of imports plus exports over GDP: It shows the weight of trade exchanges compared to the country economic activity. On a general point of view, higher deal amounts are made in countries where 'commercial dynamism' is higher.

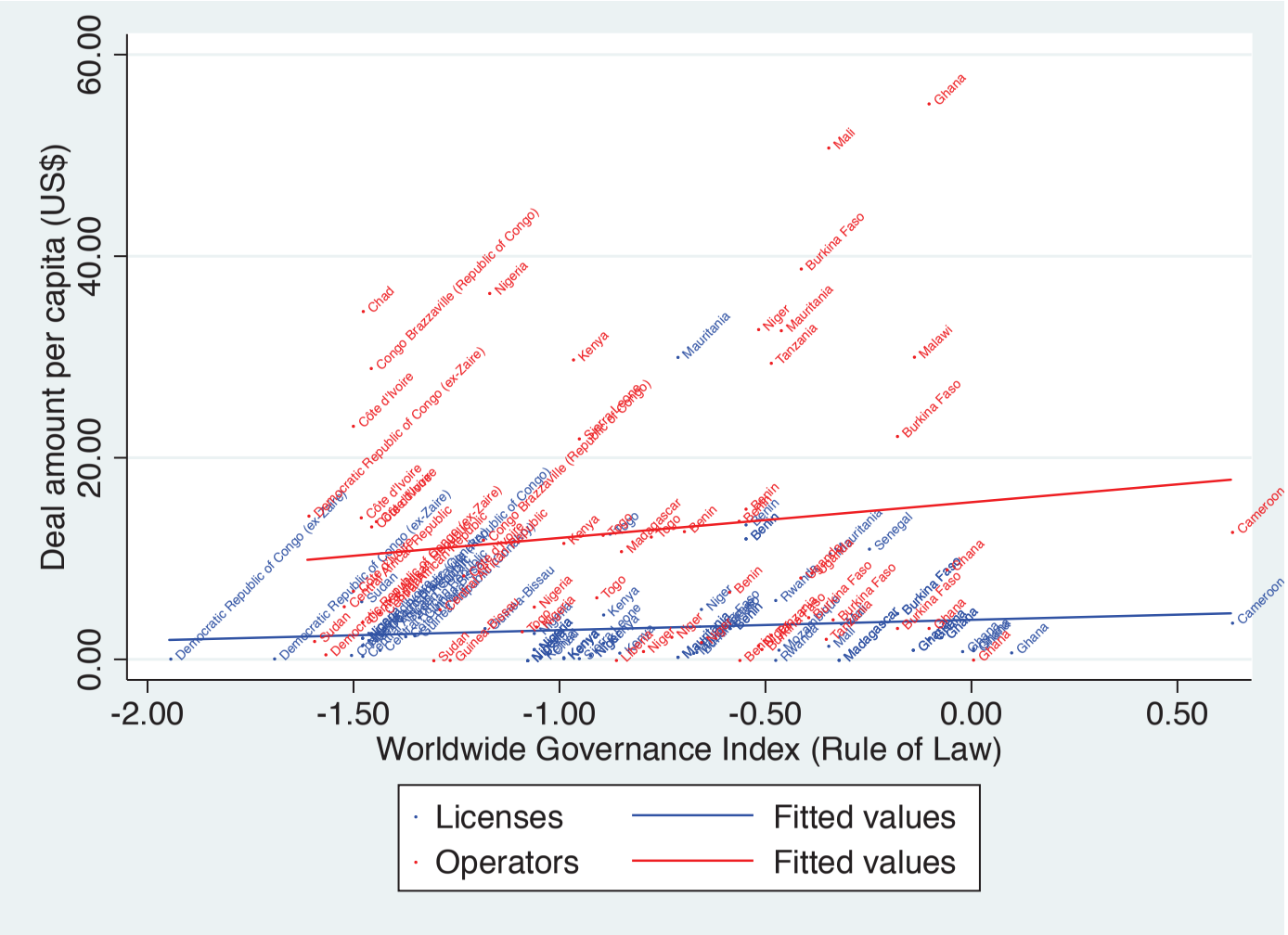
Graph 26: Deal amounts per capita vs. trade
(exports & imports as a % of GDP)
Excl. Bharti's deal in Congo Brazzaville & Zambia



On an economic point of view, higher deal amounts are associated with higher GDP per capita, with a better budget balance and a higher trade activity.

Looking now at the governance aspects, G*raph 27* shows the relationship between the deal amounts per capita and the level of the Worldwide Governance Index (WGI), Rule of Law. It shows that higher amounts of operators' acquisitions are associated with higher WGI levels, which could be expected: Deals made in countries with better levels of governance are valued higher by investors. Nevertheless, the trend is quite flat for licenses: the amount per capita might depend more on governments' expectations and does not appear to correlate with governance environment. Same graph made with EFI gives the same trends: flat curve for licences and increasing curve for operators.

Graph 27: Deal amounts per capita vs. WGI RL



Some additional analyses have been made but do not give any relevant conclusion. Graphs have been included in *Appendix 6.*

We could expect a higher literacy rate to be associated with higher deal prices, due to higher growth opportunities in terms of Internet usage and mobile BB development. But **literacy rate** does not show any clear correlation with deal amounts.

In **landlocked countries**, network operational costs are higher than in maritime countries, mainly because of the non-availability of international access via submarine cables. Thus landlock countries could be associated with lower deals. The graph shows this was true, in our sample, till around 2006, but as from this year, landlock countries have been associated with higher deals than in maritime.

Regarding the **host country currency**, as the CFA franc zone is pegged over the Euro, one could expect more stability and less risk in investing in these countries in CFA zone, and thus potentially higher value of deals and higher amounts per capita: This correlation is weak, potentially because the CFA franc zone has always been threaten of devaluation.

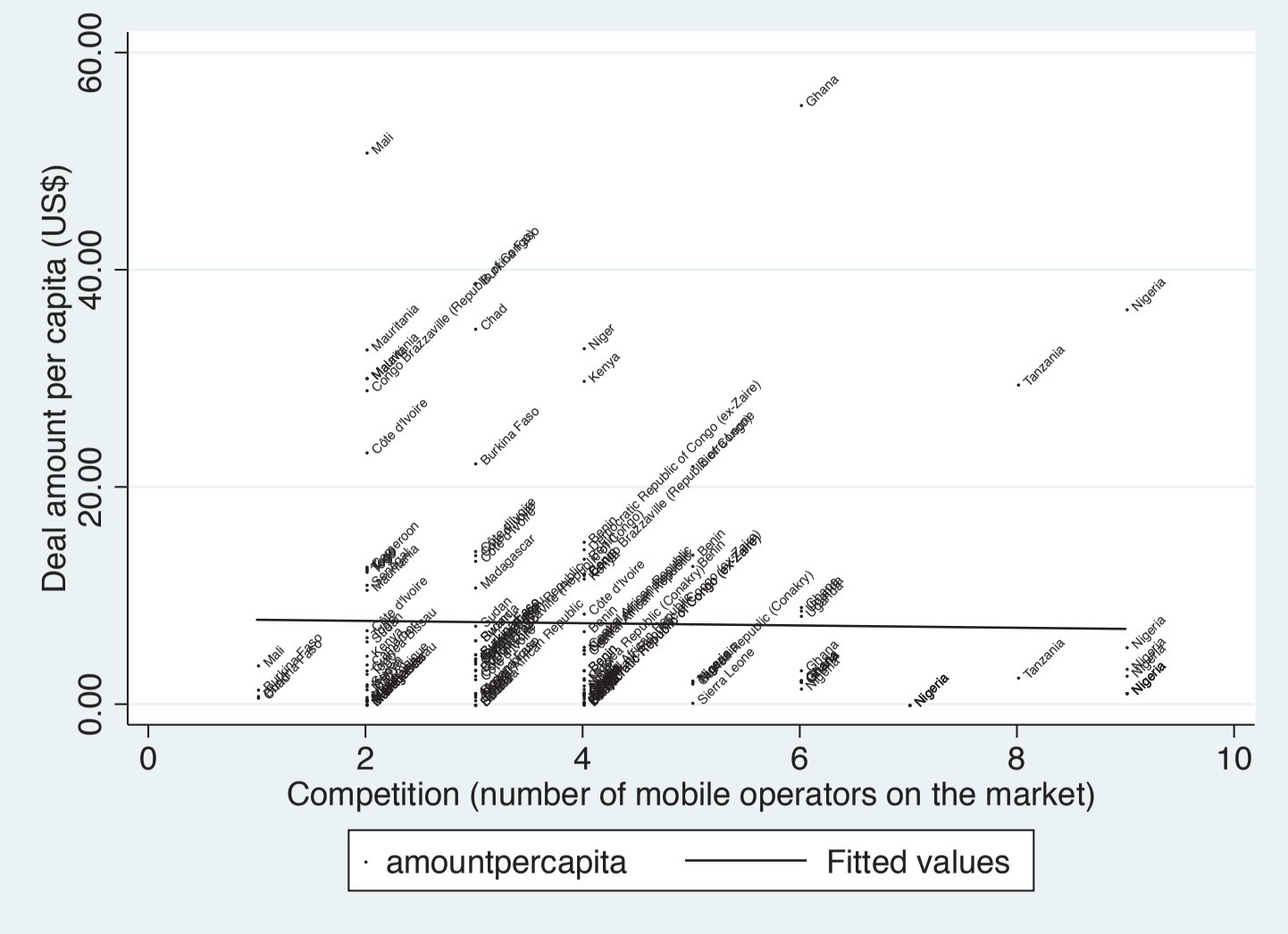
Finally, one could expect that a **common language** between investment home country and host countries would facilitate the way a MTC approaches a foreign market and would potentially entail lower prices thanks to lower cultural barriers. But this indicator doesn't show any correlation of this type.

c) **Deal amounts and market-related factors**

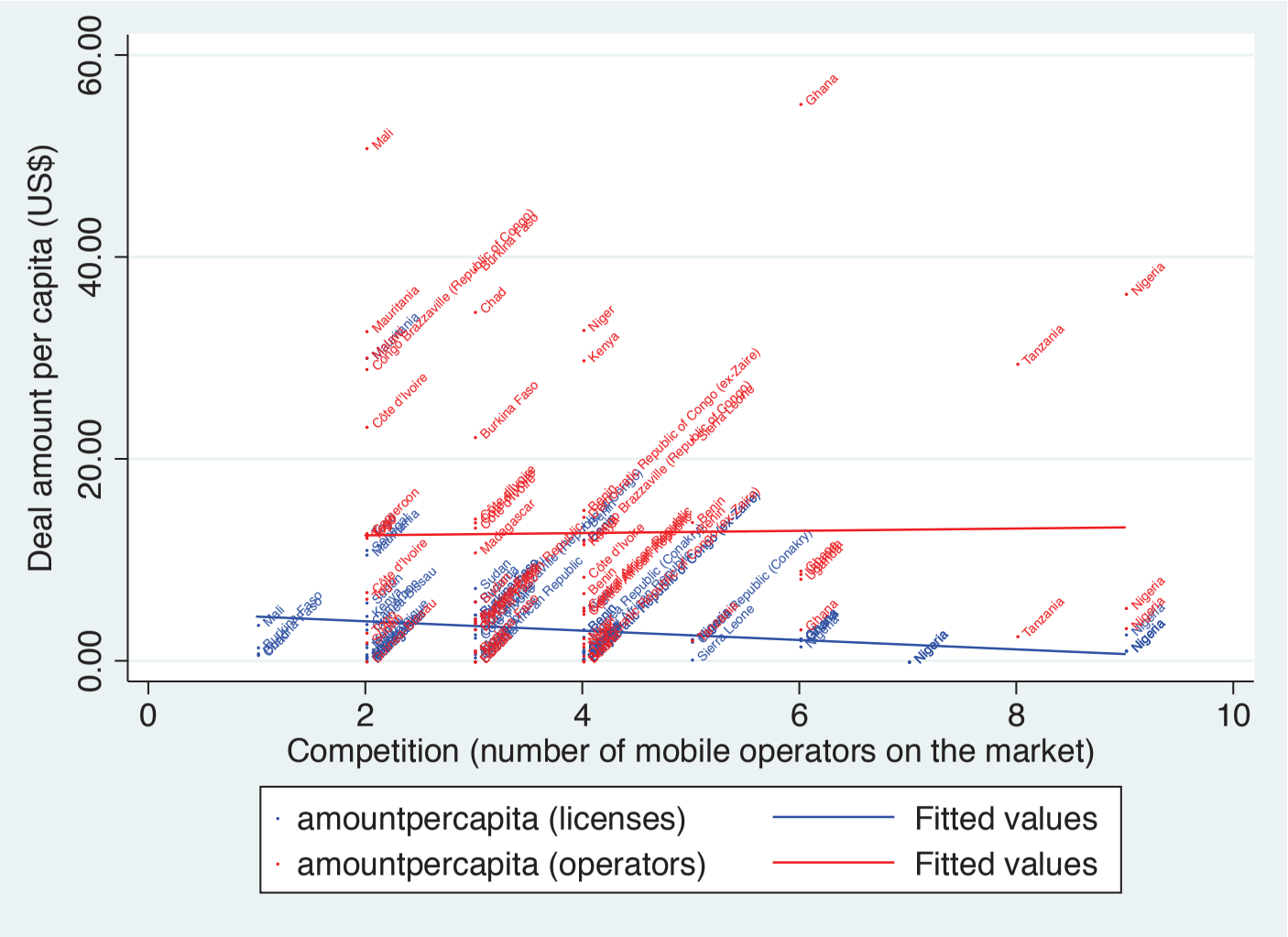
This set of graphs describes how the variable "deal amount per capita" behaves when crossed with variables related to the telecommunication market.

Graphs 28 and 29 cross the amount per capita with the number of mobile operators on the market at the date of the deal, all deals included. Looking at the whole sample *(Graph 28)*, no correlation is shown. But when looking at *Graph 29*, licenses amount per capita is lower when the number of operators on the market is higher – which is intuitive: The higher the number of operators on the market, the higher the competition, the lower the growth perspectives for stakeholders, the lower the license price. The trend is stable for operators' acquisitions: these investments are less sensitive to competition as they are more a transfer of market shares.

Graph 28: Amount per capita vs. competition (number of operators) (all deals)

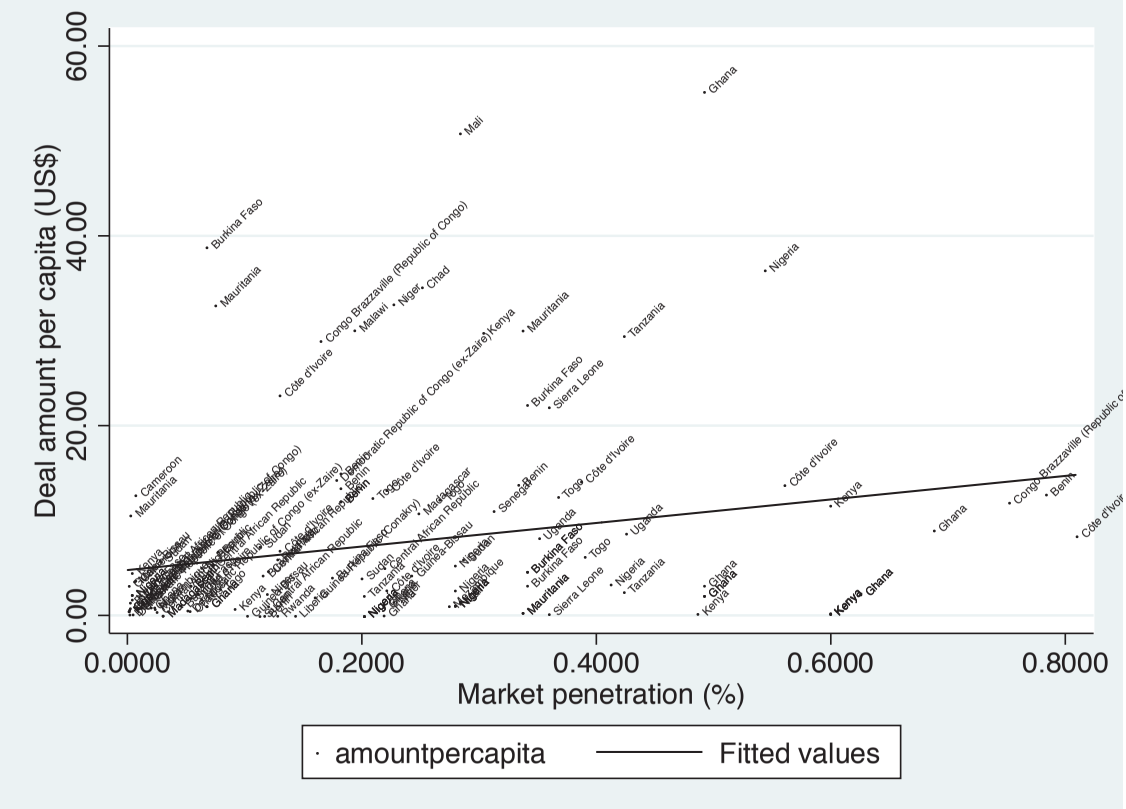


Graph 29: Amount per capita vs. competition (number of operators)
(Split operators and licenses)

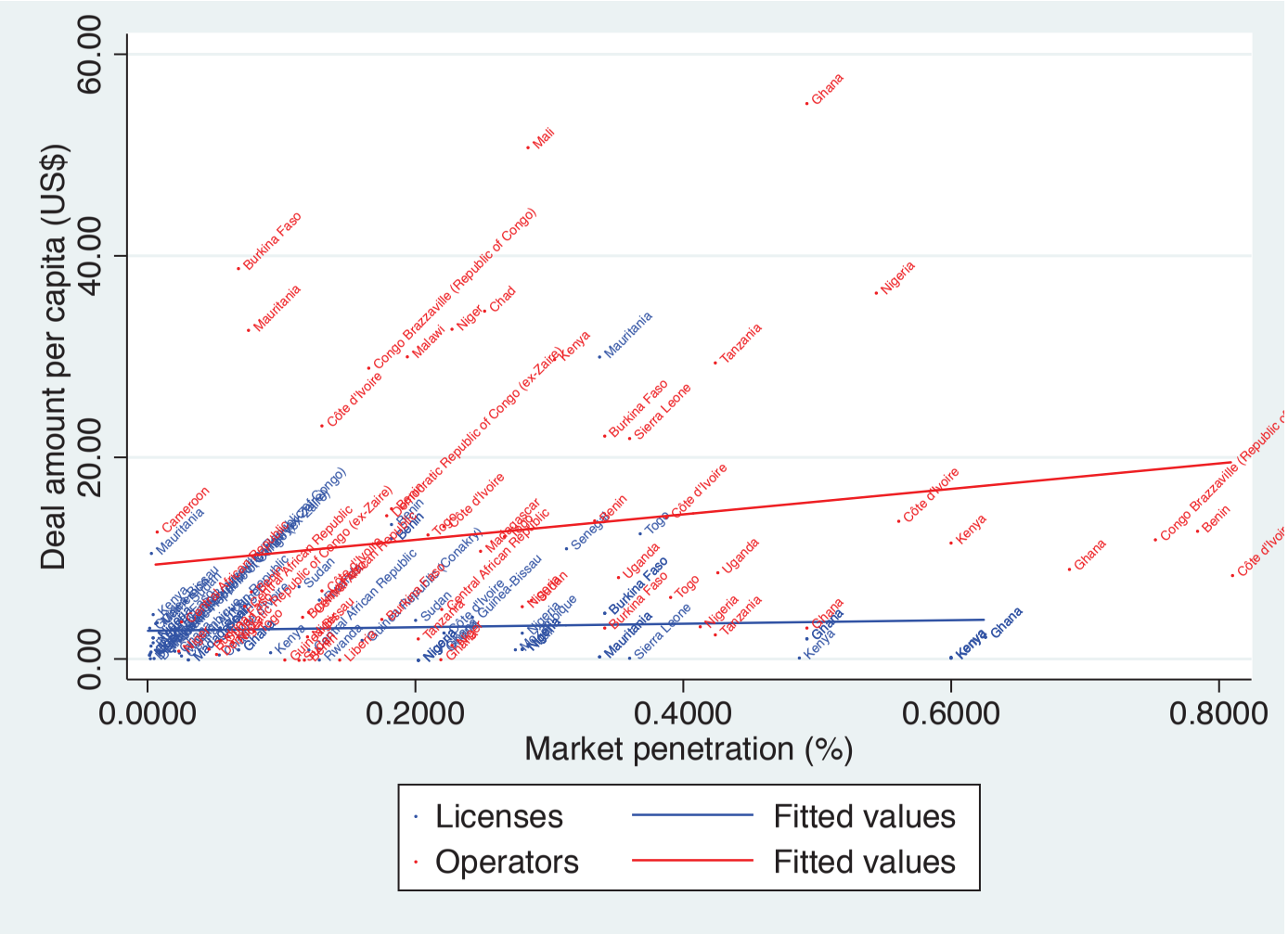


According to *Graph 30*, the correlation between the amount per capita and the mobile market penetration is positive when looking at the 133 deals (visible for operators on *Graph 31* but no apparent correlation for licenses). This appears first as a non-intuitive result: A higher penetration entails lower growth potential to be expected on the market: this would intuitively be associated with lower deal amounts per capita (Luiz, 2011). But an explanation can be given to this positive correlation between deal amount per capita and market penetration: When talking about market penetration in sub-Saharan Africa over 2000-2010, one talks about voice services mainly, as data services were insignificant. So we can assume that countries with a high market penetration are countries with widespread voice services. These countries are considered as more mature to switch to mobile broadband and data services (higher value services) than countries with low voice penetration. This results in the fact that countries with higher penetration represent a higher growth potential for investing MTC than countries with lower penetration.

Graph 30: Amount per capita vs. mobile market penetration (all deals)

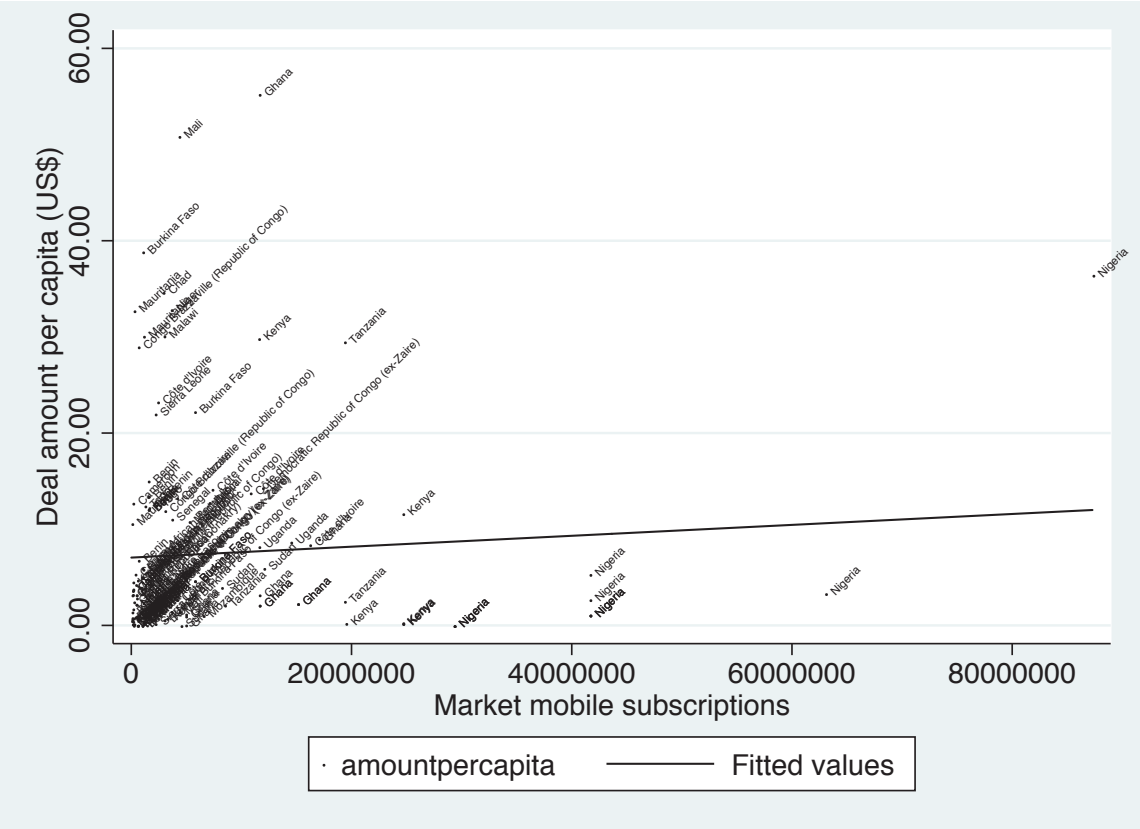


Graph 31: Amount per capita vs. mobile market penetration (split operators and licenses)

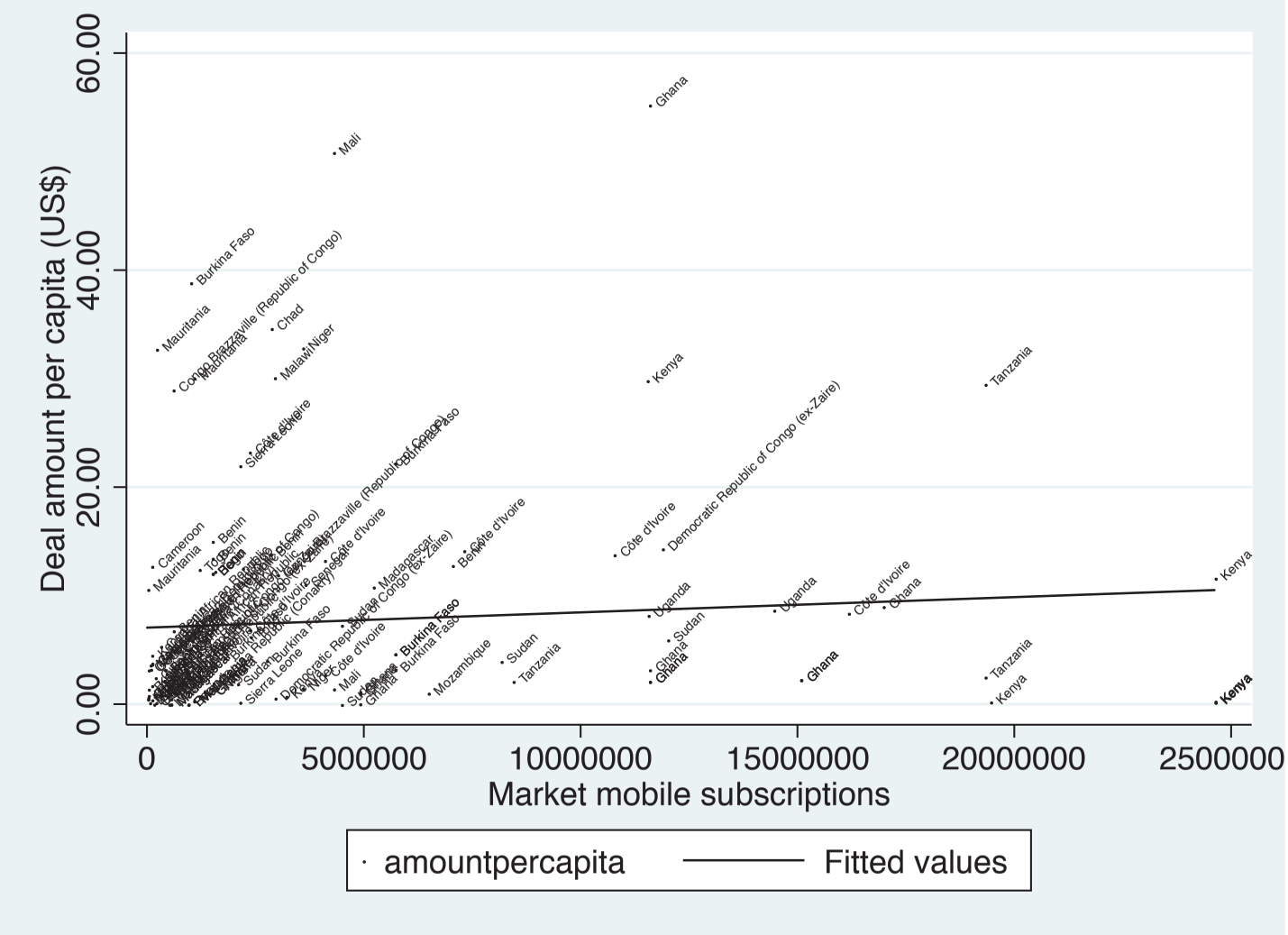


Graphs 32 to 34 cross the amounts per capita with the number of mobile subscriptions in the country at the date of the deal. As Nigeria is the largest market of our sample *(Graph 32)*, it has then been removed on *Graphs 33 and 34* for readability reasons.

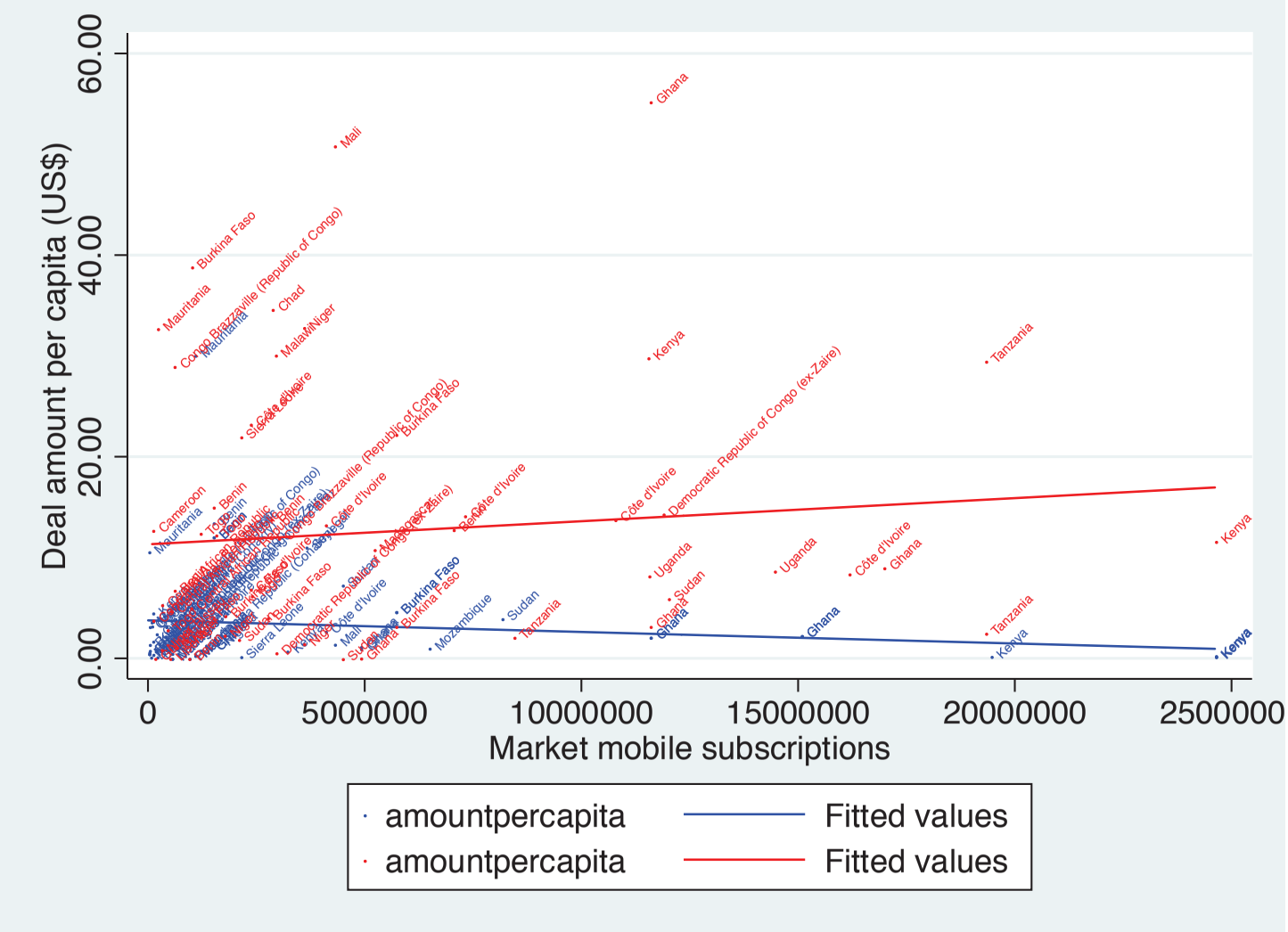
Graph 32: Amount per capita vs. mobile subscriptions (all deals)



Graph 33: Amount per capita vs. mobile subscriptions (< 30 million subscriptions)



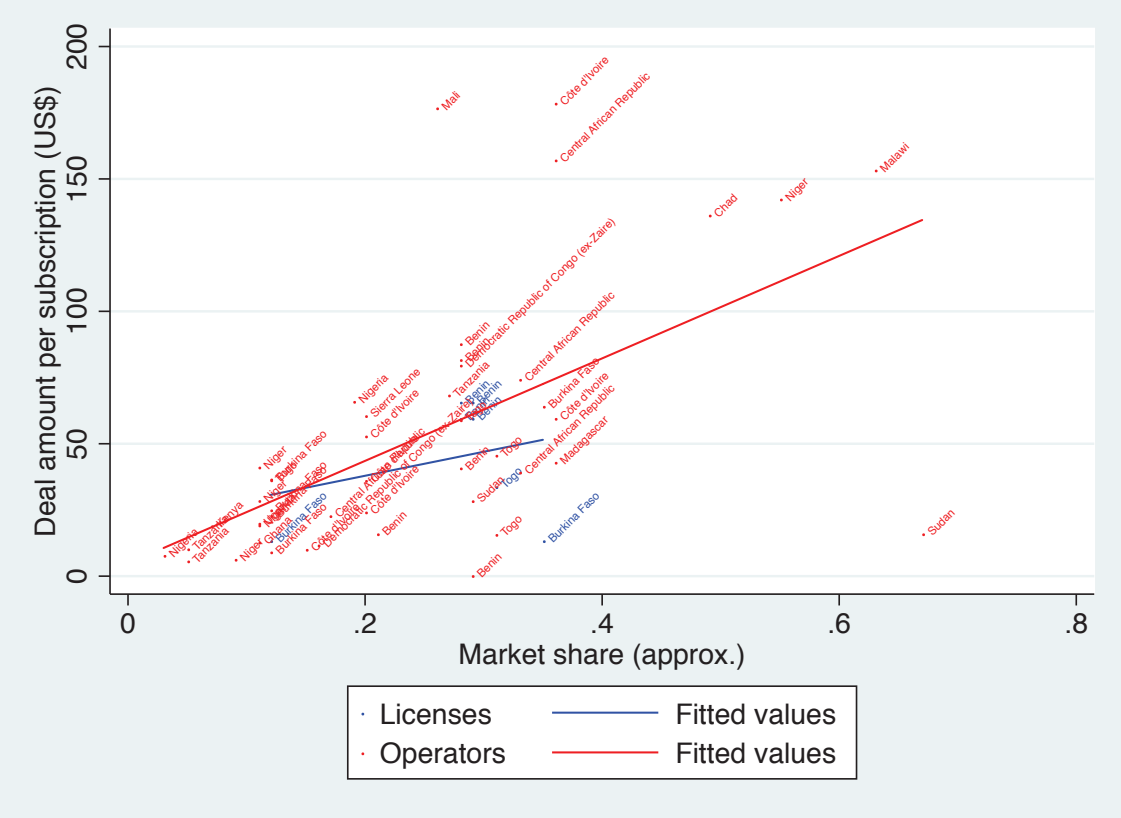
Graph 34: Amount per capita vs. mobile subscriptions (< 30 million subscriptions)
(Split operators and acquisitions)



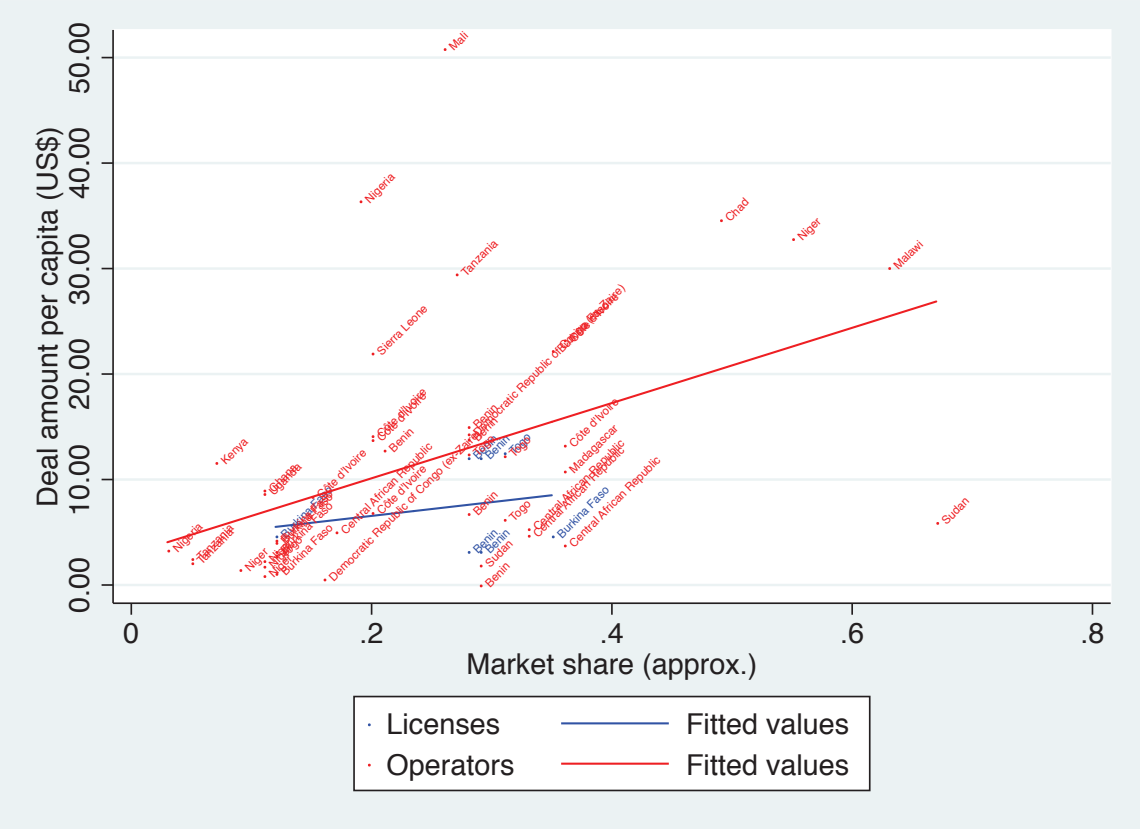
A high amount per capita is associated with a large number of subscriptions in the country when it comes to operators' acquisitions, but no clear trend has been shown regarding licenses. Market size could entail a rent effect and have an influence on the deal amount per capita.

Graphs 35 and 36 involve a market share indicator: They only take into account acquisitions of operators (market share is the one of the acquired operator) and license renewals (market share is the one of the MTC renewing its license on the market). Data on market shares are approximations, as exact data are difficult to find out on 10 years for such a large scope (11 MTC investing in 35 countries).

Graph 35: Deal amount per capita vs. market share (split licenses renewals and operators) (excl. Congo Brazzaville and Zambia)



Graph 36: Deal amount per subscription vs. market share (split licenses renewals and operators) (excl. Congo Brazzaville and Zambia)
– Focus on deal amounts <50US$ -



Higher market shares go with higher deal amounts, whether it be for deal amounts per capita *(Graph 35)* or for deal amounts per subscription *(Graph 36)*.

For operators' acquisitions, this might be due to the fact that the higher the market share of the local operator acquired, the higher the value given to the customer. A higher market share gives the operator a privileged position to manage network externalities.

For licenses, this would mean prices of license renewals take into account the operator's market share. In Togo for instance the rule set up by the regulator was that the price of renewal would be 5% of the operator's turnover on the last five years of activity (see *Box 9* for details on licences and Telecel's acquisition).

Graphs 35 and 36 confirm that a value is attributed to the market shares acquired.

Box 9 The Togolese mobile market

Market & licences

The Togolese wireless market has been a duopoly since 2000 between Togocel, the mobile subsidiary of the Togolese incumbent Togo Telecom (100%-State-owned) and Telecel (mobile brand: Moov). Both of them received 2G licenses in 1999 after a bidding process.

The market is regulated by the ARTP ('Autorité de Réglementation des Télécommunications et des Postes').

In 2009, licenses have been renewed for 12 years for 25 billion FCFA (52.5 million US$, 2009 conversion) after negotiation. Telecel (Moov) disagreed with the level of renewal fee required and was unable to finalize the license terms for the renewal of the mobile license (despite clauses included in the license), Moov operations were suspended by the regulator in August 2009 for four months, its network was shut down. In January 2010, Moov finally agreed to pay XOF25.75 billion (52.5 million US$, 2009 conversion) over 12 years and consequently resumed its operations.

In 2014, an international call for tenders has been launched for the award of a 2G/3G/4G license to a third mobile operator. The deal was to be finalized in October.

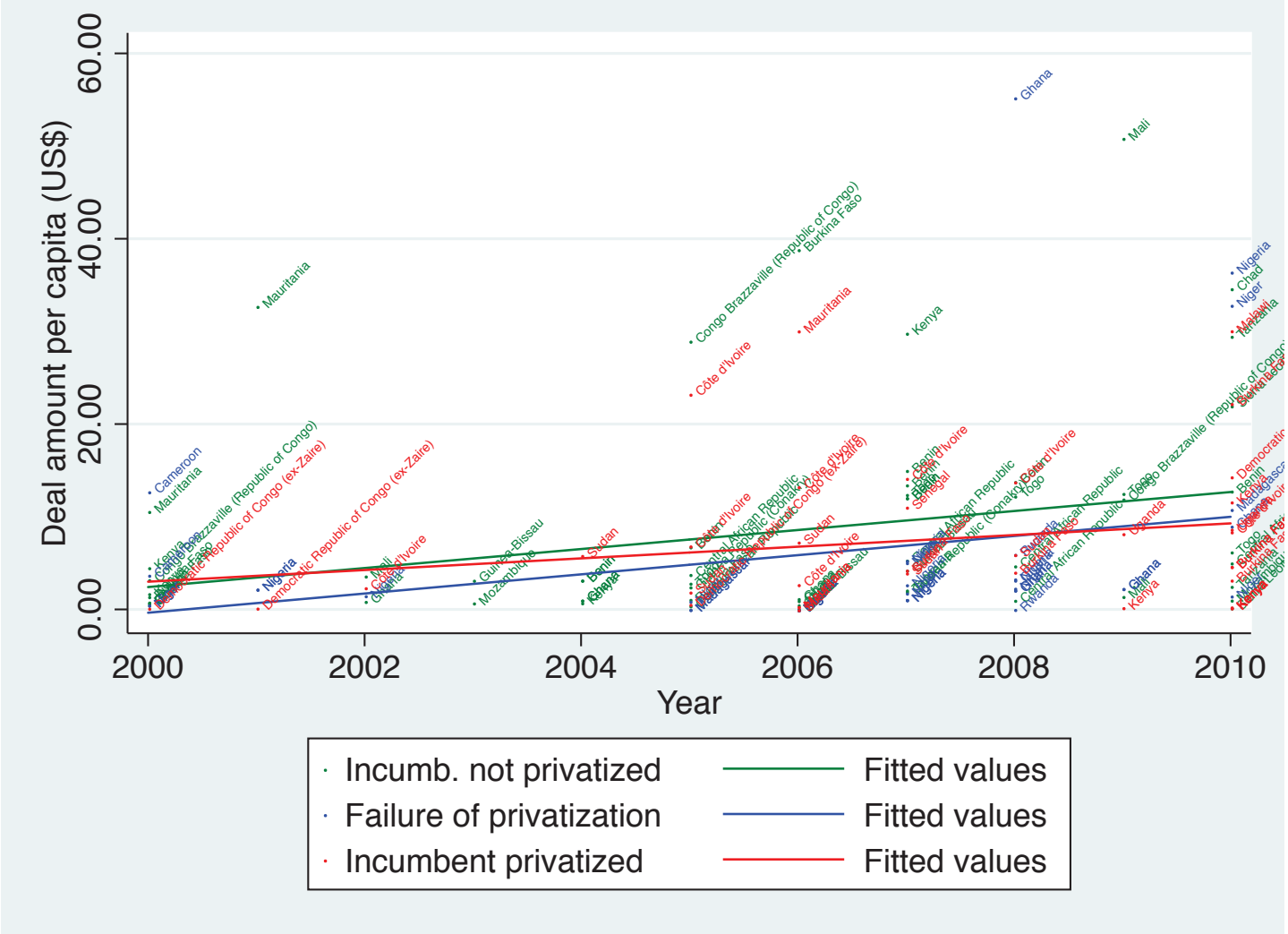
Telecel's acquisition

In April 2000, Telecel was sold to Atlantique Telecom. And as from 2005, Etisalat has progressively acquired Atlantique Telecom's stakes in several African countries (Côte d'ivoire, Burkina Faso, Benin, Niger, Togo, Central African Republic): In April 2005, 50% of Atlantique Telecom for 180 millions US$; in October 2007, 20% for 114 millions US$; in May 2008, 12% for 68 millions US$ and in May 2010, 18% for 75 millions US$. The ARTP was not informed of the deals made before 2009, for which the amounts were not transparent. This is why Etisalat was fined by the regulator. The regulatory body has a control over such transactions (Since 2012, this power has also been granted to the Ministry of Post & Digital Economy) for 2 main reasons: First because these transactions can be a threat for market competition, then because they might hide money-laundering operations. As from 2009, when Moov license was renewed, the regulator has been informed of the transactions, complying with the contract specifications. Today, Etisalat owns 100% of Telecel. In order to comply with Togolese telecom legislation on foreign companies, it has been asked to open at least 30% of its share to local shareholders.

(Sources: ARTP, Telegeography)

Graph 37 present the 133 deals over the years with a differenciation related to the privatization of the incumbent. In green are the deals that have happened in a country where the incumbent had not been privatized at deal date, in red are the deals that have happened in countries where the incumbent had been privatized at the date of the deal and in blue countries where the privatization of the incumbent had failed. A first view on the graph shows no real correlation between the level of deal amounts with the indicator of incumbent privatization, but one can notice that the deals with the highest amounts per capita (Mauritania 2001, Congo Brazzaville 2005, Burkina Faso 2006, Ghana 2008, Mali 2009) have happened in countries where the privatization of the incumbent had not been made or had been a failure.

Graph 37: Privatization of incumbent



d) **Conclusion on descriptive analysis**

This descriptive analysis shows that a few factors seem to have a correlation with deal amounts per capita, when looking at pairwise correlations. But it gives some first insights about the database.

Deal amounts per capita hardly increase over the decade but not as much as the increase in GDP per capita or in inflation; if corrected by inflation, deal amount per capita would probably be flat over time. This result is surprising: In the early 2000s, growth potential of mobile technologies were unclear and uncertain; but during the decade, it has proved to be real. So hypothesis H0 (according to which deal amounts per capita increase over the decade) has been confirmed, but on a much lower extent than expected, given the growth potential of the market.

Looking at the difference between types of deals, the slight increase of deal amounts over the decade is due to acquisitions of local operators. License prices remain generally flat: prices of 2G licences increase over the decade, whereas prices of 3G and neutral licences - awarded as from 2005 – decrease.

Some variables appear to be more significant: deal amounts per capita are higher in countries with higher GDP per capita, in countries with a better government budget balance or with a better trade ratio.
Better governance (WGI) is associated to higher deal amounts for acquisitions of operators (not for license awards).
License prices decrease with the increase of the number of operators on the market: License prices are more sensitive to local market competition than acquisitions of operators.
Acquisitions of operators are more sensitive to the market size (number of subscribers in the country) and to the market shares acquired.

Nevertheless, most variables that have been tested here seem to be not significant: growth of GDP per capita, FDI, host country literacy rate, currency, if the host country is landlocked or maritime, if the incumbent operator has been privatized or not and if the investment home country and host country have a common language.
No correlation is clear between deal amounts and demographics (such as population density, land area and urbanization), showing that network costs (Capex and Opex) have

not really been considered in the MTC's profit expectation, maybe due to generally low regulatory requirements in terms of coverage.

To conclude, this first analysis shows that whether it comes to an MTC's investment in a license ou in an operator, the value given to it is not the value of the asset in itself, but the value of its expected profit, that is linked to a monopoly position, to a customer base, to the risks, etc.

The value attributed to operators' acquisitions generally reach higher amounts per capita than licenses' deals, which could mean that network acquisition has a value in itself. Network costs related to these investments mainly depend on the country geographies (density, land area, urbanisation): The analysis shows that these costs do not seem to be taken into account in the assessment of profit expectation.

A correlation has been shown between deal amounts and country GDP per capita and between deal amounts and governance indicators. But the main point to highlight is that an MTC - when investing in a license or an operator - buys some market shares: The gap between the level of licenses' deals and the level of operators' deals show that a value is attributed to the existing customer base of the operator acquired. This raises the issue of the value of a customer base on the sub-Saharan African market, where most customers are prepaid and multiSIM.

This pairwise correlation analysis has given a general description of the database and does not prove any causation between factors.

IV. Descriptive statistical multidimensional analysis: Principal Component Analysis

Now that we have a general description of the database, our objective now is to identify the local factors that impact asset valuations. This step of analysis uses a descriptive statistics method called Principal Component Analysis (PCA). Instead of measuring data on a classic x- and y-axis, PCA measures data based on its principal components. Principal components are the directions in which the data have the most variance. This method will help us understand what underlying variables are the most meaningful in our data set. PCA demonstrates that licenses' and operators' prices are quite a complex landscape and gives some first insights on how their prices are linked to the different country and markets factors.

Several PCA have been conducted on the database, but have not been published in this document. Some of them include additional local factors. Some others exclude countries like Nigeria, in order to test the removing of the country size effect of Nigeria. But all these PCA show robust results and have common trends with PCA n°1, n°2 and n°3 that have been detailed below.

Using Stata statistical software, PCA n°1 was conducted on licenses only, PCA n°2 on operators only and PCA n°3 on all deals.

For the 3 analyses, the 10 following variables have been analysed (Reminder: All variables' definitions have been detailed in *Part 2 of this chapter)*:

- 'amountpercap' is the deal amount per capita in US$ (standard normal distribution variable) at deal date
- 'GDPpercap' is the country GDP per capita in constant US$ (standard normal distribution variable) at deal date
- 'FDI' is the average of FDI inflows (% GDP) over 5 years around the deal date
- 'population' is the country population (standard normal distribution variable) at deal date
- 'popdensity' is the country density of population (%) at deal date
- 'urban' is the urbanisation rate (%) at deal date
- 'marketpenetr-n' is the mobile market penetration (%) at deal date
- 'competition' is the number of operators on the market at deal date
- 'marketshare' is the market share (%) of the operator at deal date (only for operator's acquisitions and license renewals)
- 'WGILaw' is the level of index WGI Rule of Law (standard normal distribution variable) in the country at deal date

a) **PCA n°1: Licenses awarded**

First PCA focuses on the sample of licenses awarded. The sample is made of 71 observations and tested on the 10 items described above.

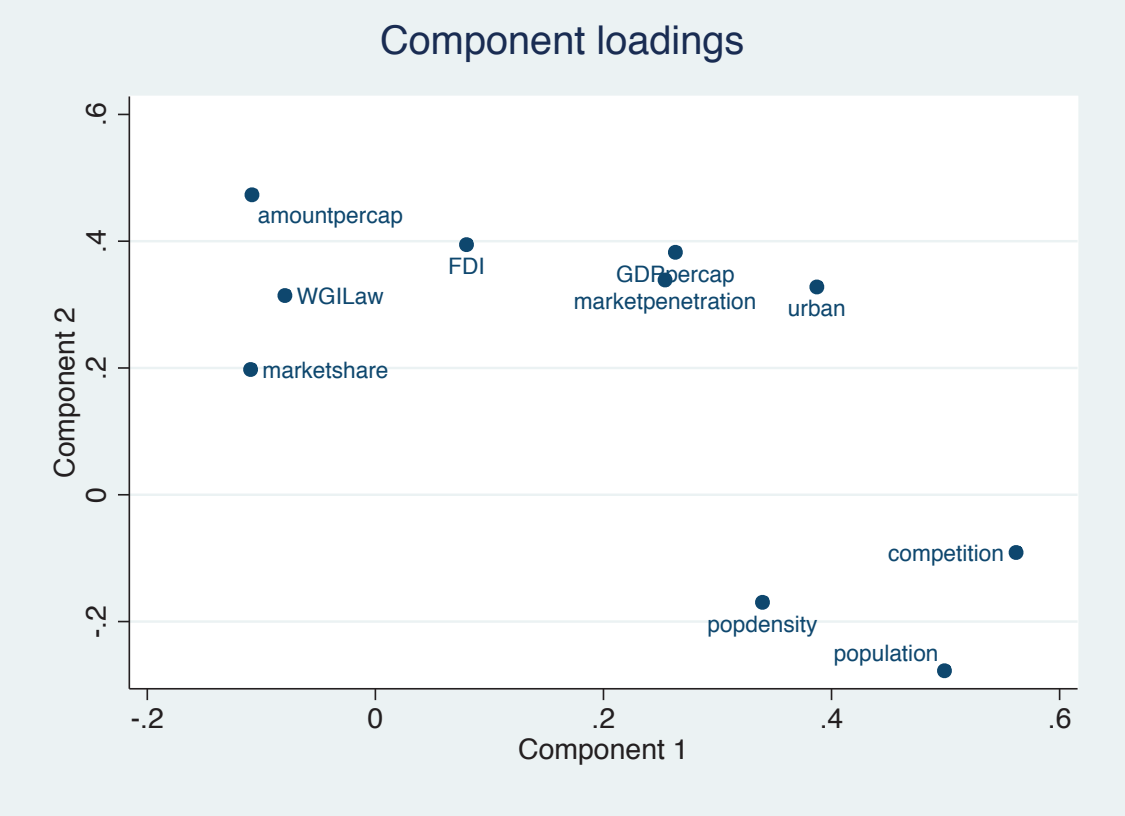
Results of PCA n°1 are the following ones:

```
pca  amountpercap GDPpercap FDI population popdensity urban marketpenetration competition marketshare WGILaw

Principal components/correlation                  Number of obs    =         71
                                                  Number of comp.  =         10
                                                  Trace            =         10
    Rotation: (unrotated = principal)             Rho              =     1.0000

    ------------------------------------------------------------------------------
       Component |   Eigenvalue   Difference         Proportion   Cumulative
    -------------+----------------------------------------------------------------
           Comp1 |        2.66408     .830034             0.2664       0.2664
           Comp2 |        1.83404     .379896             0.1834       0.4498
           Comp3 |        1.45415      .36805             0.1454       0.5952
           Comp4 |        1.08609     .306861             0.1086       0.7038
           Comp5 |       .779234    .0605322             0.0779       0.7818
           Comp6 |       .718701      .11531             0.0719       0.8536
           Comp7 |       .603391     .151072             0.0603       0.9140
           Comp8 |       .452319     .145171             0.0452       0.9592
           Comp9 |       .307148     .206298             0.0307       0.9899
          Comp10 |        .10085            .             0.0101       1.0000
    ------------------------------------------------------------------------------

Principal components (eigenvectors)

    ------------------------------------------------------------------------------------------------------------------------
        Variable |    Comp1     Comp2     Comp3     Comp4     Comp5     Comp6     Comp7     Comp8     Comp9    Comp10 | Unexplained
    -------------+----------------------------------------------------------------------------------------------------------
    amountpercap |  -0.1082    0.4731    0.1576    0.4524    0.0830    0.3232    0.4376   -0.4763    0.0570   -0.0438 |           0
       GDPpercap |   0.2631    0.3825   -0.2453    0.2592    0.0138    0.4302   -0.5927    0.2676    0.1455   -0.1667 |           0
             FDI |   0.0799    0.3945   -0.4845   -0.2391    0.0593   -0.1160    0.5525    0.4470    0.1503   -0.0377 |           0
      population |   0.4990   -0.2777   -0.0284    0.1913    0.0069   -0.0088    0.1131   -0.0862    0.6261    0.4734 |           0
      popdensity |   0.3395   -0.1698    0.3914   -0.1567    0.0338    0.5871    0.2844    0.3504   -0.3463    0.0937 |           0
           urban |   0.3872    0.3277   -0.0120    0.1132   -0.5594   -0.3067   -0.0407   -0.0863   -0.4516    0.3312 |           0
    marketpene~n |   0.2541    0.3388    0.1253   -0.3810    0.6803   -0.1519   -0.1920   -0.2408   -0.1277    0.2506 |           0
     competition |   0.5619   -0.0911    0.1237    0.0145    0.0215   -0.2524    0.1104   -0.1569    0.0327   -0.7473 |           0
     marketshare |  -0.1094    0.1976    0.5721    0.3802    0.1554   -0.4000   -0.0175    0.5241    0.1311    0.0285 |           0
         WGILaw |  -0.0793    0.3142    0.4096   -0.5541   -0.4334    0.1068   -0.0851   -0.0821    0.4502   -0.0651 |           0
    ------------------------------------------------------------------------------------------------------------------------
```

Based on Kaiser criterion (retaining components with eigenvalues over 1), we were able to derive 4 components from these 10 items. These 4 components represent 70% of variance among items. Component 1 accounts for the most variance (26.6%). Each factor (represented by each component) is a weighted combination of the input variables. For example, component 1 has a stronger correlation with variables of competition, population, etc.

The “component loadings” graph *(Graph 38)* below shows how the 10 variables are correlated to the 2 first components (45% of variance).

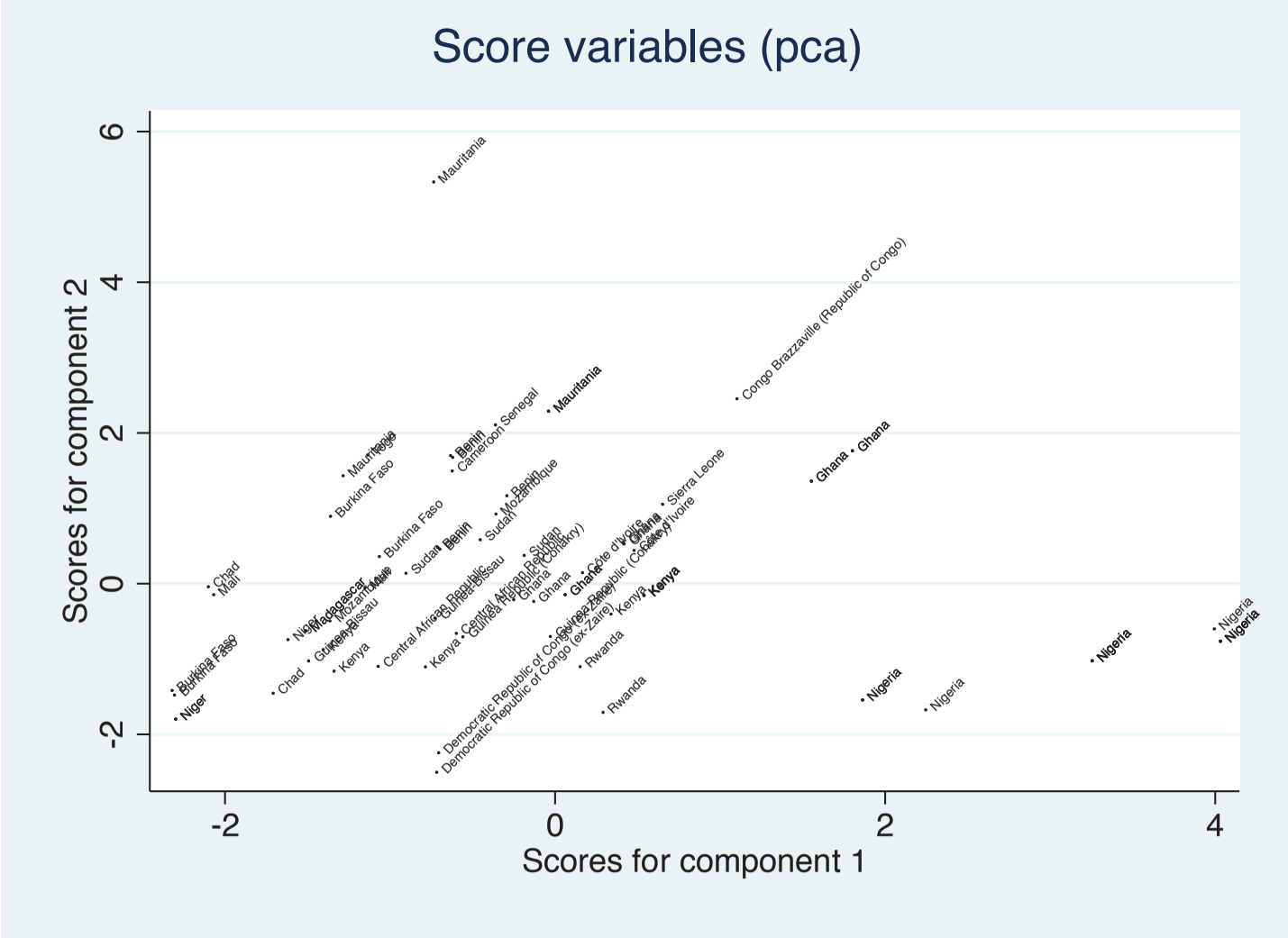
Graph 38: Licences - Component loadings



Component 1 (on axis x) could be defined as a **'market size & competition'** factor, as the strongest variables are population (eigenvector of 0.50) and competition (eigenvector of 0.56). Urbanisation (0.39) and population density (0.34) are also quite strong variables along axis x.
Component 2 (on axis y) is defined by the **'amount of deals'** that is the variable we are seeking to explain. It is also a component of **economic development**. Strongest variables along axis y are the amount per capita (eigenvector of 0.47), FDI (0.39), GDP per capita (0.38) and - on a lesser extent - market penetration (0.34).
Governance indicator - represented by WGILaw - only appears on Component 2 with an eigenvector of 0.31 (0.41 on Component 3), and is quite closed to the amount per capita.

The following graph *(Graph 39)* shows how each license awarded (71 plots, some overlapping) is correlated to these 2 first components, Component 1 and Component 2.

Graph 39: Licences - Score variables



Countries along axis x (market size and competition)

Deals made in Nigeria are at the extreme right of axis x (Component 1). This is partially explained by the large population of Nigeria compared to all other sub-Saharan countries: Nigeria went from 123.7 million inhabitants in 2000 to 158.4 million in 2010, whereas the second population of our sample is the one of Democratic Republic of Congo with 49.6 million inhabitants in 2010 and 66 million in 2010. Nigeria is also the country with the highest competition (with up to 9 mobile operators in 2010).

For the rest of the cloud of dots, deals made in Ghana, Kenya, Rwanda, Congo Brazzaville, Sierra Leone are on the right side of the graph, meaning that the mix of country size variables (population, population density, urbanisation) and market competition variables is higher in these countries. Kenya has quite a large population (40.5 million inhabitants in 2010) and Ghana has a mix of high population density (107 people/km^2 in 2010) and high urbanisation (51.2% in 2010). Rwanda is a much smaller country in terms of population, but it has the highest density of the sample: 430 people/km^2 in 2010 (far above the second population density of our sample, Nigeria with 174 people/km^2 in 2010). Congo Brazzaville and Sierra Leone also have a small population but they are more urbanized countries than others.

On the opposite side of axis x are deals that have been made in countries like Burkina Faso, Niger, Mali and Chad: the mix of country size variables (population, population density, urbanisation) and market competition variables is lower in these countries. They have low population density (Chad, Niger, Mali), low urbanisation (Burkina Faso, Niger) and a small number of market competitors (between 1 and 4 mobile operators over the decade).

Countries along axis y (amounts of deals & economic development)

Looking now at axis y (Component 2), one deal is far above the rest of the cloud of dots: This is the Mauritanian 2G license awarded to Sudatel in 2006. Its amount per capita is - by far - the highest of our license sample: 30.1$/capita, whereas the rest of licenses are below 13$/capita. The amount proposed and paid by Sudatel – 94 million US$ - in a low population country – 3.1 million inhabitants at that time - is a specific case that has been detailed in *Box 8*: Sudatel bets then on a spectacular economic growth of the country based on natural resources exploitation (oil and copper).

The other dots - on the upper side of the graph - are 2G licenses awarded in Benin, Senegal and Togo between 2007 and 2010 between 11$ and 13$ per capita. Congo Brazzaville, Cameroon and Mauritania have a high GDP per capita compared to the rest of the sample

(Congo is between 1000 and 1200 constant US$ per capita over the decade, Cameroon and Mauritania around 600 US$ per capita).
Also these countries show a general level of governance indicator WGI higher than countries on the lower side of the graph.

On the lower side of the graph are licenses awarded in DRC, Niger and Rwanda: Licenses' prices per capita are low (below 1$ per capita) and they have been awarded in countries with low GDP per capita (in 2010, 105$ per capita in DRC, 179$ per capita Niger and 352$ per capita Rwanda) and low mobile market penetration (in 2010, 18% in DRC, 23% in Niger and 31% in Rwanda).

b) **PCA n°2: Operators acquired**

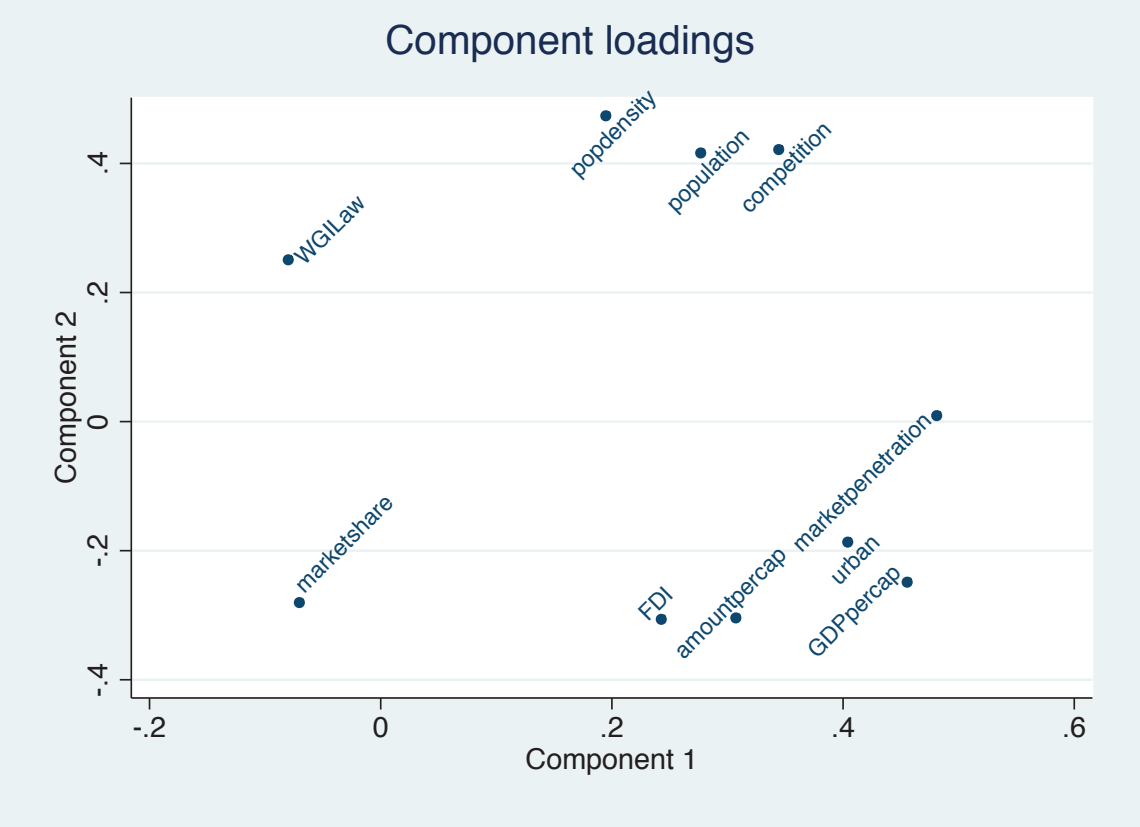
PCA n°2 focuses on operators' acquisitions by MTC in sub-Saharan Africa over 2000-2010. The sample is made of 62 observations and tested on the 10 items that have been described above.

Results of PCA n°2 are the following ones:

```
pca amountpercap GDPpercap FDI population popdensity urban marketpenetration competition marketshare WGILaw

Principal components/correlation                  Number of obs    =         62
                                                  Number of comp.  =         10
                                                  Trace            =         10
    Rotation: (unrotated = principal)             Rho              =     1.0000

--------------------------------------------------------------------------------
    Component |   Eigenvalue   Difference         Proportion   Cumulative
--------------+-----------------------------------------------------------------
        Comp1 |      2.69617      .280358             0.2696       0.2696
        Comp2 |      2.41581      1.21082             0.2416       0.5112
        Comp3 |      1.20499      .107845             0.1205       0.6317
        Comp4 |      1.09714      .194305             0.1097       0.7414
        Comp5 |      .902839      .379935             0.0903       0.8317
        Comp6 |      .522904      .103202             0.0523       0.8840
        Comp7 |      .419701     .0870514             0.0420       0.9260
        Comp8 |       .33265     .0702234             0.0333       0.9592
        Comp9 |      .262426      .117058             0.0262       0.9855
       Comp10 |      .145368            .             0.0145       1.0000
--------------------------------------------------------------------------------

Principal components (eigenvectors)

------------------------------------------------------------------------------------------------------------------------
    Variable |    Comp1    Comp2    Comp3    Comp4    Comp5    Comp6    Comp7    Comp8    Comp9   Comp10 | Unexplained
-------------+----------------------------------------------------------------------------------------+-------------
amountpercap |   0.3073  -0.3043   0.4722   0.1707   0.0585  -0.5283   0.0596  -0.0896  -0.4992  -0.1327 |           0
  GDPpercap  |   0.4555  -0.2489  -0.0751  -0.2148  -0.1938  -0.2913  -0.2038  -0.2822   0.6409  -0.1563 |           0
         FDI |   0.2428  -0.3064  -0.0833  -0.0375   0.7210   0.2877   0.4165  -0.2182   0.0914   0.0828 |           0
 population  |   0.2769   0.4161  -0.2627   0.3530   0.1147  -0.4054   0.0723   0.0084   0.0773   0.6064 |           0
 popdensity  |   0.1948   0.4737   0.1738   0.0981  -0.3201   0.2327   0.4396  -0.5459  -0.0461  -0.2187 |           0
      urban  |   0.4040  -0.1868  -0.2561  -0.2284  -0.4031   0.0942   0.4761   0.5081  -0.1554   0.0610 |           0
marketpene~n |   0.4810   0.0092   0.2767  -0.0094  -0.0632   0.5280  -0.5102  -0.0073  -0.1690   0.3468 |           0
 competition |   0.3444   0.4214  -0.0236   0.1491   0.3367   0.0137  -0.1459   0.4312   0.0724  -0.5958 |           0
 marketshare |  -0.0704  -0.2805   0.2862   0.7281  -0.1750   0.1884   0.1576   0.2250   0.4032   0.0105 |           0
     WGILaw  |  -0.0800   0.2506   0.6637  -0.4294   0.1144  -0.1069   0.2235   0.2681   0.3211   0.2377 |           0
------------------------------------------------------------------------------------------------------------------------
```

Four components were derived from these 10 items. These 4 components represent 74% of variance among items.
The "component loadings" graph below *(Graph 40)* shows how the 10 variables are correlated to the 2 first components (51% of variance).

Graph 40: Operators - Component loadings

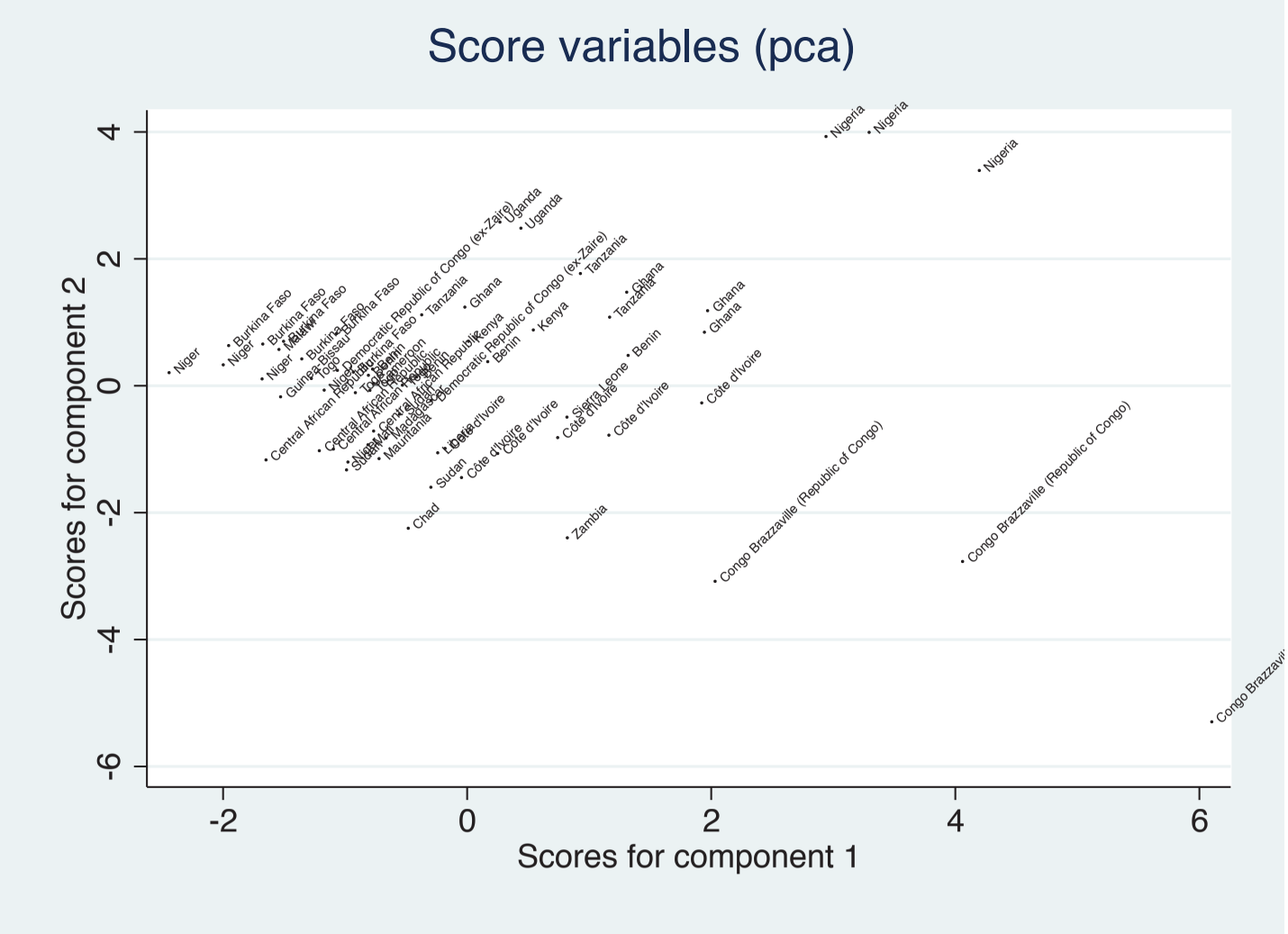


In PCA n°2, axes x and y are reverse compared to PCA n°1, meaning the market size and competition factors are less important in operators' acquisitions than on license awards.
Here, Component 1 (axis x) is defined by the **market penetration** (eigenvector of 0.48) and the **GDP per capita** (0.45), and on a lesser extent by **country urbanization** (0.4) and the **amount of deals** (eigenvector of 0.31), that is the variable we are seeking to explain. Urbanization and competition are also strong variables along axis x (respectively 0.4 and 0.34).

Component 2 (axis y) could be defined as a **'market size & competition'** component, as the strongest variables are **population density** (eigenvector of 0.47), **population** (0.42) and **competition** (0.42). The governance indicator (WGILaw) appears also in this analysis on Component 2, with an eigenvector of 0.25 (much lower than its eigenvector on Component 2 of PCA n°1) but here it is opposed to the amount per capita.

Graph 41 shows how each operator acquired is correlated to these 2 first components, Component 1 and Component 2. The 62 plots represent the 62 deals (local operators acquired in the country indicated), with some overlapping plots.

Graph 41: Operators - Score variables



Countries along axis x (market penetration and country wealth)

Some deals made in Congo Brazzaville and in Nigeria are at the extreme right of axis x (Component 1). There is a gap between these deals and deals in other countries, because Component 1 variables of Congo and Nigeria are much higher than other countries of the sample:

- Market penetration (around 80% depending on the year) and GDP per capita (over 1000US$ per capita) are high in Congo compared to other countries;
- Nigeria has a lower market penetration (up to 54% in 2010) but competition is the highest of Africa (9 mobile operators as from 2007);
- Urbanization is quite high for both countries (between 59% in 2000 and 63% in 2010 in Congo Brazzaville, between 42% to 49% in Nigeria).
- Also, the Congo dot at the extreme right represents the Bharti Airtel deal in 2010 that has a price of 167$ per capita (twice the highest price of the other acquisitions). This is due to the rule that has been used to allocate the total 10.7Bn US$ paid by Bharti Airtel between the Zain's African assets. The allocation key chosen was Zain's revenue in 2009. In 2009, Congo Brazzaville represented a large share of Zain's revenues (6%) compared to its weight in terms of population (less than 1%) in the Zain geographical area. This is why Bharti's deal in Congo has such a high amount per capita.

Looking now at the rest of the cloud, some dots at the right of the graph represent deals with a high level of price: 86$ per capita for Zain in 2010 in Zambia (by Bharti Airtel), 55$ per capita for 70% ownership in Ghana Telecom in 2008 in Ghana (by Vodafone) and 51$ per capita for 51% ownership in Sotelma in 2009 in Mali (by Maroc Telecom-Vivendi).

Component 1 graphically shows an opposition between countries with a higher mix of market penetration, GDP per capita and country urbanization on the right (Ghana, Côte d'Ivoire, Zambia, Tanzania, Sierra Leone) and countries with a lower mix on the left (Niger, Burkina Faso, Guinea Bissau, Central African Republic).

Countries along axis y (market size and competition)

Looking now at axis y (Component 2), Nigeria is above the rest of the cloud, still for competition reasons: the number of mobile operators on the market is much higher than in the other markets.

Axis 2 graphically presents an opposition between:

- Countries on the upper side of the graph with a high population density and a high competition on their mobile markets, such as Uganda, Tanzania, Ghana (with a

population density over 100 inhabitants per km^2 for Ghana and Uganda, and a competition landscape between 4 and 8 operators in all 3 countries over the decade)

- And countries on the lower side of the graph with a low population density and a low market competition such as Chad, Zambia, Congo Brazzaville (that have a population density below 20 inhabitants per km^2 and a competition landscape between 2 and 4 operators over the decade).

Also countries on the upper side of the graph show a general level of governance indicator WGI higher than countries on the lower side of the graph.

c) PCA n°3: All deals (license awards and operators' acquisitions)

PCA n°3 includes all deals of the database, license awards and operators' acquisitions. The sample is made of 133 observations and still tested on the same 10 items than the first two PCA.

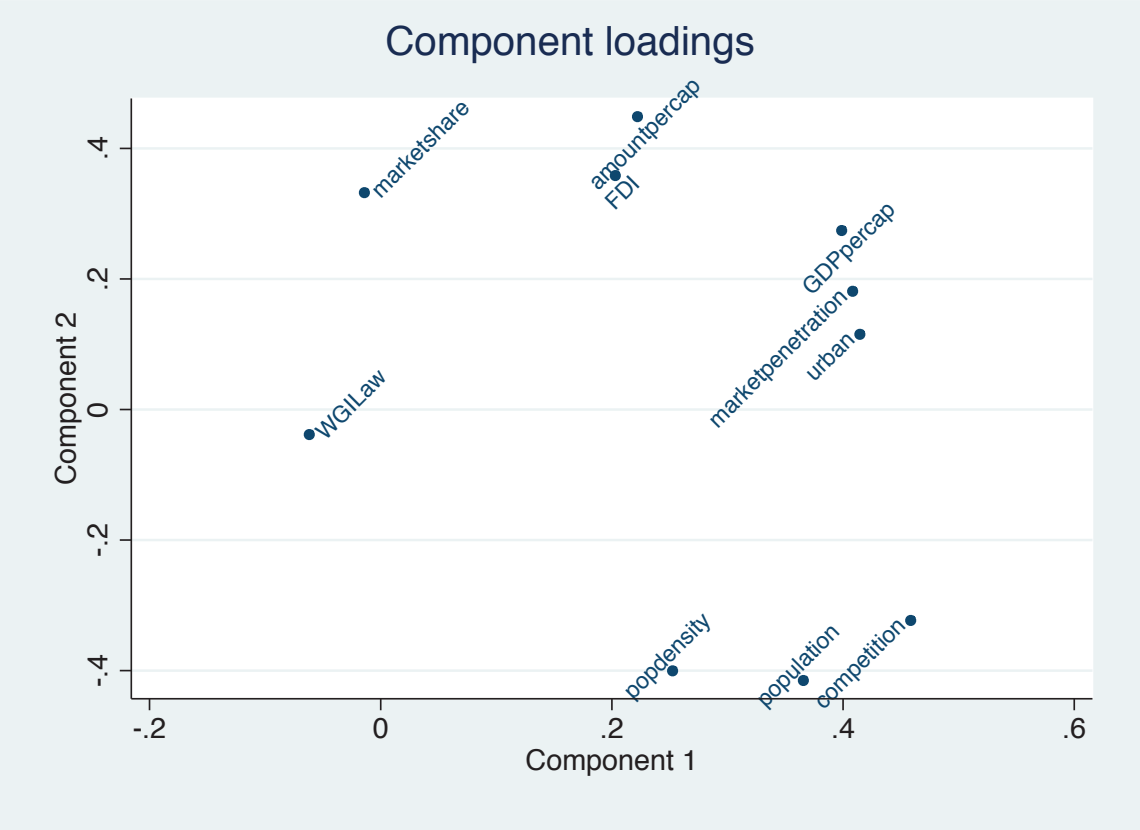
PCA n°3 gives the following results:

```
. pca amountpercap GDPpercap FDI population popdensity urban marketpenetration competition marketshare WGILaw

Principal components/correlation                  Number of obs    =        133
                                                  Number of comp.  =         10
                                                  Trace            =         10
    Rotation: (unrotated = principal)             Rho              =     1.0000

    ------------------------------------------------------------------------------
       Component |   Eigenvalue   Difference         Proportion   Cumulative
    -------------+----------------------------------------------------------------
           Comp1 |        2.59205     .382626             0.2592       0.2592
           Comp2 |        2.20942     .931382             0.2209       0.4801
           Comp3 |        1.27804     .174675             0.1278       0.6080
           Comp4 |        1.10336     .328688             0.1103       0.7183
           Comp5 |         .774676    .206821             0.0775       0.7958
           Comp6 |         .567855    .0216848            0.0568       0.8525
           Comp7 |          .54617    .0716283            0.0546       0.9072
           Comp8 |         .474542    .173091             0.0475       0.9546
           Comp9 |         .301451    .149018             0.0301       0.9848
          Comp10 |         .152434           .             0.0152       1.0000
    ------------------------------------------------------------------------------

Principal components (eigenvectors)

    ------------------------------------------------------------------------------------------------------------------------
        Variable |    Comp1    Comp2    Comp3    Comp4    Comp5    Comp6    Comp7    Comp8    Comp9   Comp10 | Unexplained
    -------------+----------------------------------------------------------------------------------------+--------------
    amountpercap |   0.2222   0.4487   0.2628   0.2171  -0.0963  -0.1225   0.5331  -0.3258  -0.4665  -0.0302 |           0
       GDPpercap |   0.3988   0.2742  -0.2221  -0.2045  -0.3959  -0.3724   0.1256   0.0000   0.5693  -0.1985 |           0
             FDI |   0.2030   0.3584  -0.2279  -0.1598   0.7124   0.1737   0.2732   0.3553   0.1064   0.0539 |           0
      population |   0.3657  -0.4152  -0.1560   0.2848   0.0801   0.0379   0.2405  -0.2893   0.2295   0.6216 |           0
      popdensity |   0.2526  -0.4004   0.3525   0.0270  -0.1522  -0.1635   0.2941   0.7035  -0.1314  -0.0483 |           0
           urban |   0.4146   0.1152  -0.2072  -0.2415  -0.4061   0.6294  -0.1782   0.1168  -0.2966   0.1385 |           0
    marketpene~n |   0.4083   0.1811   0.3287  -0.0794   0.2129  -0.3943  -0.6168  -0.0004  -0.1468   0.2888 |           0
     competition |   0.4585  -0.3232   0.0874   0.1324   0.2750   0.1955  -0.1123  -0.2869   0.0258  -0.6713 |           0
     marketshare |  -0.0141   0.3322   0.3548   0.6260  -0.0986   0.3540  -0.1535   0.1968   0.4172   0.0204 |           0
         WGILaw |  -0.0618  -0.0385   0.6298  -0.5741   0.0361   0.2699   0.1809  -0.2332   0.3047   0.1196 |           0
    ------------------------------------------------------------------------------------------------------------------------
```

Four components could be derived from the 10 items. These 4 components represent 72% of variance among items.

The "component loadings" below *(Graph 42)* shows how the 10 variables are correlated to the 2 first components (48% of variance).

Graph 42: All deals - Component loadings



Results of PCA n°3 are quite consistent with results of PCA n°1 and 2.

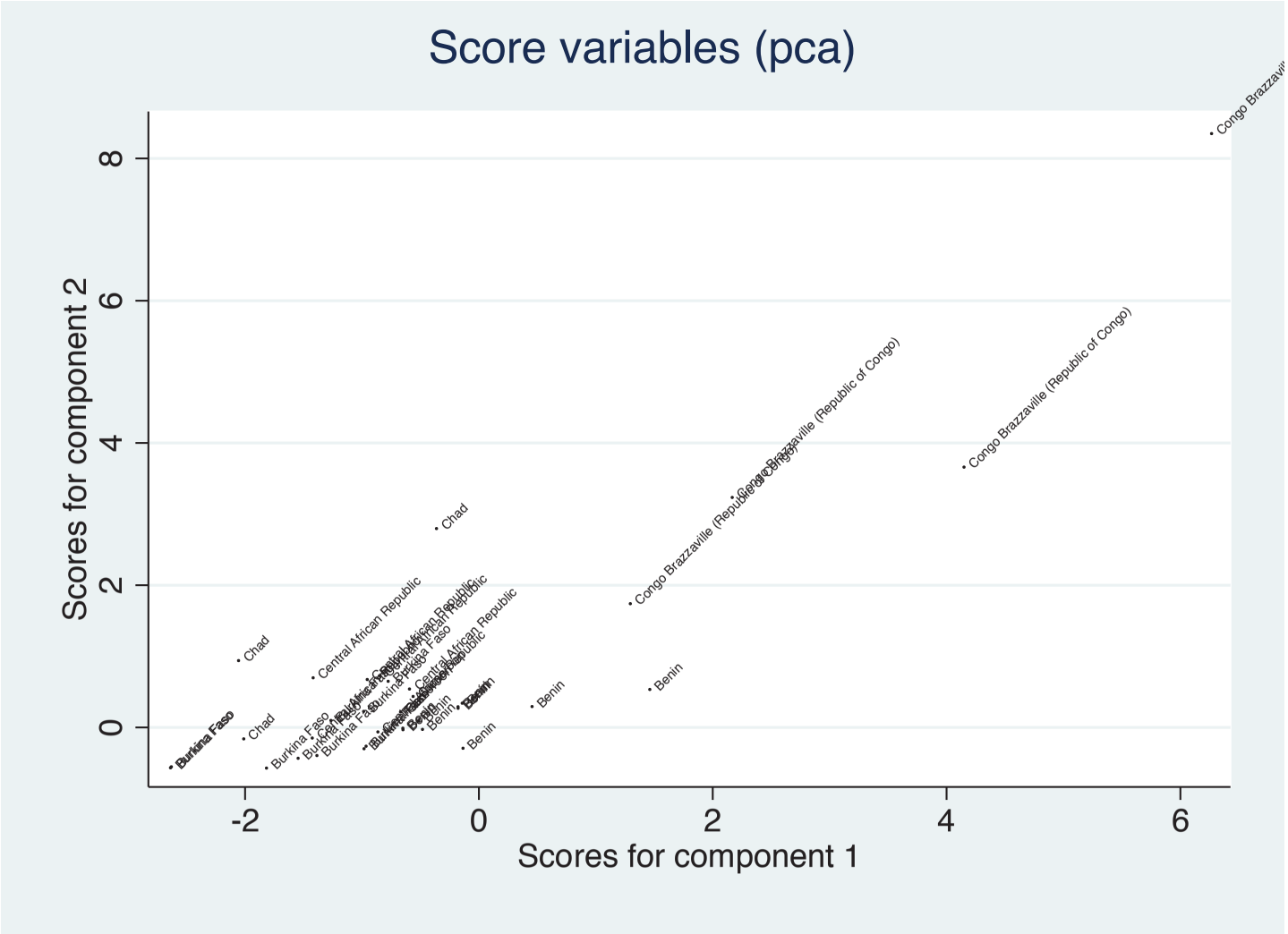
Component 1 (axis x) is a component related to the **mobile market** and to the **country wealth**: market competition (with an eigenvestor of 0.46), market penetration (eigenvector of 0.41), urbanisation (eigenvestor of 0.41) and GDP per capita (eigenvector of 0.4) are the strongest variables on axis 1.

Component 2 could be defined by the **'amount of deals'** (eigenvector of 0.45) and **market size** variables (population has an eigenvector of 0.41) and population density (eigenvector of 0.4).

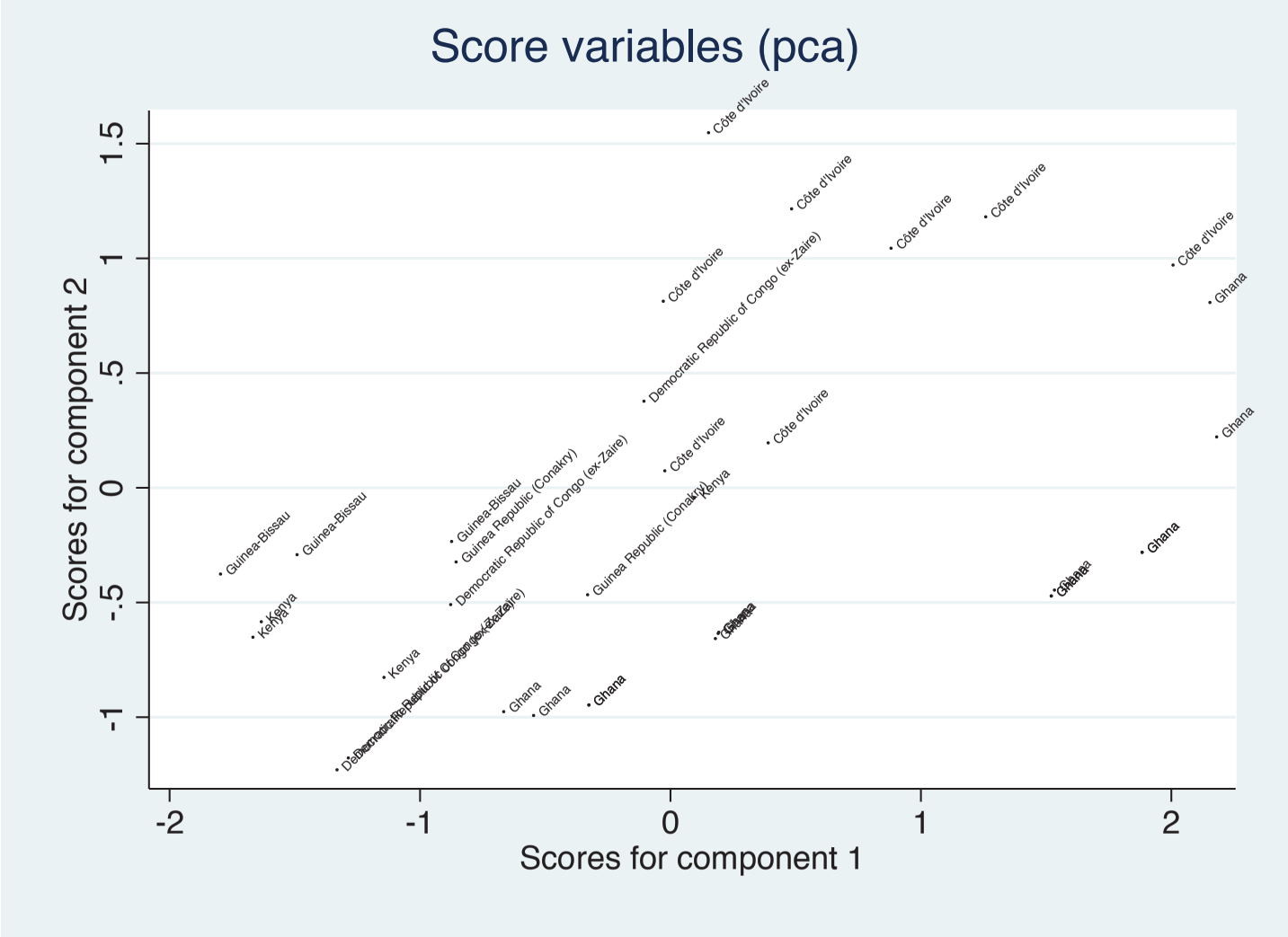
Nevertheless, on both Components, the **governance indicator** (WGILaw) has an eigenvector closed to 0. It appears only on Component 3 with a strong eigenvector of 0.63.

The 4 graphs *(Graph 43)* below show how each deal is correlated to Component 1 and Component 2. The 133 plots represent the 133 deals (license awards and operators acquired in the country indicated). In order to avoid overlapping plots, results have been presented in 4 different graphs (groups of countries are by alphabetical order).

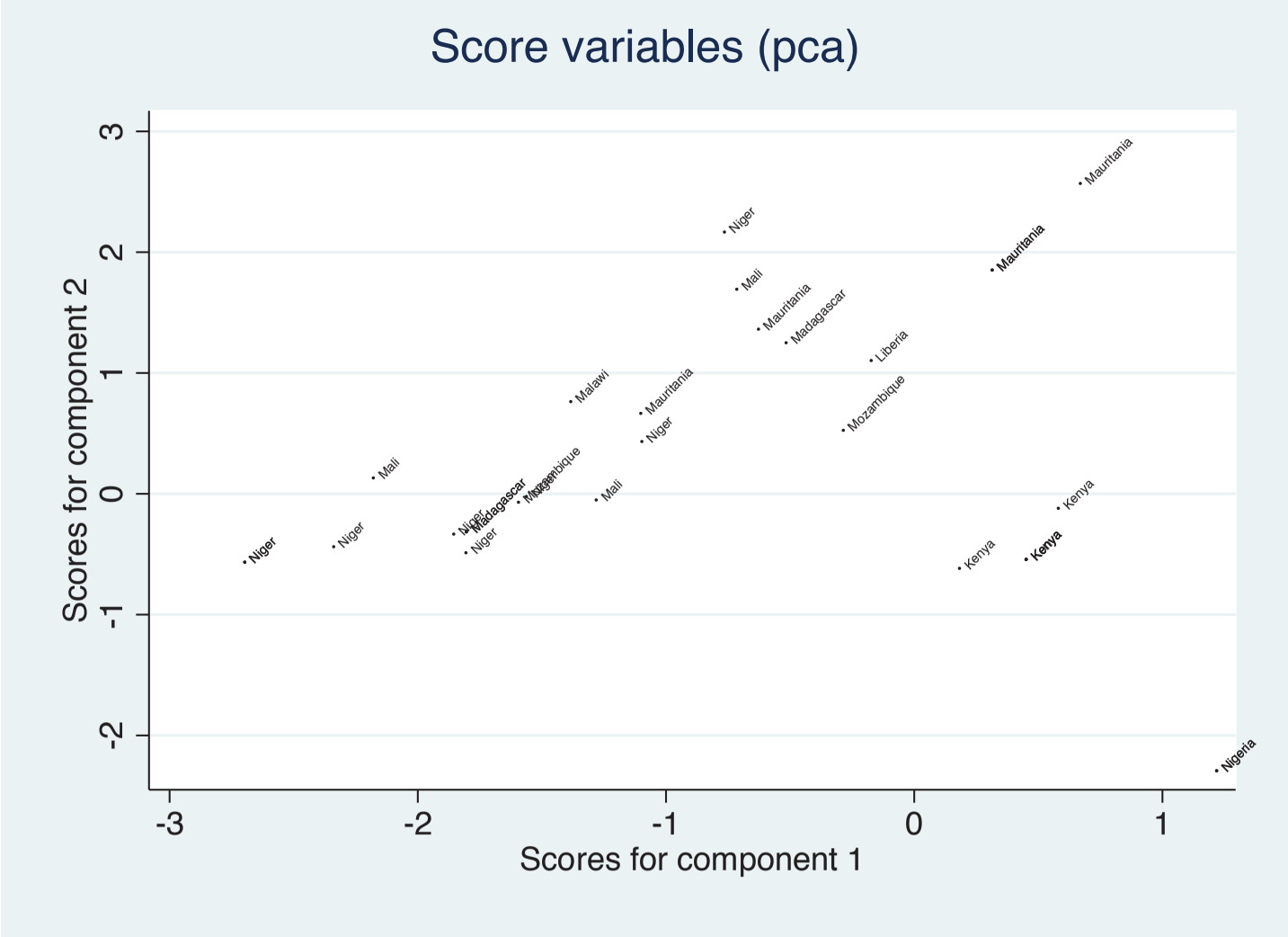
Graph 43: All deals - Score variables
(1st set out of 4)



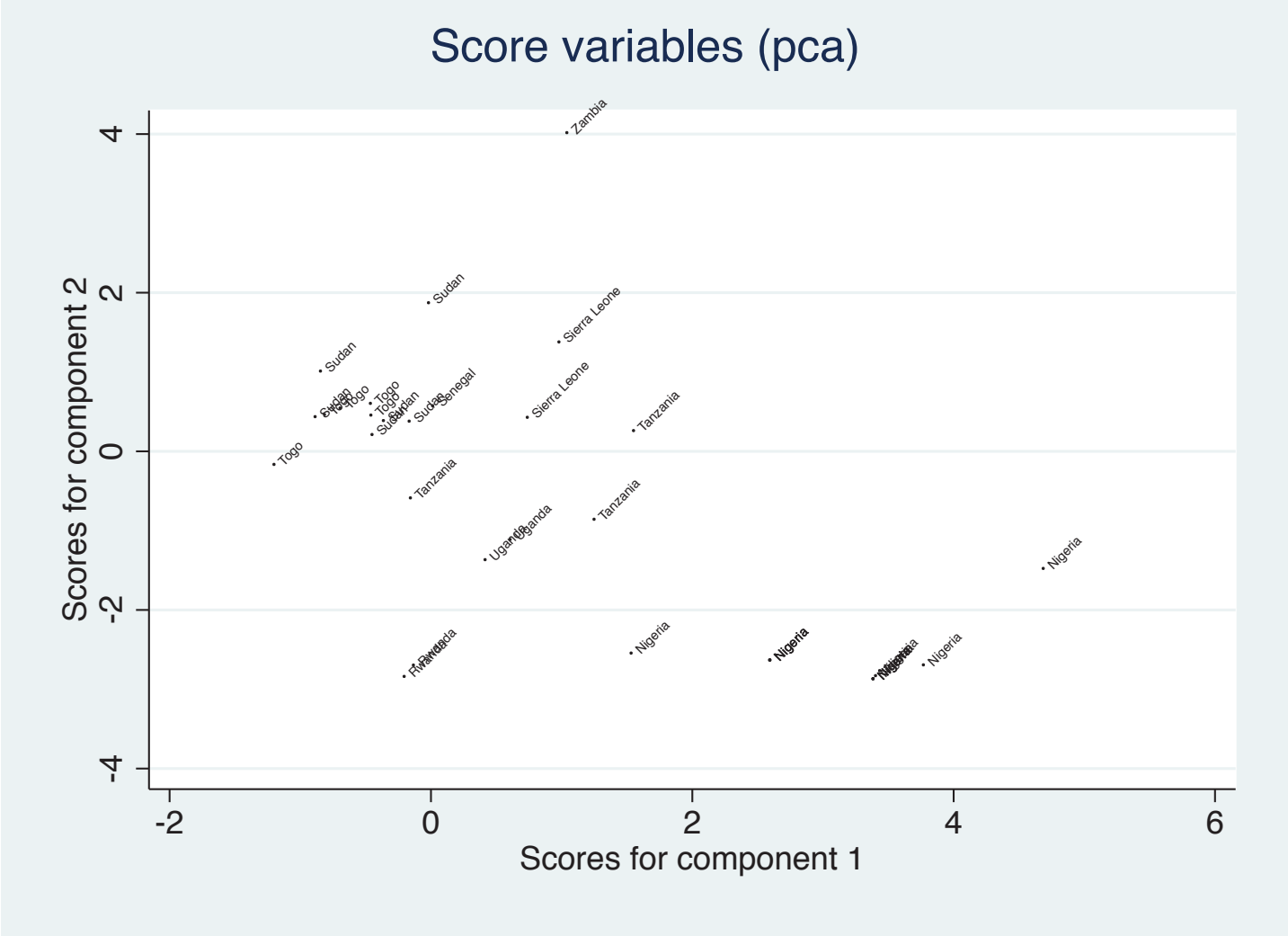
(2nd set out of 4)



(3rd set out of 4)



(4th set out of 4)



Axis x (**Component 1)** graphically shows an opposition between - on the right side - richer countries (GDP per capita) with a more developed mobile market (high penetration and high competition) such as Nigeria, Ghana, Congo Brazzaville and - on the left - countries that have lower GDP per capita and lower market variables, such as Burkina Faso, Niger and Mali.

On **axis y (Component 2)**, there is an opposition between - on the upper side of the graph - countries where deal prices have been higher and the mix of population and population density is weaker (Congo Brazzaville, Chad, Niger, Mauritania, Zambia) and - on the lower side of the graph - countries where the amount per capita has been lower and the mix of population and density is higher (Nigeria, Rwanda).

d) **Conclusion on Principal Component Analysis**

Our PCA show robust results: the three of them present the same types of correlations between variables, except for the governance factor.

First of all, PCA shows some correlations between **country variables**. **Population, population density, urbanisation and GDP per capita** are positively correlated in our sample: Countries with larger populations are also the more densely populated countries, the most urbanized and the most economically developed: a higher standard of living is correlated with higher migrations from villages to cities.
GDP per capita is also positively correlated to the level of **FDI inflows** to the country, meaning that the more economically developed countries have a higher share of their GDP coming from foreign investments.

Regarding **mobile market variables**, richer countries (with a higher GDP per capita) have more competitive mobile markets (the number of operators is larger). More competitive markets are also markets with a higher penetration: these are mature markets. **Competition** is negatively correlated to **market shares** (of the operator acquired or of the license renewal): the more competitors on the market, the less the relative market shares of the competitors.

Finally, let's look at the correlations between the **deal amounts per capita** and the other variables. The amount per capita is positively correlated to the **GDP per capita** and to the

FDI inflows: MTC invest higher amounts in more economically developed countries. The amount per capita is negatively correlated to the **number of operators** on the market: The more operators on the market, the less the growth perspectives for the investor, the less the level of amount per capita invested. This negative correlation between deal amounts per capita and competition shows that valuation is based on the monopoly rent. The deal amount per capita is also positively correlated with the **market share**: By acquiring an operator or renewing its license, the MTC buys a level of market shares.
A higher **market penetration** entails lower growth potential to be expected by the investor on the market: This would intuitively be associated with lower deal amounts per capita. Nevertheless, PCA shows that the amount per capita is positively correlated to the market penetration. This confirms the result of the descriptive analysis. An explanation can be given to this positive correlation between deal amount per capita and market penetration: When talking about market penetration in sub-Saharan Africa over 2000-2010, one talks about voice services mainly, as data services were insignificant. So we can assume that countries with a high market penetration are countries with widespread voice services. These countries are considered as more mature to switch to mobile broadband and data services (higher value services) than countries with low voice penetration. This results in the fact that countries with higher penetration represent a higher growth potential for investing MTC than countries with lower penetration.

Let us now look at the governance indicators. In theory, one could think that countries with well established governance and regulation propose higher levels of license amounts, as they offer a safer framework for business. But results seem a bit more complex: **Worldwide Governance Indicator** seems to be positively correlated to the amount per capita when it comes to licenses but negatively correlated when it comes to operators' acquisitions. This would mean that:

- Licenses with higher prices have been awarded in countries where governance is stronger
- Licenses with lower prices have been awarded in countries where governance is weaker
- Operators' acquisitions have higher deal prices in countries where governance is weaker
- Operators' acquisitions have lower deal prices in countries where governance is stronger

This can be interpreted the following way:

When an MTC acquires a license in a country, it follows a dynamic of market entry, in which politics and governance are strongly at stake in the deal. This is why an MTC would be more entitled to invest in a license in a country where governance is more established.
When an MTC acquires a local operator in a country, it follows an M&A dynamic: Transaction is made between the MTC and the local operator, and there is usually no intervention of country politics and governance (or at least, it is lower than for a license award). These results could mean that an MTC would be more willing to invest high amounts in countries where governance is lower: in countries with a weaker regulatory framework, MTC will have more power to influence regulation and governance decisions.

Some counter-intuitive results have been found:

- The amount per capita is negatively correlated to the population density. This confirms the counter-intuitive result found in the descriptive analysis that might be explained by the features of our sample.
- The amount per capita is positively correlated to the WGI for licenses, but negatively for operators. This result is different from the result of the descriptive analysis: These different results are explained by the fact that our variables are not fully uncorrelated from each other.

Some other variables have been tested in other PCA. Literacy has proved to be correlated to GDP per capita and urbanisation rate. The trade indicator - representing the country commercial dynamism – is strong in smaller countries that are open to the outside world by necessity.

To conclude on our sample, country size and economic dynamism appear to be the first factors to determine deal valuation, before political and governance factors.

V. Business model explaining the price of a telecom asset based on local factors

The objective of this part is to set out what the - not necessarily linear - relationships are between the deal amounts per capita and the local factors as explanatory variables. This model is an attempt to express the deal value based on the variables available.

The acquisition price V of an asset[84] A - whether the asset is already operating or is a license for future operation - is the market capitalization of this asset. In other words, it corresponds to the market value of the company's equity, possibly increased by a control premium[85] (coefficient c).

This market capitalization is the discounted sum of future profits of the asset. With i the discount rate and P_t profits of the year t (EBIT for instance), we have:

$$V = \sum_{t=1}^{T} \frac{P_t}{(1+i)^t}$$

If profits are considered as stable overtime (P_t=P), so $V = P.\sum_{t=1}^{T} \frac{1}{(1+i)^t} = P.\frac{(1+i)^T-1}{i.(1+i)^T}$

If T tends to infinity, V tends to P/i and thus V/P (Price Earning Ratio) tends to 1/i.
V is therefore proportional to profit and inversely proportional to i that represents the risk incurred. The higher the level of risk, the lower V will be. A multiple of profits 1/i determines the asset price V. i is the discount rate and can be considered as the cost of capital (average of financing costs from the different funding sources used): WACC (Weighted Average Cost of Capital) includes a component of cost of equity and debt capital represented by a capital market line (and its beta). (See paragraph on Discount Rate in Chapter 3). We will add the country risk premium to the risk-free rate.

This formula gives a first idea of the relationships to test. If V=P/i and if we consider that the only variable is i (P is stable) and that in i, only the country risk may vary, i = f (country risk), beta being fixed for instance, therefore, in order to estimate the relationship between the acquisition price and i, we must assess the following formula:
V=P/i
And transform this multiplicative relationship into a linear relationship:

[84] Asset : resource with economic value that an individual, corporation or country owns or control with the expectation that it will provide future benefit. (Source : Investopedia)
[85] Control premium : How much the acquiring company is willing to pay on top of the « real » value of the company to be purchased, in order to present an attractive deal. (Source : Investopedia)

V=P/I entails logV= logP-logi: a logarithmic relationship will be tested between V and i (and thus country risk factor). LogP is a constant under the assumption that P is stable.

If P is not constant, we must explain how P varies, based on local factors (explanatory variables) in order to assess market risks.

P is generally considered as FCF (Free Cash Flow), therefore, for a t period:
$P_t = FCF_t = EBITDA_t – Capex_t – (EBIT_t \text{ x tax rate}_t) – WCM_t$
With:
EBITDA = Earnings Before Interests, Taxes, Depreciation & Amortization = revenues – Opex (Operational Expenditures, excluding amortization)
Capex = Capital expenditures
EBIT = Earnings before Interests & Taxes = EBITDA – Depreciation & Amortization[86]
WCM = Working Capital Movements = receivables + payables

We will consider here the EBITDA, holding all other factors constant.

Considering:
R A's revenues
N country total population
r A's market share (This is a function of A's rank of market entry and of the number of operators n on the market. It will be applied in the same way to subscribers and communications traffic, with a biais.)
S A's number of subscribers; S/N=t (bias linked to multihoming)
G country GDP per capita
T total market traffic units (Traffic per subscriber T/S is a function of country GDP per capita G)
n number of operators
t mobile penetration in the country (t=S/N with a biais due to multiSIM rate. It is a function of coverage.)

[86] Depreciation refers to spreading tangible assets' costs (e.g. network assets) over the period of the asset's life. Amortization refers to the same but for intangible assets (e.g. content).

d country population density
p price of a unit of communication (decreasing function of number of operators n)

The Average Revenue per User (ARPU) equals $\frac{R}{S} = \frac{r.T.p}{S}$

A's revenues per inhabitants equals $\frac{R}{N} = \frac{rTp}{N} = r.\frac{T}{S}.\frac{S}{N}.p = r.f(G).t.g(n)$

Cost per minute is a decreasing function of total communications traffic (volume effect) and of population density d:

$\frac{C}{rT} = h(rT, d)$

Therefore:

$\frac{C}{N} = r.\frac{T}{N}.h(rT, d)$ ou $\frac{C}{N} = \frac{R}{N}.\frac{1}{p}.h(rT, d)$

If V/N=(P/N)/i, and P is the EBITDA (function of R-C):

$$\frac{P}{N} = \frac{R-C}{N} = \frac{R}{N} - \frac{C}{N} = \frac{R}{N} - \frac{R}{N}.\frac{1}{p}.h(rT, d) = \frac{R}{N}.\left(1 - \frac{h(rT, d)}{p}\right)$$

$$= rtf(G)g(n).\left(1 - \frac{h(rT, d)}{g(n)}\right) = rtf(G).(g(n) - h(rT, d))$$

$g(n) - h(rT, d)$ is the difference between the price per minute and the cost per minute (unit profit). Assumption is made that this unit profit is function of n (competitive pressure) and increasing function of d (investment requirement).

Under these restrictive assumptions, the regression of log(V/N) (log of deal amounts per capita) should be tested, with log (V/N)= log (P/N) – log i, over (with – between brackets – the expected sign of the regression coefficient):

Logarithm of a risk factor (negative):	WGI
Logarithm of r (positive):	market share
Logarithm of t (positive):	mobile penetration
Logarithm of G (positive):	GDP per capita
Logarithm of n (negative):	number of operators on the market
Logarithm of d (positive):	population density

VI. Multiple regression analysis

Based on the Principal Component Analysis previously conducted and based on the business model developed earlier in *Part V of this chapter*, multiple regression analyses have then been conducted. The purpose of multiple regressions is to learn more about the relationship between the dependent variable to be explained (deal amount per capita, named 'dealpercapita' in regressions) and the independent variables (local factors) explaining the variance in the dependant variable. Regressions have been done on three different samples: licences awards only (71 observations), operators' acquisitions only (62 observations) and all deals included (133 observations). We estimate the coefficients in the model using Ordinary Least Square linear regression.
All regression results have been included in *Appendix 7.*

a) Analyses and results

i. Testing the business model

The first set of analysis (**Regression 1: 1a** with licences awards only**, 1b** with operators' acquisitions only **and 1c** with all deals included) is based on the business model developed in *Part V of this chapter.* The independent variables tested are the logarithms of the following indicators:

- GDP per capita, named G (Reminder: The GDP per capita (in constant 2005 US$) is "gross domestic product divided by mid-year population".)
- Market share, named r (Reminder: Market share is the percentage of the total sales volume in the local mobile market that is captured by the operator. When the deal is an operator acquisition, market share is the one of the local operator acquired. In case of a license renewal, market share is the one of the operator that operates under this license. In case of a license award, market share has been considered as equal to 0%, as it is a totally new business. For the regression analysis, this indicator has been used under logarithm: then it has been considered as equal to 0,01%, as log0 is not defined.)
- Market penetration, named t (Reminder: Mobile market penetration measures the adoption of mobile services in the country population. It is basically the number of subscriptions divided by total population multiplied by 100.)
- Population density, named d (Reminder: Population density is midyear population divided by land area in square kilometres.)

- Market competition, named n (Reminder: This 'competition' indicator gives the number of operators already competing on the market at the date of the deal.)
- WGI Rule of Law, named WGI (World Governance Indicator, Rule of Law is the most representative of WGI as it has been found earlier. Its definition is "perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence")

Thus data have been re-expressed in log, using the Stata generate command:
generate logx=log(x)

Regression 1a (License award)
A multiple linear regression has been conducted with the log of the deal amount per capita as the dependant variable and with the following independent variables in log: GDP per capita G, market share r, market penetration t, competition n, population density d and a governance indicator WGI.
Number of observations is 71. The p-value of the model equals 0,0149: As it is lower than 5%, it shows a statistically significant relationship between the dependant variable dealpercapita and the independent variables. The R^2 of 21,3% means that 21,3% of the variance of deal amount per capita is explained by these independent variables.
Market share r is the only variable with a p-value under 5%: It is statistically significant in explaining deal per capita. The coefficient associated to this variable is 0,25: The deal amount per capita is expected to increase by 0,25 point when the market share increases by 1 point, holding all the other independent variables constant.

Regression 1b (Operators' acquisitions)
Same regression analysis has been conducted on operators only. Number of observations is 62. 21,2% of the variability of deal amount per capita is made up by the independent variables. The most significant variable is **market penetration t** (p-value under 5%) with a regression coefficient of 0,7.

Regression 1c (All deals)
Same regression analysis has been conducted for the whole sample, including both licences awards and operators acquisitions. Number of observations is 133. The R-squared equals

28,7%. The most significant variables are **GDP per capita G and market share r,** with respectively the coefficients of 0,22 and 1,033.

This first set of regressions 1 is the basis analysis that has been built on the business model above *(Part V of this chapter).* The independent variables explain roughly a quarter of the variance of deal amounts per capita and few variables are significant.

The objective of the analyses below is to test several regressions in order to improve our model by increasing the R-squared and the number of variables with a significant coefficient.

ii. Introducing a market maturity variable

Based on analysis 1, we will test some other independent variables. As we saw in previous analysis, the use of a **national density indicator** might give distorted results, as the operators' main concern lies more in covering urban areas than rural ones. This is why the indicator d (population density) will be replaced by the indicator **urbanisation (u)** in the analyses below.

Also, the **market penetration t** might not be a good indicator of market maturity: For instance, a market with a 70% penetration and only 1 operator on the market is not at the same stage of maturity as a market with a 70% penetration and 4 operators. This is why another indicator of market maturity has been used instead in the analysis to come, introducing a multiSIM rate associated to the number of competitors on the market. The hypothesis has been made that a greater competitive pressure tends to increase the multiSIM rate: the more operators there are on the market, the higher the multiSIM rate, following a logarithmic curve.
The **market maturity indicator m** that has been used in the following analyses is the ratio between the market penetration of the country at deal date and the multiSIM rate at deal date.

In **Regressions 2,** here again, the log of the deal amount per capita has been regressed on the following independent variables:

- G: GDP per capita
- r: market share

- m: mobile market maturity (replaces market penetration t)
- n: market competition
- u: urbanisation (replaces population density d)
- WGI: WGI Rule of Law

Regression 2a (License award)
The number of observations is 71. 24,8% of the variability of deal amount per capita is accounted for the independent variables (R-squared = 0,2477). There are 2 significant variables: **market competition n and market share r**, with the regression coefficients of respectively -0,94 and 0,23.

Regression 2b (Operators' acquisitions)
Number of observations is 62. The R-squared is 21,3% and the most significant variables (coefficient between brackets) are **GDP per capita G** (1,14) and **market maturity m** (0,63).

Regression 2c (All deals)
Same regression analysis has been conducted for the whole sample, including both licences awards and operators acquisitions. Number of observations is 133. The R-squared equals 27,8%. The most significant variables are **GDP per capita G and market share r**, with respectively the coefficients of 1,03 and 0,22.

	Regression 1	**Regression 2**
License awards (Regression a)	**R^2=** 21,3% **Significant variables:** r (.25)	**R^2=** 24,77% **Significant variables:** n (-.94), r (.23)
Operators' acquisitions (Regression b)	**R^2=** 21,2% **Significant variables:** t (.7)	**R^2=** 21,3% **Significant variables:** G (1.14), m (.63)
All deals (Regression c)	**R^2=** 28,7% **Significant variables:** G (1.03), r (.22)	**R^2=** 27,8% **Significant variables:** G (1,03), r (.22)

Regressions 1 and 2 show that variables u (urbanization) and m (market maturity) improve the results compared to variables t (market penetration) and d (population density). Thus variables u and m will replace variables t and d in the analyses below.

iii. Testing the population indicator

Regressions 3 introduce a market size variable: country population p. They are then conducted on the following independent variables: G (GDP per capita), r (market share), m (mobile market maturity), n (market competition), u (urbanisation), p (country population) and WGI (governance indicator WGI Rule of Law).

Regression 3a (License award)

Including population p improves by more than 4 points the R-squared on licences (compared to regression C) and makes p a significant variable.

The number of observations is 71. 29,1% of the variability of deal amount per capita is made up by the independent variables (R-squared = 0,2909). There are 2 significant variables: **market share r and population p**, with the regression coefficients of respectively 0,2 and -0,39.

Regression 3b (Operators' acquisitions)

Including p does not make a change for operators. Number of observations is 62. The R-squared is 21,33% and the most significant variables (coefficient between brackets) are still **GDP per capita G** (1,12) and **market maturity m** (0,63).

Regression 3c (All deals)

Including p in the analysis does not make any significant change either for the whole sample. Number of observations is 133. The R-squared is equal to 28,75%. The most significant variables are **GDP per capita G and market share r**, with respectively the coefficients of 1,12 and 0,21.

iv. Testing the governance indicators

Regressions 3 explained above take into account the WGI. The objective of regressions 4 below is to test the influence of WGI on the model by excluding it.

Thus analyses 4 test the regression of the deal amounts per capita over the following variables: GDP per capita (G), market share (r), mobile market maturity (m), market

competition (n), population (p) and urbanisation (u). Their results have been detailed in the following table:

	Regression 3	Regression 4
License awards (Regression a)	**R^2**=29,09% **Significant variables:** r (.20), p (-.39)	**R^2**=29% **Significant variables:** r (.21), p (-.38)
Operators' acquisitions (Regression b)	**R^2**=21,33% **Significant variables:** G (1.12), m (.63)	**R^2**=21,2% **Significant variables:** G (1.13), m (.63)
All deals (Regression c)	**R^2**=28,75% **Significant variables:** G (1.12), r (.21)	**R^2**=28,5% **Significant variables:** G (1.12), r (.21)

Comparison between regression 3 and regression 4 shows the very low impact of the WGI on the deal amounts per capita. Improvement of R-squared is minimal and significant variables have the same regression coefficients. WGI has then been excluded from the other tests.

Choice has been made to test the same regression with the Index of Economic Freedom ('EFI') instead of the WGI. Results show that EFI generally increases the R-squared but never appears as a significant variable.

v. Testing the impact of competition

The objective of regression 5 is to test the impact of the competition n (number of operators on the market) on the deal amounts. The independent variables are: GDP per capita (G), market share (r), market maturity (m), urbanisation (u) and population (p). Results are given in the following table:

	Regression 4	Regression 5
License awards (Regression a)	**R^2**=29% **Significant variables:** r (.21), p (-.38)	**R^2**=28,76% **Significant variables:** G (.9), r (.2), p (-.45)
Operators' acquisitions (Regression b)	**R^2**=21,2% **Significant variables:** G (1.13), m (.63)	**R^2**=19,98% **Significant variables:** G (1.2), m (.54)
All deals (Regression c)	**R^2**=28,5% **Significant variables:** G (1.12), r (.21)	**R^2**=28,5% **Significant variables:** G (1,13), r (.21)

Removing competition from the analysis (regression L) does not significantly change its results: R-squared is slightly lower, but significant variables remain more or less the same.

vi. Testing the impact of extreme deals

As it was detailed in former analyses, some deal amounts are eccentric compared to the others: the Mauritanian license awarded to Sudatel (Chinguitel) in 2006 and the Zain's acquisition of Bharti Airtel in Congo Brazzaville and Zambia in 2010.
Some regressions (6 and 7 for instance) have been tested removing these three points. Results give the same significant variables with a lower R^2, showing that these extreme deals are relevant in our general analyses' results.

vii. Introduction of dummy variables

In the following analyses, some dummy variables have also been tested: "landlocked", "oil", "islam" and "fix". As explained earlier, their definitions are the following:

- **'Maritime/landlocked'** (binary variable) indicates the geographical position of the host country of investment: maritime (country with sea borders) or landlocked (country entirely enclosed by land). This is to test the hypothesis that deal amounts would be higher in maritime countries.
- **'Oil country/Not'** (binary variable): Have been considered as oil countries those with proved oil reserves in 2010 (Source: Ernst & Young, 2010 data[87]). This is

[87] http://www.ey.com/GL/en/Industries/Oil---Gas/Africa-oil-and-gas--a-continent-on-the-move---The-African-oil-and-gas-landscape (accessed 09June14)

based on the hypothesis that oil countries would have overrated GDP per capita and higher deal amounts.

- **'Islamic country/Not':** Have been considered as Muslim countries those in which at least 40% of total population is Muslim in 2010 (Source: Pew Research, 2010 data[88]). This is based on the hypothesis that investments coming from Middle East to African Islamic countries are more lenient than investments coming from Occident. Given the fact that Middle East countries are a major investor in African telecommunications, deal amounts would be higher in African Islamic countries.
- **'Fixed/Not'** (binary variable) indicates – for operators' acquisitions - whether the operator acquired has fixed activities. This concerns the following operators: Onatel (Burkina Faso), Ghana Telecom (Ghana), Telkom Kenya (Kenya), Sotelma (Mali), Mauritel (Mauritania) and Zantel (Tanzania).

Taking now each type of deal individually, we refine the analyses.

viii. Refining the analysis for licences

Based on regression 5 that gives GDP per capita G, market share r and population p as significant variables, we test the regression with only G, r and p as independent variables (m and u are not significant variables for the license sample).

Regression 5 Independent variables: G, r, m, u, p	**Regression 8** Independent variables: G, r, p
R^2=29% **Significant variables:** G (.9), r (.21), p (-.38)	**R^2**=25,7% **Significant variables:** G (.78), r (.19), p (-.46)

Then, regression 8 has been done including DJTTEL index as an additional independent variable. In the different analyses, the DJTTEL variable has been included as independent variable, in order to test the impact of international financial markets towards the telecom

[88] http://www.pewforum.org/2011/01/27/table-muslim-population-by-country/

sector. DJTTEL does not improve regression results compared to regression 8 and does not appear as a significant variable.

Regression 8 Independent variables: G, r, p	**Regression 8-DJTTEL** Independent variables: G, r, p, DJTTEL
R^2=25,7% **Significant variables:** G (.78), r (.19), p (-.46)	**R^2**=28,44% **Significant variables:** r (.18), p (-.46)

Finally, another analysis has been done on the license sample, to test the impact of our dummy variables. Whether one includes the "landlock", the "oil", the "islam" or the "fix" dummy variable, R^2 are slightly improved but significant variables remain the same as for 8 (G, r and p) and dummy variables never appear as significant ones (Regression 8, *Appendix 7*).

Conclusion on licences: Regression 8 seems to be the most relevant analysis for the license sample. The independent variables GDP per capita, market shares and country population per capita explain 25,7% of the variance of the deal amounts.

According to the regression coefficients and holding all the other independent variables constant, the deal amount per capita is expected to:

- Increase by 0,77 point when the GDP per capita increases by 1 point
- Increase by 0,19 points when the market share increases by 1 point
- And decrease by 0,46 points when the population increases by 1 point.

The output indicates that the least-square regression line is given by:

Log (dealpercapita) = 0,77572*log(G) + 0,1874308*log(r) -0,6097871*log(p)

Log (dealpercapita) = log ($G^{0,77572}$) + log($r^{0,1874306}$) + log($p^{-0,4609166}$)

Log (dealpercapita) = log ($G^{0,77572} * r^{0,1874306} * p^{-0,4609166}$)

dealpercapita = $G^{0,77572} * r^{0,1874306} * p^{-0,4609166}$

Licences:

dealpercapita = $G^{0,77572} * r^{0,1874306} * p^{-0,4609166}$

with G: GDP per capita, r: market share and p: country population

(R^2=25,7%)

The graphs below plots the residuals in the license deal equation.

Chart 18: Licenses – Dispersion of deals compared to regression line

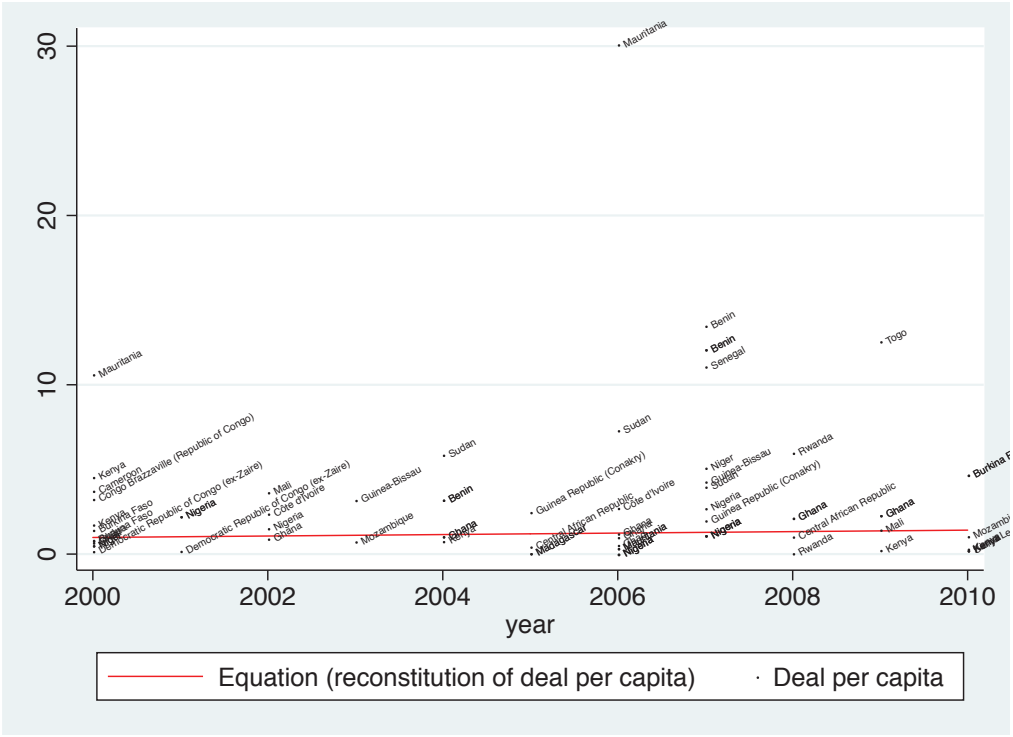
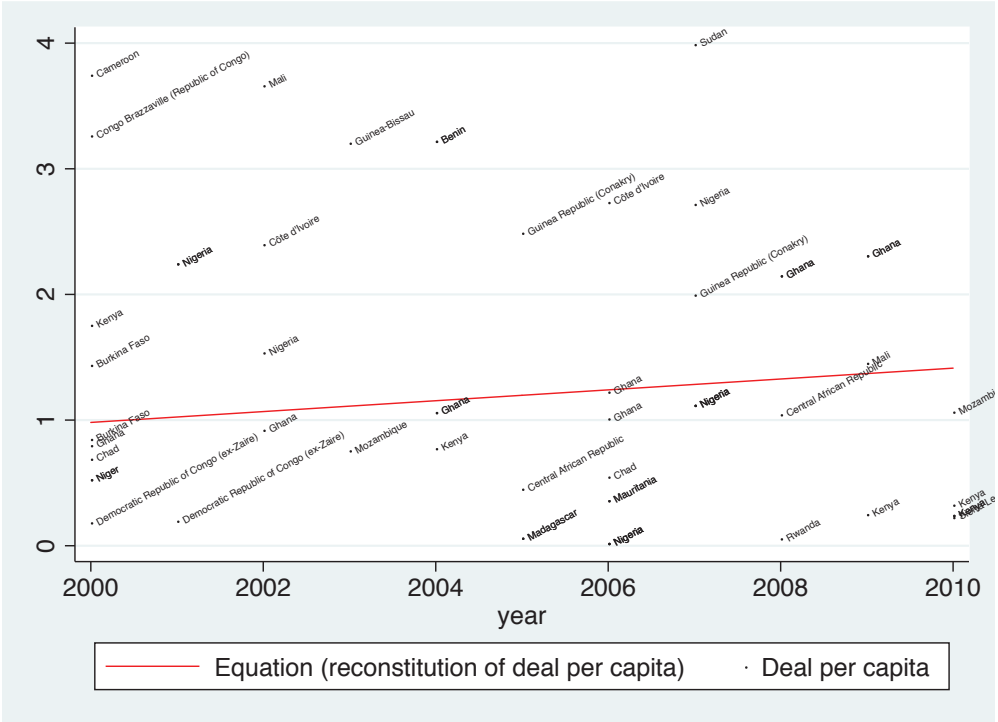


Chart 19: Focus on licenses under 4$ per capita – Dispersion of deals compared to regression line



ix. Refining the analysis for operators

The analysis on DJTTEL index has been conducted as follows:

Regression 9 Independent variables: G, m, landlock, fix	**Regression 9-DJTTEL** Independent variables: G, m, landlock, fix, DJTTEL
R^2= 29% **Significant variables:** G (1.27), m (.56), landlock (-1.21)	**R^2** = 29,6% **Significant variables:** G (1.26), m (.56), landlock (-1.2)

On the operator sample - as for licences -, the DJTTEL Index does not improve regression results compared to regression 9 and does not appear as a significant variable. This confirms that there is no correlation between international markets and the level of deal amounts in operators' acquisitions.

Then, based on regression 5 that gives GDP per capita G and market maturity m as significant variables, we test the regression 10 with only G and m as independent variables (r, p and u are not significant variables for the operator sample).

Regression 5 Independent variables: G, r, m, u, p	**Regression 10** Independent variables: G, m
R^2=19,98% **Significant variables:** G (1.2), m (.54)	**R^2**=17,5% **Significant variables:** G (.86)

Regression 10 results into a unique significant variable (G). In order to get more satisfying results, dummy variables are added into the regression in order to test their impact. Compared to regression 10, the addition of the "landlock" dummy variable improves the R^2 and gives G, m and landlock as significant variables, with respectively the coefficients 1.31, 0.56 and -1.2. The other dummy variables give lower R^2, lower regression coefficients and never appear as significant ones.

Regression 10 Independant variables: G, m	**Regression 10-landlock** Ind. var.: G, m, landlock	**Regression 10-oil** Ind. var.: G, m, oil	**Regression 10-islam** Ind. var.: G, m, islam	**Regression 10-fix** Ind. var.: G, m, fix
$\mathbf{R^2}$=17,5% **Significant variables:** G (.86)	$\mathbf{R^2}$=25,4% **Significant variables:** G (1.31), m (.56), landlock (-1,2)	$\mathbf{R^2}$=19,3% **Significant variables:** G (1.15), m (.50)	$\mathbf{R^2}$=17,6% **Significant variables:** m (.50)	$\mathbf{R^2}$=21,14% **Significant variables:** m (.51)

Conclusion on operators: Regression 10-landlock appears to be the most relevant analysis for the operator sample.

Three independent variables (G, m, and landlock) account for more than 25% of variance in deal amount per capita. (Adding the "fix" dummy as independent variable to this analysis improves the R^2 to 29% but the significant variables remain the same.) According to the regression coefficients and holding all the other independent variables constant, the deal amount per capita for operators is expected to:

- Increase by 1,315702 point when the GDP per capita increases by 1 point
- Increase by 0,5585827 point when the market maturity increases by 1 point
- Decrease by 1,201545 point when the host country is landlocked

The output indicates that the least-square regression line is given by:
Log (dealpercapita) = 1,1865*log(G) + 0,5699*log(m) -1,201545*landlock
Log (dealpercapita) = log ($G^{1,1865}$) + log($m^{0,5699}$) -1,201545*landlock
Dealpercapita = exp (log ($G^{1,1865}$) + log($m^{0,5699}$) -1,201545*landlock)
Dealpercapita = $G^{1,1865} * m^{0,5699} * e^{(-1,201545*landlock)}$

Operators:

Dealpercapita = $G^{1,1865} * m^{0,5699} * e^{(-1,201545*landlock)}$

with G: GDP per capita, m: market maturity and landlock: dummy variable

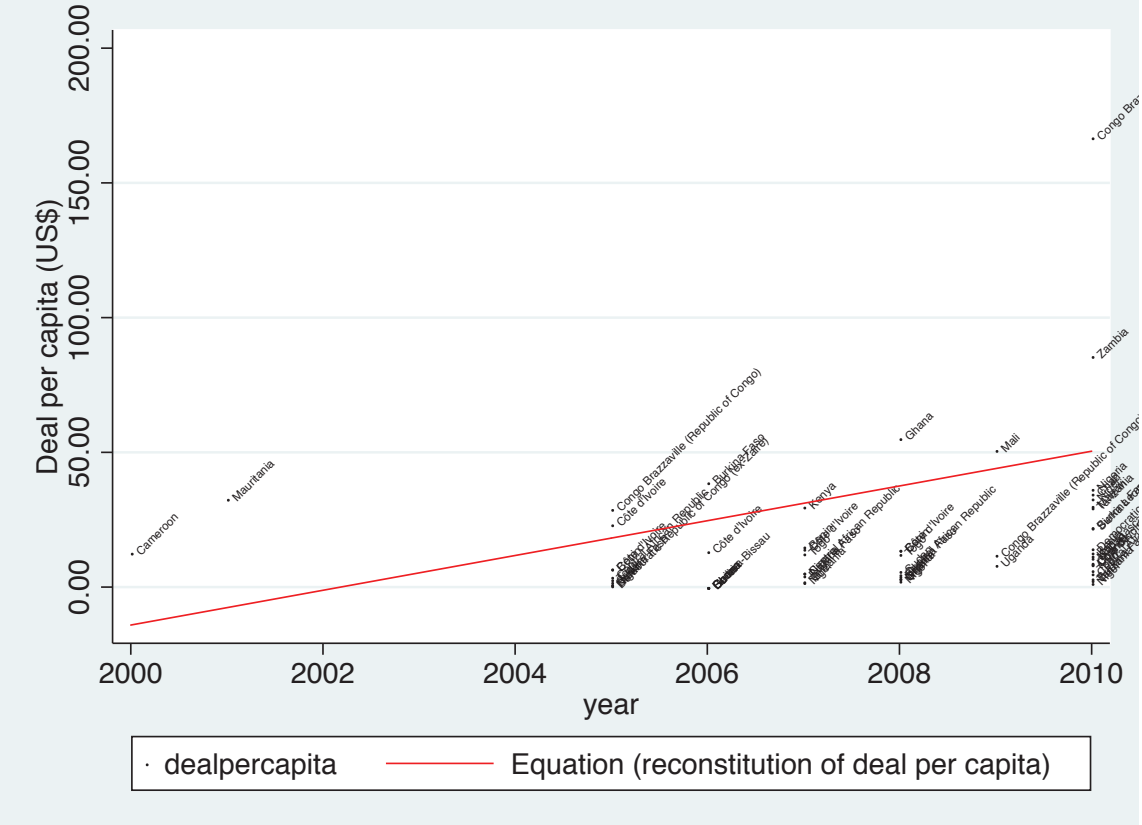
(R^2=25%)

The "landlock" dummy variable has a negative coefficient, meaning that maritime countries have lower deal amounts per capita and landlock countries higher deal amounts (Even

when removing extreme points of Congo Brazzaville and Zambia, the sign remains negative). This result is surprising, as we could expect maritime countries to have better GDP per capita and thus higher deal amounts. This result is probably to be linked to our sample: Among operators' acquisitions, there are 21 deals in landlock countries, with an average of 16,7$ per capita (and a variance of 479) and there are 41 deals in maritime countries, with an average of 16,1$ per capita (and a variance of 723). Deals made in maritime countries are almost twice as numerous as those made in landlocked ones in our sample with a much higher variance of their deal per capita.

The graph below plots the residuals in the operators' deal equation.

Chart 20: Operators – Dispersion of deals compared to regression line



x. Refining the analysis for all deals

Based on regression 5 that gives GDP per capita G and market share r as significant variables, we test the regression 11 with only G and r as independent variables (m, u and p are not significant variables for the "all deals" sample).

Regression 5 Independent variables: G, r, m, u, p	**Regression 11** Independent variables: G, r
R^2=28,5% **Significant variables:** G (1.13), r (.21)	**R^2**=26,6% **Significant variables:** G (.98), r (.22)

G and r remain significant variables in regression 11.

Then, dummy variables have been tested on the "all deals" sample.

Regression 11 Independant variables: G, r	**Regression 11-landlock** Ind. var.: G, r, landlock	**Regression 11-oil** Ind. var.: G, r, oil	**Regression 11-islam** Ind. var.: G, r, islam	**Regression 11-fix** Ind. var.: G, r, fix
R^2=26,6% **Significant variables:** G (.98), r (.22)	**R^2**=28,5% **Significant variables:** G (1.24), r (.21)	**R^2**=26,7% **Signif. Var.:** G (1), r (.22)	**R^2**=26,7% **Signif. Var.:** G (.99), r (.22)	**R^2**=29,6% **Signif. Var.:** G(.94), r(.21), fix(-1.45)

The "fix" dummy improves R^2 and appears as a significant variable for the "all deals" sample.

Then, regression 11-fix has been tested including the DJTTEL index as an additional independent variable. DJTTEL does not improve regression results compared to 11-fix regression and does not appear as a significant variable.

Regression 11-fix	**Regression 11-fix-DJTTEL**
Independent variables: G, r, fix	Independent variables: G, r, fix, DJTTEL
R^2=29,6% **Significant variables:** G (.94), r (.21), fix (-1.45)	**R^2**=29,8% **Significant variables:** G (.93), r (.21), fix (-1.4)

Conclusion on "all deals": Most of regressions conducted on the sample 'all deals' give G, r and fix as significant variables (examples of regressions 7, 12 and 13).
So based on these analyses, according to **regression 11**, the independent variables GDP per capita G, market shares r and the "fix" dummy per capita explain 29,6% of the variance of the deal amounts with the respective regression coefficients: 0.94, 0.21 and 1.45.

According to the regression coefficients and holding all the other independent variables constant, the deal amount per capita is expected to increase by:

- 0,94 point when the GDP per capita G increases by 1 point
- 0,21 points when the market share r increases by 1 point
- 1,45 points when the acquired operator has fixed activities

The output indicates that the least-square regression line is given by:
Log (dealpercapita) = 0,9415*log(G) + 0,2085844*log(r) – 1,446287*fix
Log (dealpercapita) = log ($G^{0,9415}$) + log($r^{0,2085844}$) – 1,446287*fix
Dealpercapita = exp (log ($G^{0,9415}$) + log($r^{0,2085844}$) – 1,446287*fix)
Dealpercapita = $G^{0,9415} * r^{0,2085844} * e^{(-1,446287*fix)}$

All deals:
Dealpercapita = $G^{0,9415} * r^{0,2085844} * e^{(-1,446287*fix)}$
with G: GDP per capita, r : market share and fix : dummy variable
(R^2=29,6%)

The graphs below plot the residuals in the regression equation.

Chart 21: All deals – Dispersion of deals compared to regression line

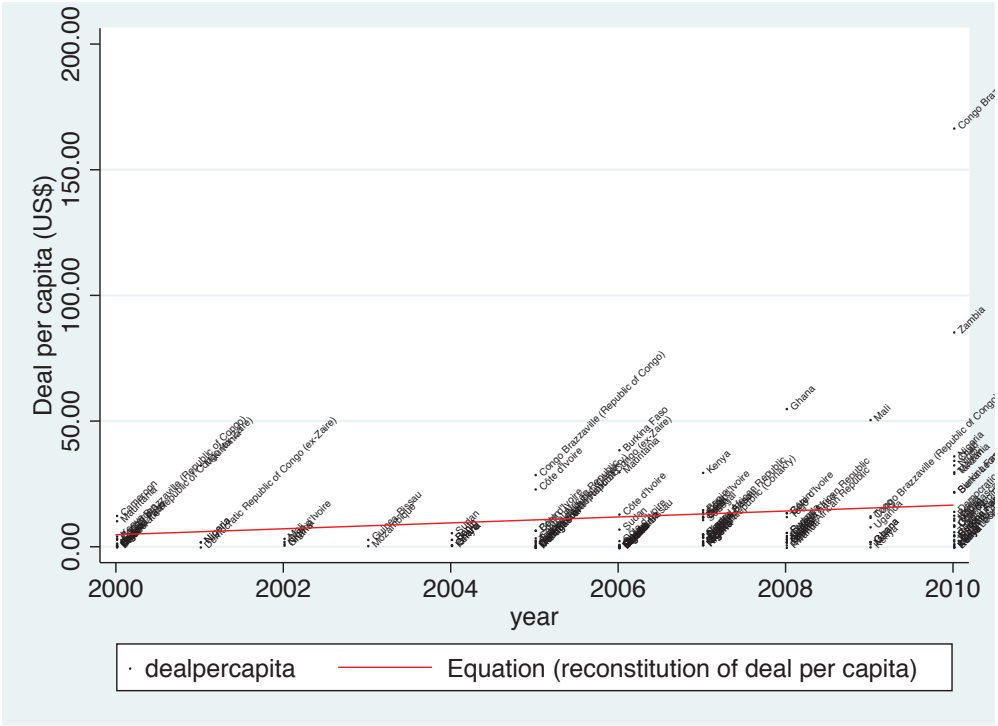


Chart 22: All deals – Dispersion of deals compared to regression line (excluding Bharti's deals in Congo Brazzaville and Zambia)

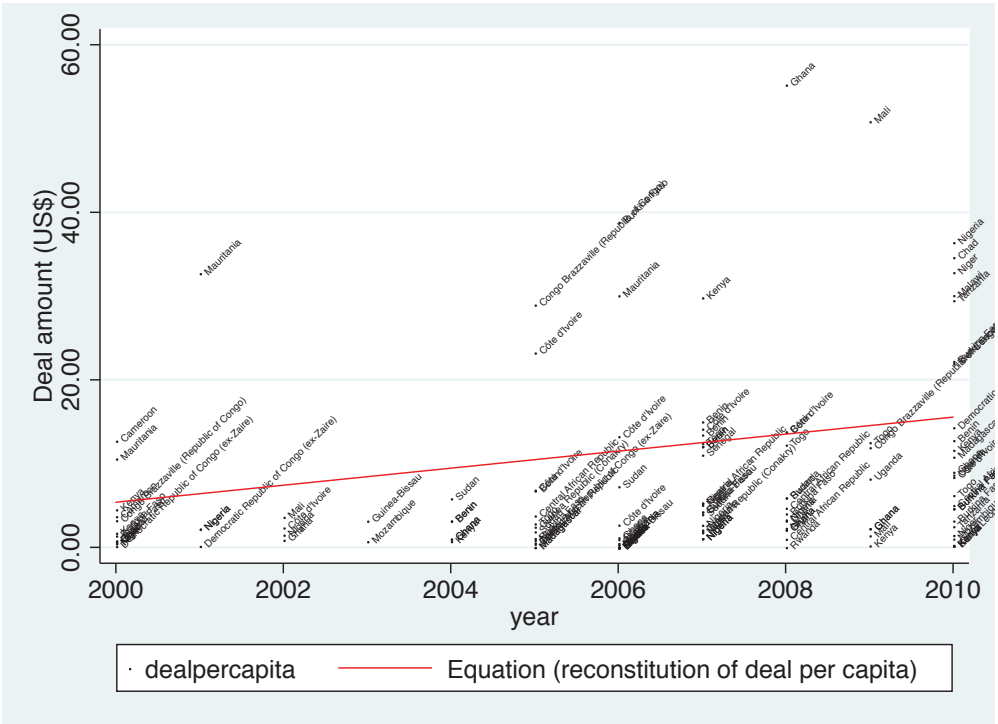
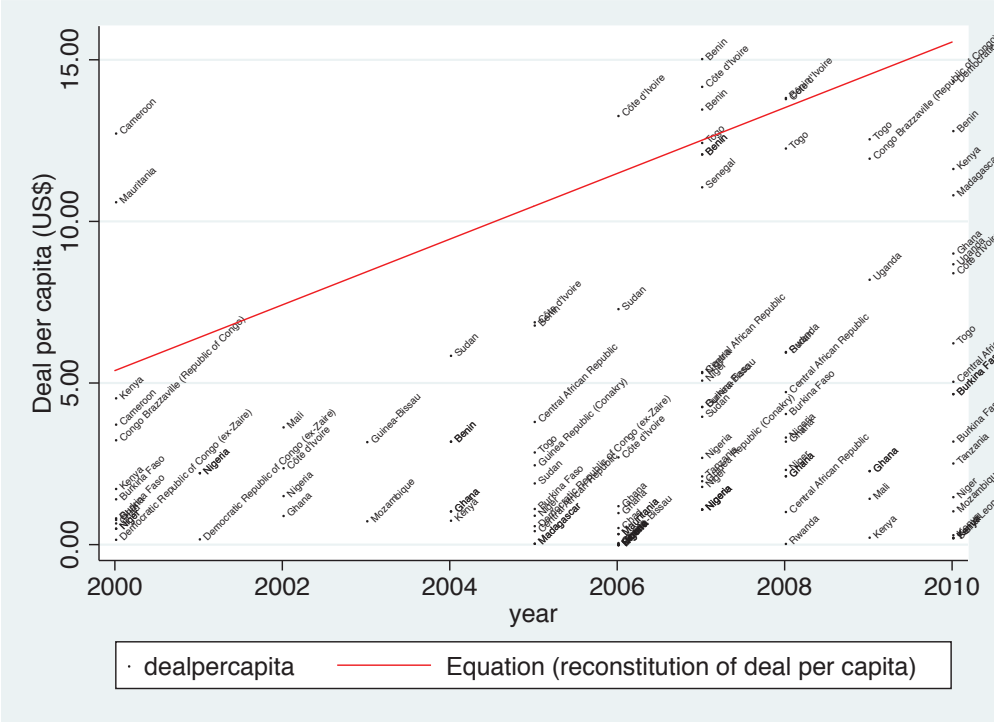


Chart 23: Focus on all deals under 15$ per capita – Dispersion of deals compared to regression line



b) **Conclusion on regression results**

i. **Determinants of a license price**

Based on the analyses made on the database, it appears that country factors of **GDP per capita** and of **population**, as well as the **market share** (in case of a license renewal) are the most relevant factors of deal amount in the licences awarded on the period 2000-2010.

The **GDP per capita** is positively correlated to the license price (regression 5), showing that country wealth at the time of the deal is taken into account in the license valuation. This shows that the different stakeholders take the population's purchasing power - at the time of the deal - into account.

Country population is negatively correlated to the license price (regression 3). This was already suggested in Principal Component Analysis. This result is quite counter-intuitive,

as one could expect that a bigger market (a larger population) is preferable than a small market in terms of profit expectations. This result is probably to be associated to our country sample, where big countries (Nigeria, DRC) are also countries with a particular geostrategic and political instability. Another hypothesis can be related to the existence and the possible effects of an "entry ticket" in the total price of a license: Whatever the country, there is a minimum amount to pay for a license by the investing MTC. This "entry ticket" strongly impacts deal amounts per capita in countries with a small population.

Regarding market factors, the **market share** of the operator that has renewed its license is a relevant factor of the deal price (regression 1, 2, 3 and 4): The higher the market share, the higher the deal amount. This confirms the fact that a value is associated to the market shares "bought".

On a lesser extent, the **number of operators** on the market at the time of the deal (**competition**) shows a negative correlation with the deal amount (regression 2), confirming the fact that competitive pressure is associated with lower licence prices.

ii. Determinants of an operator's price

Regressions show that the **GDP per capita**, **market maturity** and the **landlocked** characteristics of the host country are some of the determinants of operators' prices on the decade 2000-2010.

As for license awards, the **GDP per capita** is positively correlated to deal amounts when it comes to an operator's acquisition (regressions 2, 3, 4 and 5), confirming that deal amounts are partially determined by country wealth at the time of the deal.

The **market maturity**, which is composed of market penetration and of the number of operators on the market shows a positive correlation (regressions 2, 3, 4 and 5) with deal amounts. Regression 1 confirms the positive correlation between deal amounts and penetration.

Also, higher deal amounts are associated with the fact that the host country is **landlocked**. This confirms the trend of the curve in the descriptive analysis, where – as from 2007 –

deals in landlocked countries have higher amounts than in maritime countries. Also, in general in our database, landlocked countries have an average deal amount of 10,6$ per capita whereas maritime countries have an average amount of 8,8$ per capita. This result is counter-intuitive because maritime countries are associated with higher GDP and thus higher amounts of deals. Moreover, in our sample, landlocked countries have lower market competition: an average of 3 operators on the market, compared to 4 in maritime countries. Thus in landlocked countries, lower GDP per capita and lower market competition are two uncorrelated factors pushing towards higher amounts of deals.

iii. Determinants of all deals' prices

When looking at the whole sample – licences and operators included – the main determinants of deal prices are the **GDP per capita** (regressions 1, 2, 3, 4 and 5), the **market share** (regressions 1, 2, 3, 4 and 5) and the **fixed telephony activity** of the operator acquired.

Higher GDP per capita and market share are associated with higher deal prices. And the fact that fixed telephony is part of the activities of the operator acquired is associated with a higher deal price (regression 11-fix). Even if fixed activity has been dormant, it represents several hundreds of thousands of lines in some countries, linked to subscribers with a high purchasing power (residential customers with high purchasing power, administrations and business subscribers). This results means that a value is attributed to the existing assets (fixed network, existing subscriber base, high ARPU). This is why a deal price is higher when a fixed activity is part of the activities of the acquired operator.

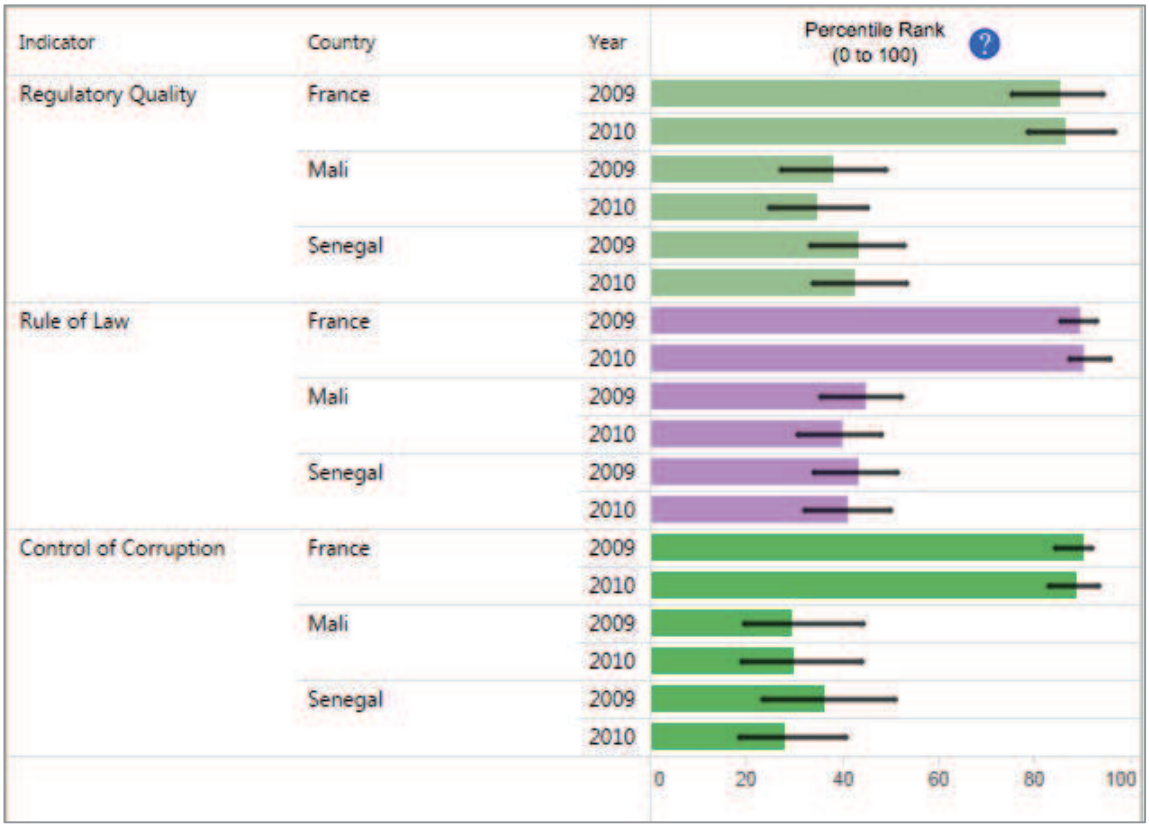
iv. Factors with low or no impact on deal amounts

In the analyses, EFI seems to be more efficient than WGI in showing a correlation with deal amounts, but in general, governance indicators (EFI and WGI) only appear in Component 3 in the Principal Component Analysis and with a low regression coefficient in regression analyses.

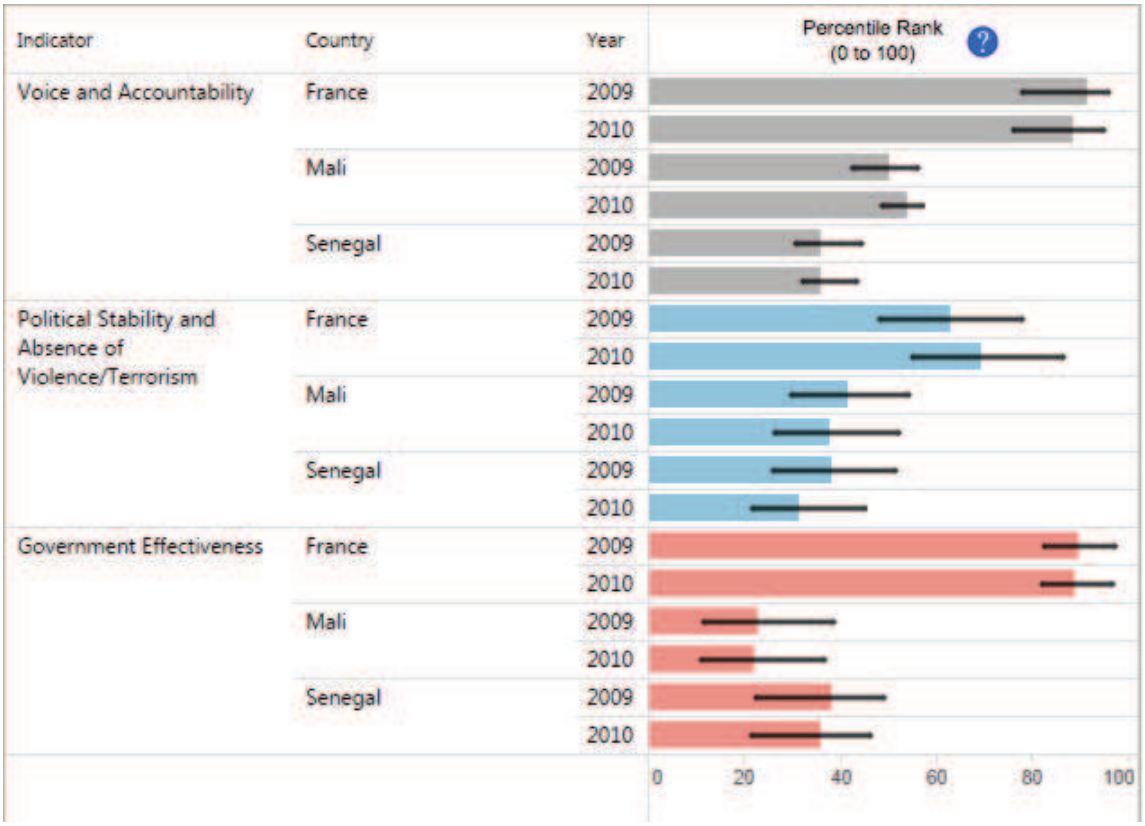
Governance and business climate appear to be disregarded by investors in the choice of country of investment. It is true that profits can be high in countries independently of level

of governance. For instance, the Sonatel Group – that is made up by Sonatel Senegal (65% of Group's turnover in 2010), Orange Mali (30%), Orange Guinée (5%) and Orange Bissau (1%) - has higher profits than Orange France, despite the gap between governance indicators of these different countries. In 2010, the EBITDA of Sonatel's Group was 54,1% (50,4% for Sonatel Senegal and 59% for Orange Mali) whereas the EBITDA of Orange France was 37,8%[89]. This excellent performance of the Senegalese group occurred in a context of much lower level of governance compared to France, as the following WGI graphs show it *(Chart 24)*.

Chart 24: Worldwide Governance Indicators – Comparison of France, Senegal and Mali



[89] All figures of this paragraph have been drawn from 2010 financial reports of Sonatel Group and France Telecom Group.



Another factor that has proved to have a low impact on deal prices is the **context of international markets.** The DJTTEL variable slightly improves the R^2 but never appears as a significant variable, meaning that the international markets have not impacted the level of deals in Africa over the decade. It can be explained:

- First by the fact that the economic wealth of MTC has been good over the decade despite the 2008 crisis and thus, MTC could keep on investing at comparable levels. *Charts 25 to 27* present the historical prices for African MTCs' stocks.
- Second by the fact that when an MTC decides to make this type of investment, its level depends more on the host country characteristics than on the international business climate.

Chart 25: Historical prices for MTN stock

Chart 26: Historical prices for Maroc Telecom stock

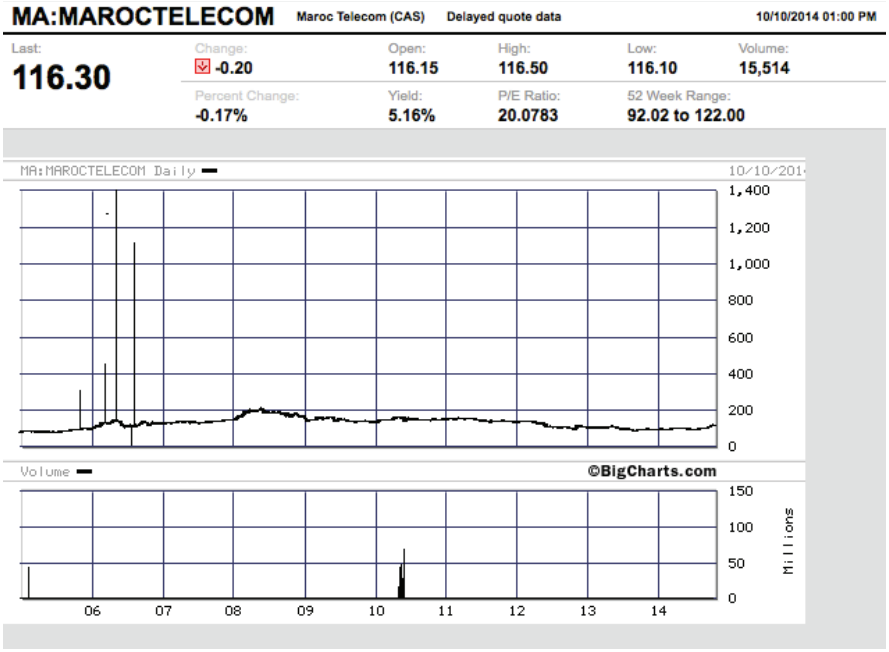


Chart 27: Historical prices for Vodacom stock

c) **Discussion on hypotheses**

As a reminder, the hypotheses that have been made before the analyses capture the effects of local factors on the level of deal amounts:
H1: A major part of deal amounts per capita is based on "local" factors (country, market and governance factors).
H2: Governance factor (which includes political and stability factors) is the main determinant for deal amounts, as it is the major uncertainty of an investment in sub-Saharan Africa.
H3: Country and market indicators have a secondary impact on deal amounts.

H1 has been invalidated by the analysis, as variance of the deal amount that is explained by "local" factors (country, market and governance factors) only reaches 20 to 30% (25,72% for licences, 20,46% for operators and 29,6% for all deals). Some other regression analyses using twice the number of independent variables (compared to selected analyses) reach a maximum of 40% for R^2. Thus deal amounts are defined by other factors that "local" ones. It will be discussed in the next part below what these other factors might be.

Some factors that we might think as being relevant in the deal amount are finally not major determinants. EFI and WGI do not appear as relevant factors in determining deal prices of MTCs' investments in sub-Saharan Africa. Stakeholders do not take into account governance. Moreover, country factors such as their size (population) and their wealth (GDP per capita) as well as market factors such as their dynamism and maturity (mobile market competition and penetration) are the most relevant factors in our analyses to determine deal prices. This invalidates H2 and H3, making country and market factors the main determinants and governance factors not relevant. Also, another factor appears to be key: market shares – in case of an operator's acquisition or a license renewal – are relevant, showing that MTC investing in an existing asset "buy" existing market shares.

VII. Hypotheses on other potential determinants of deal amounts

On the basis of the analyses conducted above, we know that the main determinants of deal amounts for **licences** are the **host country size** (population) and **wealth** (GDP per capita) as well as the **market share** (in case of a license renewal). For **operators' acquisitions**, the main determinants of deal amounts are the host country **wealth** (GDP per capita), its **mobile market maturity** and the fact that it is **landlocked or maritime**. Nevertheless, we

could demonstrate that the "local" factors that have been tested only explain up to 30% of deal amounts.
It should be kept in mind here that we are talking about an **international context** that includes issues linked to **country and MTC specificities**. So it is difficult to reflect this complexity in analyses' results. Moreover, the **telecommunication sector** is sensitive and thus tricky, grounded on objectives that might be conflicting. Indeed, one objective of the sector is to foster network development by investment in order to give access to services to the largest possible share of population. The second objective is to maintain affordable service prices for the subscriber. The third objective is to generate adequate public revenues thanks to license awards (S.Diop, 2014). The **specificities of each country and of each MTC** of the sample, added to the **complexity and sensitivity of the telecommunication sector**, make the determinants of deal amounts difficult to grasp.

Some hypotheses can be made to explain the residual variance of our analyses. Some factors - linked to the investing **MTC's strategy**, to the tender **context or to a so-called "ratchet effect"** - might also determine the level of deal amounts.

When responding to a tender – whether it is about a license award or an operator's acquisition - an MTC adjusts its bid according to its own **corporate strategy and objectives.** Thus a share of the final price might be what is called an "opportunity cost". An "opportunity cost" is "the cost of an alternative that must be forgone in order to pursue a alternative action"[90]. This is the cost the MTC accepts to pay, in addition to the intrinsic value of the asset acquired, to reach its own distinctive goals: It might be a strategic **willingness to enter a country** or even an **irrational attachment** of the investor to the asset, in order to get access to **specific resources** (spectrum, submarine cable, terrestrial backbone, international capacity, human resources…), to **externalities** or to **synergies**. An MTC may be willing to enter a particular market, country or region for strategic reasons, because investing in this place at this particular moment will enable access to a cable for example or because it will prevent a competitor from accessing this market and benefitting from externalities.
Also, for instance, MTC from the Gulf are willing – and have the financial capacity - to pay more to **internationalize** their activities. The strategy of Etisalat for example is to diversify

[90] Source : Investopedia

its investment portfolio into emerging countries with high growth perspectives (acquisition of Maroc Telecom in 2014 and earlier Atlantique Telecom, among other deals).
When it is about an operator's acquisition, the deal amount might also include a **"control premium"**, when the investing MTC is taking a majority in the ownership structure that will give it a relevant impact and control over the decisions of the new structure.

A second type of price determinant is the **tender itself (**contractual issues and specifications, as well as tender context).
The **spectral band** and the **spectrum capacity** allocated could not be taken into account in our analyses, for an issue of access to historical data on such a large sample of deals (MTC and countries concerned). But they contribute to determine part of the deal price. Both spectral band and spectrum capacity are subject to a trade-off between the level of license price and the future Capex to invest in the network.
Lower frequency bands (800MHz, 900MHz) have a larger transmission range: They are more expensive to buy but require less future network investments. This is contrary to higher frequency bands (1800MHz, 2100MHz) that are cheaper but necessitate higher network investment to compensate their lower transmission range.
In terms of capacity, acquiring a larger capacity leaves more room to the operator in its frequency management depending on the needs of its customer base. Acquiring a smaller capacity is less costly but requires deploying additional sites when needed.
Still regarding contract specifications, the requirements in terms of **territory coverage** can be a price determinant.
Competitive factors in the tender process can play a role in the level of deal amounts: For an investment opportunity, the notion of competition is important. If there is no competition on a deal, an MTC may be induced to propose a lower amount of money. On the contrary, more operators bidding on the same deal may induce them to propose higher amounts in order to be the highest bidder.
Finally, **information asymmetry** can influence the level of price in some cases, to higher or lower levels (e.g. Orange and Telkom Kenya, *Box 2*).

Third and last, a determinant that could explain the residual variance of our analyses is related to a so-called **"ratchet effect"**. This effect occurs when a price increases as a result of temporary pressure but fails to fall back when the pressure is removed. It can be based on a comparison of prices despite totally different periods and contexts. For instance, for 2015 license renewal in Mauritania, it seems there is an incentive of authorities to base their

price requirement on what Chinguitel (Sudatel) paid in 2006. The “ratchet effect” can also be based on a comparison of prices between countries.

To conclude and summarize this part, others factors that have not been tested in the analyses can participate in the shaping of deal final prices. The international context, the country and MTC specificities, as well as the complexitiy and sensitivity of the telecom sector make the determinants of deal amounts difficult to grasp. The following hypotheses can be the main explanations of the residual variance of deal amounts in our analyses:

- **MTC strategy:** strategic willingness to enter a region or a country, irrational attachment to an asset, access to specific resources (spectrum, submarine cable, terrestrial backbone, international capacity, human resources), externalities, synergies, internationalization, majority in ownership structure.
- **Call for tender (specifications and context):** spectrum band and capacity, contractual obligations of the provider (e.g. coverage), competitive factors, information asymetry.
- **“Ratchet effect”** leading to determine a price mainly based on what has already been done at another time or in another country.

A quantitative analysis is tricky to make on these factors, as they are not possible to catch in simple indicators. Nevertheless, it is necessary to bear them in mind when providing insights into the challenges of understanding deal amounts in African telecommunications.

CHAPTER 5

GENERAL CONCLUSION

CHAPTER 5: GENERAL CONCLUSION

Since the early 2000s, Africa has become an attractive host region for investments from Multinational Telecom Companies (MTC) - mainly coming from Middle East and Europe – that are looking for new growth drivers. This work focuses on two main types of external growth: acquiring a license and acquiring a local operator (through an M&A) in a foreign country.

A major motivator for writing this thesis was the desire to investigate deeper **the issue of international telecom investments of these MTC in Africa**, after observing the disparities in license prices and the amount of money reached by some recent acquisitions (Telkom Kenya by Orange in 2007, Ghana Telecom by Vodafone in 2009, Zain by Bharti Airtel in 2010). Moreover, the issue of valuation in developing countries is challenging and has recently emerged in the international business and financial literature.

The work presented here is expected to contribute to a better understanding of the level of investment in such cases, by analysing their determinants. As a reminder, the **research question** was the following one: "To what extent 'local' factors (characteristics and risks of the host country and of its telecom market) have an impact on the valuation of telecom investments in sub-Saharan Africa?"

In order **to answer this question**, the thesis has first investigated on the **theoretical valuation of a telecom asset in Africa**. Based on the fact that asset valuation is based on the future profit perspectives of this investment, valuation methods currently used for M&A and license evaluations are largely based on the Discounted Cash Flow method, supplemented by other methods such as sensitivity analyses, multiples and comparables. A classification of the factors impacting this valuation has then been proposed, based on Miller's classification of risks in international investments (1992): Determinants have been detailed with examples; they relate to the host country of investment (demographics and stability factors, economic, financial and business factors, governance and political factors), to the local telecom market (competition and market factors, customers-related and suppliers-related factors) and to the firm-specific factors (operational and financial factors).

Then the thesis proposes **quantitative analyses** to understand what determinants have been the most significant in valuation of MTC investments in Africa over the decade 2000-2010. Only factors related to the host country and to the local markets have been tested. Firm-specific factors are not part of the database and have not been tested, because of a data collection issue on such a large sample.
These analyses are of three types:

- A descriptive analysis in two dimensions crosses the different deal amounts with each of the different factors and shows no strong correlation. Results show that over the decade, the deal amount per capita for operators' acquisitions has increased (MTC have assigned an increasing value to future profits of their acquisitions over the decade) but licences' amounts per capita remain quite flat (possibly due to a poor assessment of market evolution by governments and by bidding MCT - in case of auctions).
- A descriptive analysis in multi-dimensions, called a Principal Component Analysis, shows the prevalence of country- and market-factors, compared to governance ones in asset prices.
- Regression analyses highlight that around 30% of variance can be explained by the factors tested.

I. Summary of main findings and contribution

The quantitative analyses conducted enable to study on what extent the 'local' factors (country- and market-factors) have an impact on the valuation of telecom investments in sub-Saharan Africa: Some of these factors do contribute to determine asset prices, but only for one third of them.

First of all, factors related to the **host country governance and stability** (represented by Worldwide Governance Indicators and Index of Economic Freedom) **do not appear as relevant in determining deal prices** of MTCs' investments in sub-Saharan Africa, showing that governance is not strongly considered by stakeholders in valuation, compared to other factors of country and market potential.

The most determining factors in deal prices are the **country size** (population) and **country wealth** (GDP per capita) as well as market factors such as their **dynamism and maturity** (mobile market competition and penetration).

Market shares – in case of an operator's acquisition or a license renewal – are also determinants, showing that MTC assign an economic value to the market shares of the asset it invests in (so to its existing customer base). Market shares and market power are usually correlated to innovation. Innovation increases market shares and improves market power. Nevertheless, in Africa, MTC like MTN, Vodafone, Orange, Etisalat have a sufficient power in their relationship to their suppliers, but do not appear as innovative companies. Their market power is not due to their innovation power, but more to other factors such as a loose regulation, a low competition, etc.

Moreover, **only 30% of variance** can be explained by the country-, market- and governance-factors tested. Determinants of deal amounts are **difficult to grasp** because of the international context, the country and MTC specificities, and the complexity and sensitivity of the telecom sector. Other factors than "local" ones can contribute to determine the deal amounts:

- **MTC strategy:** strategic willingness to enter a region or a country, irrational attachment to an asset, access to specific resources (spectrum, submarine cable, terrestrial backbone, international capacity, human resources), externalities, synergies, internationalization, majority in ownership structure.
- **Call for tender (specifications and context):** spectrum band and capacity, contractual obligations of the provider (e.g. coverage), competitive factors, information asymmetry.
- **"Ratchet effect"** leading to determine a price mainly based on what has already been done at another time or in another country.

In general, analyses in this research yield disappointing results. It appears to be relevant here to try to understand why results have been less fruitful than expected.

First of all, as it was detailed in the analyses, some deal amounts appear to be **outliers** in the results: the Mauritanian license awarded to Sudatel (Chinguitel) in 2006 and the Zain's acquisition of Bharti Airtel in Congo Brazzaville and Zambia in 2010. And one can wonder on what extent outliers must be removed from the analyses to get more relevant results. Some tests have been conducted for that: When these outliers have been excluded from regression analyses, variance does decrease but only by 1 to 8 points depending on the analysis.

Similarly, in descriptive analyses, other tests have been conducted by removing deals that have occurred in Nigeria (as its population size is largely above the other countries'[91]) and Rwanda (as its population density is largely above the other countries'[92]). These tests do not improve results either. So outliers are relevant in the analyses and removing them does improve neither the significance of variables nor the variance.
Secondly, the variables manipulated have strong uncertainties, because of the **lack of reliability of data** in Africa.
Finally, **auto-correlations** (correlations between independent variables) are difficult to control. Some indicators (GDP, population, etc.) increase in parallel, which sometimes give contradictory results between the different types of analyses (e.g. in the descriptive analysis, a better governance is associated to higher deal amounts, whereas in the Principal Component Analysis, it is associated to lower deal amounts).

II. Recommendations for future work

Regarding license awards, two factors that could not be taken into account in our analyses is the **spectrum capacity** and the **frequency range**, whereas they are a subject of discussion between investing MTC and local authorities. Indicators such as the license price per MgH per capita are important for investors. In terms of **spectrum capacity**, the bigger the capacity, the better for the operator: In case of network saturation, more transceivers (combination transmitter-receiver) have to be put on and there is no need to deploy a larger network. In terms of **frequency range**, lower frequencies are more expensive because they have a larger coverage and thus require less network deployment; on the contrary, higher frequencies are cheaper when buying the license, but necessitate more investment for network deployment.
Thus, spectrum capacity and frequency range would be interesting determinants to investigate in future research. But for data availability constraints, the sample would probably need to be reduced. This issue has probably to be raised in terms of threshold: More spectrum capacity and lower frequency range are needed when a traffic threshold has been reached. But between 2000 and 2010 in Africa, traffic level has remained below a

[91] Nigeria has a population of 158.4 million in 2010, whereas the second population of our sample is the Democratic Republic of Congo with 66 million in 2010.
[92] Rwanda has the highest density of the sample (430 people/km2 in 2010), far above the second population density of our sample: Nigeria with 174 people/km2 in 2010.

certain threshold, making that all operators buy roughly the same packet. In analyses, this would probably lead to capacity and frequency as weak determinants of licence amounts.

Another suggestion for future research would be to expand the analysis to **a larger sample,** by updating the database with license awards and renewals, as well as operators' acquisitions since 2010. This would enable to understand whether deal amounts have started to become more rational as stakeholders have become more aware of growth potential of Africa.
Scope could be expanded to **another geographical region of developing countries**, such as Latin America, in order to compare with our results.

More specifically, our quantitative results show that a high competition is associated to low deal value. An issue to investigate in future research could be whether there is an **optimal level of market competition** on a mobile market that would optimize the country's incentives for foreign investment.

Finally, it is noticeable that in the last few years, the African telecom market has shown some signs of **consolidation**; acquisitions of local operators have slowed down. The MTC in place on the African market are moving towards complementary investment strategies in order to mitigate their risks and face this market consolidation.
Infrastructure sharing between operators is an economic model that has recently appeared. It is a cooperative model of telecom network management, whether shared infrastructures are passive (masts, cables…) or active (antennas, transmission systems…), and whether this network already exists or still has to be built. Operators share passive infrastructures according to various types of agreements, depending on market structure and penetration, on local regulation, on operators' situation (whether it is a new entrant or an incumbent) and on their strategies: it can be a direct agreement between operators, a joint-venture or an outsourcing agreement with a third-party called a 'tower company'. This new investment scheme has arisen in Africa (between Zain and Essar in Kenya in 2009; between 8 operators across 47 countries in Middle East and Africa in 2014[93]). Besides positive effects, network sharing might also be a source of uncertainties for investing operators.

[93] http://www.rcrwireless.com/20140319/carriers/operator-consortium-agree-to-network-sharing-deal-across-middle-east-africa

Regulation of the host country can still be uncertain when operator's decision is made, which implies some risks in the valuations the operator will make[94].

Based on these new trends on the African market and on the academic question of **"ally or acquire"**, future research could be to compare a network sharing strategy with an acquisition (operator, licence) depending on institutional context, in order to investigate under what environmental and institutional conditions is network sharing preferable to a more 'classical' investment (M&A or license award) for a MTC.

*

[94] For more details on infrastructure sharing in sub-Saharan Africa: Network sharing: a hot topic for operators and regulators in sub-Saharan Africa, A. Schoentgen, COMMUNICATIONS & STRATEGIES, no. 86, 2nd Q. 2012 (Dossier on "Development of ICT in Africa")

LIST OF CHARTS

Chart 1: FDI net inflows (US$) to sub-Saharan Africa 14
Chart 2: Breakdown of Africa's population by income bracket 16
Chart 3: Ivory Coast – Number of subscriptions 20
Chart 4: Annual growth of telecommunication service revenues 21
Chart 5: Growth of mobile subscriber base in Africa (million SIM cards) 22
Chart 6: Growth of mobile subscriber base in Africa (million SIM cards) 22
Chart 7: FDI inflows in telecom services 25
Chart 8: Private sector in African telecommunications 26
Chart 9: Mobile and Internet penetration by region 28
Chart 10: MNOs market shares (mobile subscribers) 30
Chart 11: Mobile subscribers (in million) 40
Chart 12: Market penetration and growth rates for Mobile Telephony 45
Chart 13: From revenues to free cash flows 76
Chart 14: Contribution of mobile operators to government revenues 99
Chart 15: Total taxes as a share of total revenue by mobile operators, 2006 100
Chart 16: Base stations powered by renewable energy source 106
Chart 17: Evolution of DJTTEL Index over 2000-2010 140
Chart 18: Licenses – Dispersion of deals compared to regression line 219
Chart 19: Focus on licenses under 4$ per capita – 219
Chart 20: Operators – Dispersion of deals compared to regression line 222
Chart 21: All deals – Dispersion of deals compared to regression line 225
Chart 22: All deals – Dispersion of deals compared to regression line 225
Chart 23: Focus on all deals under 15$ per capita 226

Chart 24: Worldwide Governance Indicators 229
Chart 25: Historical prices for MTN stock 231
Chart 26: Historical prices for Maroc Telecom stock 232
Chart 27: Historical prices for Vodacom stock 232

LIST OF BOXES

Box 1: The impact of growth on the level of ARPU 24
Box 2: Orange in Kenya 35
Box 3: The Arab Spring 36
Box 4: Orange in Central African Republic 37
Box 5: The different steps of the award of a license 42
Box 6: The different steps of the acquisition of an operator 43
Box 7: Factors impacting telecom MTCs investments in Africa 92
Box 8 Licenses in Mauritania 149
Box 9 The Togolese mobile market 182

LIST OF MAPS

Map 1: Democracies in Africa.....13
Map 2: GDP annual growth and populations in Africa.....15
Map 3: Top 20 mobile markets.....21
Map 4: 2013 World Economic Freedom map.....126

LIST OF GRAPHS

Graph 1: WGI - Evolution of average of the 6 WGI over 2000-2010 130
Graph 2: WGI component loadings 132
Graph 3: WGI score variables 133
Graph 4: WGI - Bivariate correlation between PV and RL 134
Graph 5: WGI - Bivariate correlation between CC and GE 135
Graph 6: Deals amounts per capita vs. years (all deals) & GDP/capita growth 143
Graph 7: Deals amounts per capita vs. years (all deals) & GDP/capita growth 144
Graph 8: Deals amounts per capita vs. years (all deals) & Consumer Price Index growth 146
Graph 9: Deals amounts per capita vs. years (split operators & licenses) 147
Graph 10: Deals amounts per capita under 20$/capita vs. years (split operators & licenses) 151
Graph 11: Deals amounts per capita vs. years (split 2G licenses & 3G/neutral licenses) .. 152
Graph 12: Deals amounts per capita vs. years 153
Graph 13: Deals amounts per subscription (all deals) vs. years (split operators & licenses) 154
Graph 14: Deals amounts per subscription (below 1100$/deal) vs. years (split operators & licenses) 155
Graph 15: Deals amounts per capita vs. population density (split operators & licenses) .. 157
Graph 16: Deals amounts per capita vs. land area (split operators & licenses) 158
Graph 17: Deal amounts per capita vs. country urbanization (split operators and licenses) 159
Graph 18: Deal amounts per capita vs. country GDP per capita (split operators and licenses) 161

Graph 19: Deal amounts per capita vs. country GDP per capita (split operators and licenses) 162
Graph 20: Deal amounts per capita vs. growth of country GDP per capita (all deals) 164
Graph 21: Deal amounts per capita vs. growth of country GDP per capita (split operators & licenses) 165
Graph 22: Deal amounts per capita vs. CPI annual growth..... 166
Graph 23: Deal amounts per capita vs. CPI annual growth..... 167
Graph 24: Deal amounts per capita vs. FDI inflows (split operators and licenses) 168
Graph 25: Deal amounts per capita vs. budget balance (as a % of GDP) (all deals) 169
Graph 26: Deal amounts per capita vs. trade..... 170
Graph 27: Deal amounts per capita vs. WGI RL..... 171
Graph 28: Amount per capita vs. competition (number of operators) (all deals)..... 173
Graph 29: Amount per capita vs. competition (number of operators)..... 174
Graph 30: Amount per capita vs. mobile market penetration (all deals)..... 175
Graph 31: Amount per capita vs. mobile market penetration (split operators and licenses) 176
Graph 32: Amount per capita vs. mobile subscriptions (all deals)..... 177
Graph 33: Amount per capita vs. mobile subscriptions (< 30 million subscriptions)..... 178
Graph 34: Amount per capita vs. mobile subscriptions (< 30 million subscriptions)..... 179
Graph 35: Deal amount per capita vs. market share (split licenses renewals and operators) 180
Graph 36: Deal amount per subscription vs. market share (split licenses renewals and operators)..... 181
Graph 37: Privatization of incumbent 184
Graph 38: Licences - Component loadings 189
Graph 39: Licences - Score variables..... 190
Graph 40: Operators - Component loadings..... 193

Graph 41: Operators - Score variables 195
Graph 42: All deals - Component loadings 198
Graph 43: All deals - Score variables 200
Graph 44. Deal amounts per capita vs. literacy rate (all deals) Excl. Congo Brazza & Zambia 274
Graph 45. Deal amounts per capita vs. literacy rate (split operators and licenses) Excl. Congo Brazza & Zambia 275
Graph 46. Differentiation between deals made in maritime and in landlocked countries .. 276
Graph 47. Local currency: Euro-pegged (FCFA) vs. other currencies 277
Graph 48. Languages 278

LIST OF TABLES

Table 1: Market capitalization of some MTC (April 2014) 29
Table 2: Largest MTC of Africa (2011) 31
Table 3: Examples of 3G licenses awarded in sub-Saharan Africa 33
Table 4: Mobile technologies 41
Table 5: Effect of selected variables on FDI 59
Table 6: FDI inflows to different regions of the world (1970-2006) 60
Table 7: Integrated framework of uncertainties 64
Table 8: Business model 75
Table 9. Comparison of beta between developing and developed markets 80
Table 10. Example of DCF valuation 82
Table 11. Example of DCF valuation 82
Table 12. Description of options 86
Table 13. Estimated GDP impact of Ebola (2014) 163

APPENDICES

Appendix 1. Sub-Saharan Africa, Latin America and East Asia indicators

Source: World Bank databank

	Sub-Saharan Africa			Latin America & Caribbean			East Asia Pacific (upper income excluded)		
	48 countries			41 countries			24 countries		
	2000	2005	2010	2000	2005	2010	2000	2005	2010
Population under 15 (% of total population)	43,40%	42,60%	**41,80%**	32,12%	29,90%	**27,95%**	36,40%	33,90%	**31,95%**
Rural population (% of total population)	65,80%	63,80%	**61,70%**	38,90%	37,30%	**35,80%**	61,10%	58,80%	**56,60%**
Population density (number of inhab. per squ.meter)	75,8	84,5	**94,9**	172,6	183,6	**191,1**	118,4	124,1	**128,2**
Literacy (% of pop>15yrs)	62,2% (only 19 countries fulfilled)	N/A	N/A	N/A	N/A	92% (only 12 countries fulfilled)	85,5% (only 9 countries fulfilled)	N/A	N/A
GDP per capita (constant US$)	1349,2	1613,4	**1799,6**	6030,7	6443,2	**6411,9**	1971,1	2214,6	**2335,5**
Infrastructures: Logistic performance index	N/A	N/A	2,05	N/A	N/A	2,45	N/A	N/A	2,45 (only 13 countries fulfilled)
Regulatory Quality (Worldwide Governance Indicator)	29	29	**30**	59	57	**56**	49	51	**44**

Appendix 2. Details on P&L

This Appendix details the content of the P&L of a telecom asset to be assessed, called X (operator in case of an M&A, license in case of a license award).

Revenues

The following indicators are used to estimate the **revenues**:

- The **average subscriber base** (calculated by dividing by two the sum of subscriber base end of year and subscriber base beginning of year). For mobile, the number of active customers is considered but this definition slightly varies across operators); for fixed, the number of lines operated is considered. Growth of this indicator might depend on market penetration (a high penetration lowers room for growth of subscriber base) and on competition intensity (the number of competitors and their strength will impact future market shares of the new entrant). Share of prepaid customers and share of multiSIM customers in the country might also influence evolution of subscriber base, as they tend to increase churn.
- The **ARPU** is the Average Revenue Per User. It is usually considered on a yearly basis, both for mobile (split into prepaid and postpaid) and fixed customers. A high competition intensity as well as a weak rule of law (preventing enforcement of anti-dumping laws) might lead to price volatility on the market and thus to ARPU volatility. Inflation and urbanization are also likely to influence level of ARPU.

Detailed revenue lines:

Revenues are divided into **retail revenues** and **wholesale revenues** (in case the operator to be assessed has its own network and alternative operators can rent access lines from it and resell them to their customers).

First part of revenues is **retail revenues**.

First of all, « a prepaid mobile connection (also commonly referred to as pay-as-you-go) is a mobile connection for which credit is purchased in advance of service use. »[95] **Prepaid revenues** can be estimated by adding: subscription revenues (in case new subscribers must pay a subscription fee), revenues of incoming calls, of outgoing calls (voice revenues) and of data (non-voice revenues such as SMS, MMS, video, etc.). For incoming calls for example, the average number of prepaid subscribers will be multiplied by the prepaid ARPU of incoming calls. Same calculations can be used to estimate revenues of outgoing calls and data. For X, having a majority of prepaid in its subscriber base is riskier compared to post-paid: There is no commitment period from subscribers with prepaid and subscribers can easily switch operators: Most of them have several SIM cards ('multi-SIM' effect, Bresson 2010), which can lead to price wars between operators. On the other hand, a large share of prepaid customer base will limit billing costs and risks of customers' bad debts that are larger with postpaid subscriptions.

Postpaid revenues can be considered as having the same structure: subscription revenues (if any), revenues of incoming calls, of outgoing calls and of data. A postpaid mobile connection (also commonly referred to as contract mobile connection) is « a mobile connection where usage is billed after each period and for which a contract is signed, typically for a fixed term. »[96]

A risk for X related to incoming calls revenues, whether for prepaid or post-paid: Some competing operators might be bad payers and not pay operator X for incoming calls, which adds to operator X's bad debt.

'Mobile roaming in' relates to revenues coming from roaming of foreign customers coming to the country, on condition that X has an agreement with the operator of the foreign customer. It can be estimated based on the average number of visitors per year multiplied by the mobile penetration of visitors and by their ARPU.

Fixed lines revenues are made of post-paid copper lines (number of copper lines multiplied by ARPU), prepaid copper lines (number of minutes of usage multiplied by

[95] Source : GSMA Intelligence
[96] Source: GSMA Intelligence

revenue per minute). When necessary, CDMA revenues can be included in this part (handset revenues plus prepaid CDMA cards plus service revenues).

Internet revenues are made of ADSL revenues plus mobile BB revenues.

Second part of revenues is **wholesale revenues**: they are made of interconnection revenues and potential others like revenues from VSAT (satellite internet) or potential submarine cables, depending on the operator concerned.

Simplification of revenues:

Prepaid revenues can be the only type of retail revenues considered in a model to sub-Saharan Africa, for simplification reasons:

- In 2010, prepaid connections represented 98,7% of total number of mobile subscriptions over the countries covered by our research scope[97].
- Roaming market is still nascent in sub-Saharan Africa, representing only 1,8% of total mobile revenues of this region.[98]
- Fixed telephony is very low and even declining in certain countries: its penetration went from 1.0% in 1998 to 1.4% only in 2008.

Internet revenues can be considered as closed to 0: Fixed access to the Internet has remained closed to 0,1%, as deployment of ADSL is strongly constrained by the limited number of fixed telephone lines.[99] Mobile Internet shows greater potential than fixed Internet: It has started to grow since 2006 but was still at 0,9% penetration rate in 2008.

Operational expenses (Opex)

Detailed cost lines:

This part details the main categories of costs that have the strongest structuring impact: products & services costs, network costs and costs of personnel.

[97] Source: Market statistics database, GSMA, Mobile for Development Intelligence
[98] Source: GSMA 2012, « Roaming in sub-Saharan Africa », V. Raval, May 2012, http://www.itu.int/ITU-D/finance/work-cost-tariffs/events/tariff-seminars/Cotonou-12/pdf/Session6_3_Raval.pdf
[99] Source: ITU World Telecommunications / ICT Indicators database

Products & services costs include all the expenses that are directly and indirectly related to products and services sold, as well as to customer relationship.

- **Cost of scratch cards** is also included in the costs of selling: It is evaluated by multiplying the number of scratch cards sold by the cost of a card.
- **Recharge commission** is the commission that operator X pays to the distributor depending on its sales: it is a percentage of the price of the scratch card (or of the e-voucher). Each operator applies its own percentage, which usually ends up by aligning with all operators applying the same on the market.
- **Marketing costs** include marketing staff, as well as advertising and promotion costs (for mobile as for fixed). Advertising and promotion include branding licence, 'above the line'[100], 'below the line'[101] and public relations. The total of these costs is usually estimated as a percentage of sales (2% for instance). Marketing costs can be particularly high, when a new brand or a new operator is setting up in a country. In 2009 in Benin, Glo managed to gain 20% of market shares in eight months, mainly thanks to a good marketing and communication.
- **Subscriber management** includes costs related to customer relationship management, like billing and collection, as well as bad debt. Billing and collection can be estimated by multiplying the number of bills issued by the cost of a bill. Bad debt is the debt owed by customers (subscribers and other operators) to X (it is written off by X as a loss). In order to calculate the amount of bad debt, one usually multiplies the total revenue on each segment (post-paid, internet, wholesale) by the estimated percentage of bad debt on each segment.
- **Subscriber Acquisition Costs** are the sum of acquisition costs. For mobile part, they basically include the handset subsidy (calculated by multiplying the percentage of subsidy by the average price of a handset and by the eligible customer base) and commissions (which is a function of the number of gross adds or of the number of existing customer base) paid by X to the distributor. There can be cases of favouritism with undeclared commissions with some distributors. For fixed part, these acquisition costs include equipment subsidy (modem, box) when equipments

[100] 'Above the line' includes costs related to communication on TV, radio, press, billboards, cinema, Internet...

[101] 'Below the line' includes costs related to communication made out of media, such as flyers, direct marketing, point of sales communication like merchandising...

are sold, sales commissions, call-centres sales-related costs, ULL set up fees to be paid to the incumbent. There might also be some **Subscriber Retention Costs**, in case X has a marketing approach of retention. Loyalty and retention are very difficult to assess, given the large rate of 'multiSIM'. They can include discounts and free equipment upgrades for example.

- **Shops running costs** include shops' rent (which can be estimated by the cost of a square meter applied to the average size of the shops).
- **Administrative costs** include office rent, facilities costs, telephone and postal charges, IT maintenance (estimated with a percentage applied to IT Capex) and recurring licence & spectrum fees. Poor country infrastructures (and high public services costs) might increase administrative costs related to facilities (water, electricity, etc.).

Network costs include:

- **Network operations and maintenance**. This line includes costs to keep the network and its services up and running and costs of repairs and upgrades when necessary. Here, power supply of sites is critical in sub-Saharan Africa: Few of them are supplied by solar equipment; most of them are still supplied by fuel generators, meaning that particular attention shall be paid to price of fuel. For instance, in Chad, electricity network is almost inexistent[102], meaning that sites have to be supplied by generators, which seriously impacts costs. This cost line must also include security, around 1,5 watchman per site. Country population density and rurality, as well as poor infrastructure networks, are key determinants for this cost line, as they raise the issue of the easy access to sites. Also country stability is important for costs related to network operations & maintenance: in instability periods, when destruction of networks happen, this might represent a significant cost for the operator to rebuild the damaged network, added to the cost of the non-activity period.
- **Interconnection.** It includes interconnection fees paid to other operators for prepaid users (estimated by multiplying average interconnection cost per prepaid user by the number of prepaid users), for post-paid users (estimated by multiplying average

[102] Source: Balancing Act, issue n°180, April 5th 2012

interconnection cost per post-paid user by the number of post-paid users) and for fixed users.

Personnel costs includes sales, network, as well as support functions, such as marketing, Customer Relationship Management, Human Resources, finance and IT services staff. **Salaries** are usually estimated by multiplying the number of headcount by an average yearly salary (that includes taxes). In case of the acquisition of operator X, staff must be examined carefully by the potential investor: Incumbents have large headcounts and the investor shall check that all declared headcounts are real ones and not fictive. **Training** (percentage applied to the total amount of salaries) and recruitment (average cost of **recruitment** multiplied by number of recruitments) are also included in personnel costs.

Simplification of costs:

Expenses related to Points of Sales (PoS), such as shops rent, can be removed in a model applied to sub-Saharan Africa: Most of PoS in Africa are not exclusive ones and non-exclusive distributors are remunerated via a recharge commission system.

Bad debts and billing can be removed, as most of the subscriber base in Africa is prepaid: by definition, bad debts and billing are proper to postpaid subscribers.

Customer retention is not considered in the model, as this marketing strategy is nascent over the continent on the period 2000-2010.

Appendix 3. Details on database sources

African Economic Outlook:

- http://www.africaneconomicoutlook.org/en/

GSMA:

- GSM network and coverage maps, GSMA Intelligence: http://maps.mobileworldlive.com

Heritage foundation:

- Index of Economic Freedom: http://www.heritage.org/index/

IMF:

- IMF data mapper: http://www.imf.org/external/datamapper/index.php

- World Economic Outlook database: http://www.imf.org/external/pubs/ft/weo/2013/02/weodata/index.aspx

ITU:

- ITU statistics: http://www.itu.int/en/ITU-D/Statistics/Pages/default.aspx
- ICT Eye: http://www.itu.int/net4/itu-d/icteye/

OECD:

- OECD statistics: http://www.oecd.org/statistics/

Operators' annual reports

Press:

- Agence EcoFin: http://www.agenceecofin.com/telecom
- Balancing Act Africa: http://www.balancingact-africa.com
- Jeune Afrique: http://www.jeuneafrique.com
-

Telegeography (Authoritative telecom data):

- Telegeography, GlobalComms, Country overviews
- CommsUpdate: http://www.telegeography.com/products/commsupdate/
- Telegeography Indiser, Country statistics map: http://www.telegeography.com/products/telegeography-insider/country-statistics-map/index.html

World Bank:

- World Bank databank: http://databank.worldbank.org/data/home.aspx
- Worldwide Governance Indicators: http://info.worldbank.org/governance/wgi/index.aspx#reports

Appendix 4. The Index of Economic Freedom

The Index of Economic Freedom is an annual guide published jointly published by the Wall Street Journal and the Heritage Fundation, Washington's think tank. Definition of Economic Freedom given on their website (http://www.heritage.org/index/) is 'the fundamental right of every human to control his or her own labor and property. In an economically free society, individuals are free to work, produce, consume, and invest in any way they please. In economically free societies, governments allow labor, capital and goods to move freely, and refrain from coercion or constraint of liberty beyond the extent necessary to protect and maintain liberty itself.' The Index has covered 186 countries since 1995.

The Index of Economic Freedom is based on ten factors that are gathered in four main components: Rule of Law (includes property rights and freedom from corruption), Limited Government (includes fiscal freedom and government spending), Regulatory Efficiency (includes business freedom, labor freedom and monetary freedom), Open Markets (trade freedom, investment freedom and financial freedom). The ten factors are qualitative and quantitative and graded on a 0-100 scale.

Details on the ten factors (Excerpt from website):

Rule of Law:

- **Property Rights:** The property rights component is an assessment of the ability of individuals to accumulate private property, secured by clear laws that are fully enforced by the state. It measures the degree to which a country's laws protect private property rights and the degree to which its government enforces those laws. It also assesses the likelihood that private property will be expropriated and analyzes the independence of the judiciary, the existence of corruption within the judiciary, and the ability of individuals and businesses to enforce contracts.
- **Freedom from Corruption:** Corruption erodes economic freedom by introducing insecurity and uncertainty into economic relationships. The score for this component is derived primarily from Transparency International's Corruption Perceptions Index (CPI) for 2010, which measures the level of corruption in 178 countries.

Limited Government:

- **Fiscal Freedom:** Fiscal freedom is a measure of the tax burden imposed by government. It includes both the direct tax burden in terms of the top tax rates on individual and corporate incomes and the overall amount of tax revenue as a percentage of GDP.
- **Government Spending:** This component considers the level of government expenditures as a percentage of GDP. Government expenditures, including consumption and transfers, account for the entire score.

Regulatory Efficiency:

- **Business Freedom:** Business freedom is a quantitative measure of the ability to

start, operate, and close a business that represents the overall burden of regulation as well as the efficiency of government in the regulatory process. The business freedom score for each country is a number between 0 and 100, with 100 equaling the freest business environment.

- **Labor Freedom:** The labor freedom component is a quantitative measure that looks into various aspects of the legal and regulatory framework of a country's labor market. It provides cross-country data on regulations concerning minimum wages; laws inhibiting layoffs; severance requirements; and measurable regulatory burdens on hiring, hours, and so on.
- **Monetary Freedom:** Monetary freedom combines a measure of price stability with an assessment of price controls. Both inflation and price controls distort market activity. Price stability without microeconomic intervention is the ideal state for the free market.

Open Markets:

- **Trade Freedom:** Trade freedom is a composite measure of the absence of tariff and non-tariff barriers that affect imports and exports of goods and services.
- **Investment Freedom:** In an economically free country, there would be no constraints on the flow of investment capital. Individuals and firms would be allowed to move their resources into and out of specific activities, both internally and across the country's borders, without restriction. Such an ideal country would receive a score of 100 on the investment freedom component of the Index of Economic Freedom.
- **Financial Freedom:** Financial freedom is a measure of banking efficiency as well as a measure of independence from government control and interference in the financial sector. State ownership of banks and other financial institutions such as insurers and capital markets reduces competition and generally lowers the level of available services. In an ideal banking and financing environment where a minimum level of government interference exists, independent central bank supervision and regulation of financial institutions are limited to enforcing contractual obligations and preventing fraud. Credit is allocated on market terms, and the government does not own financial institutions. Financial institutions provide various types of financial services to individuals and companies. Banks are free to extend credit, accept deposits, and conduct operations in foreign currencies. Foreign financial

institutions operate freely and are treated the same as domestic institutions.

Appendix 5. Worldwide Governance Index

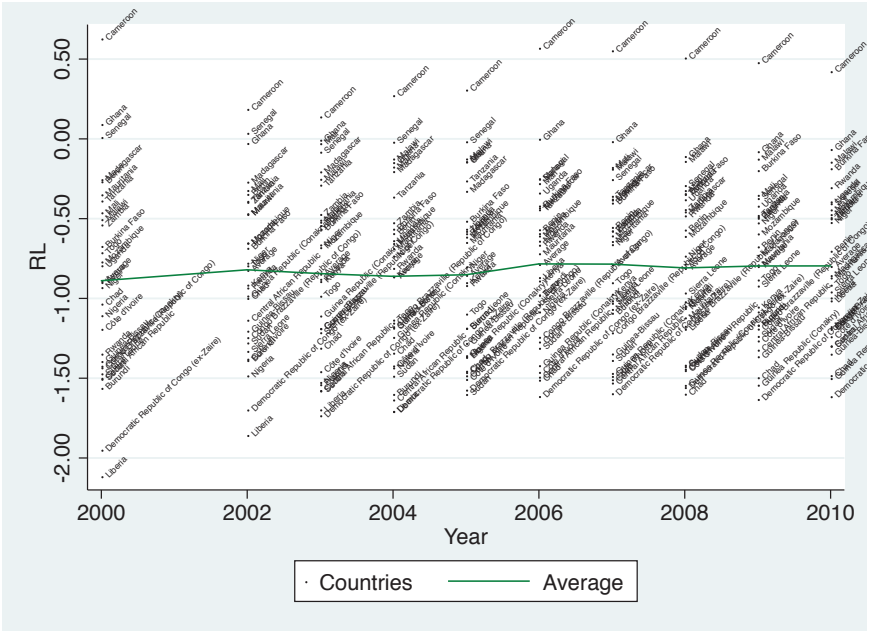
The WGI are a dataset produced by Daniel Kaufmann (Revenue Watch and Brookings Institution), Aart Kraay (World Bank Development Research Group) and Massimo Mastruzzi (World Bank Institute), reporting "aggregate and individual governance indicators for 215 economies over the period 1996–2012. Six indicators are aggregated based on 31 different sources, such as think tanks, survey institutes, NGOs, private sector firms, etc.:

- Voice & accountability (VA): « perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media»
- Political Stability and Absence of Violence/Terrorism (PV): « perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism »
- Government effectiveness (GE): « perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies »
- Regulatory quality (RQ): « perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development »
- Rule of law (RL): "perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence"
- Corruption (CC): "control of corruption"

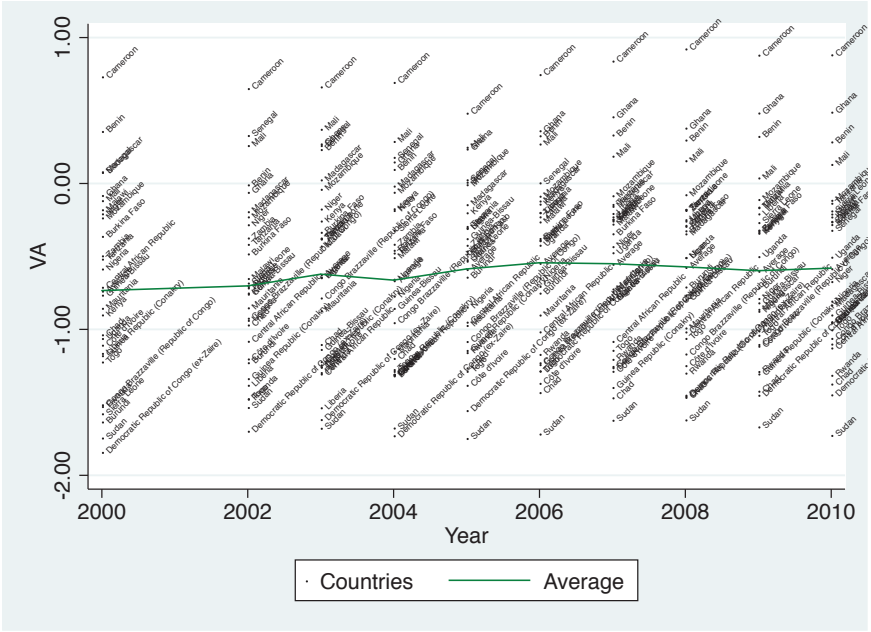
These measures are in units of a standard normal distribution, with mean zero, standard deviation of one, and running from approximately -2.5 to 2.5, with higher values corresponding to better governance.

WGI evolution over 2000-2010

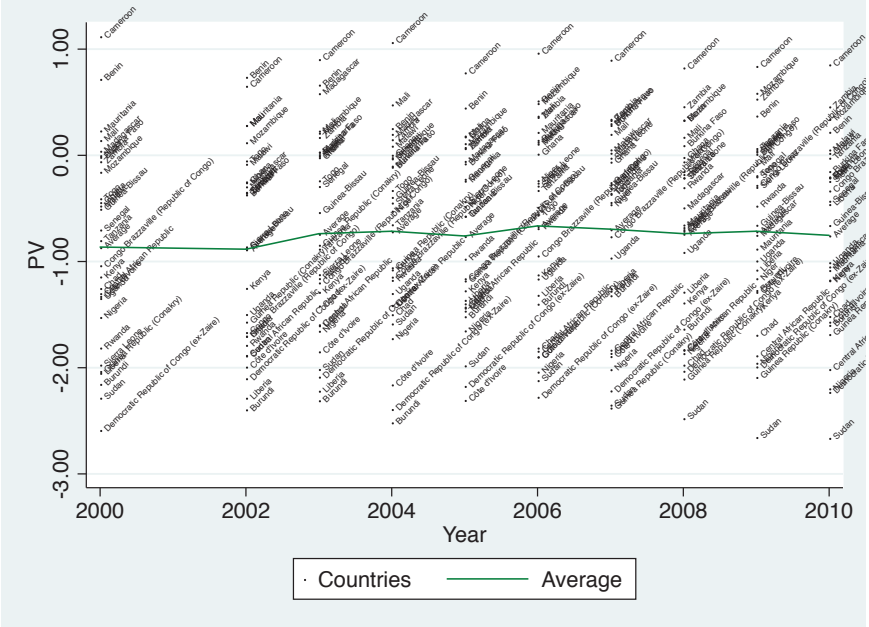
WGI - Evolution of Rule of Law (RL) over 2000-2010



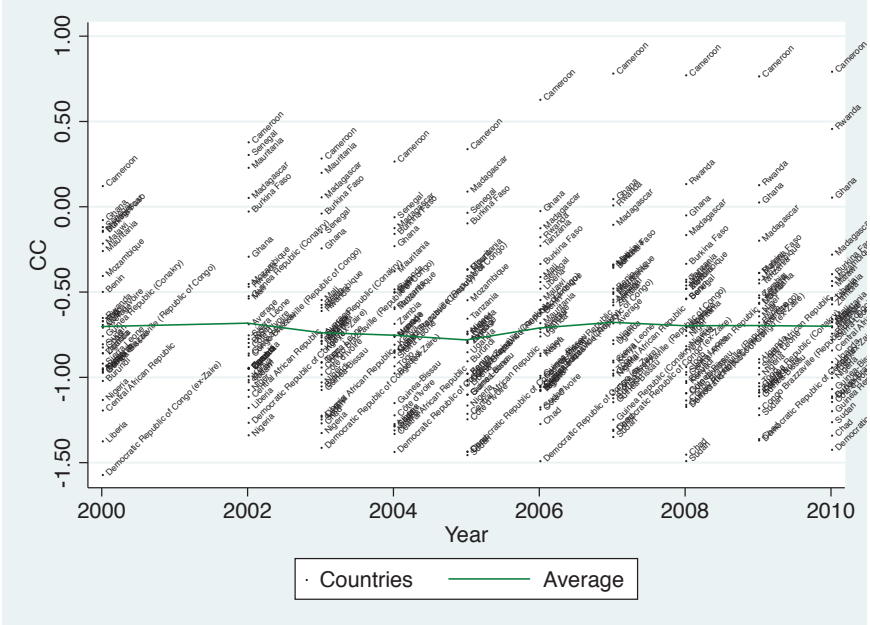
WGI - Evolution of Control of Corruption (CC) over 2000-2010



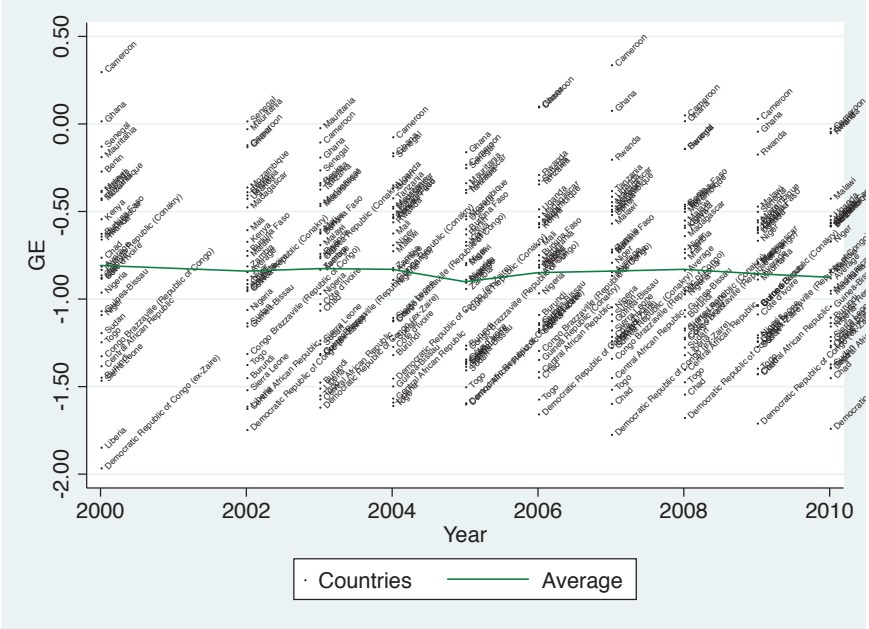
WGI - Evolution of Voice & Accountability (VA) over 2000-2010



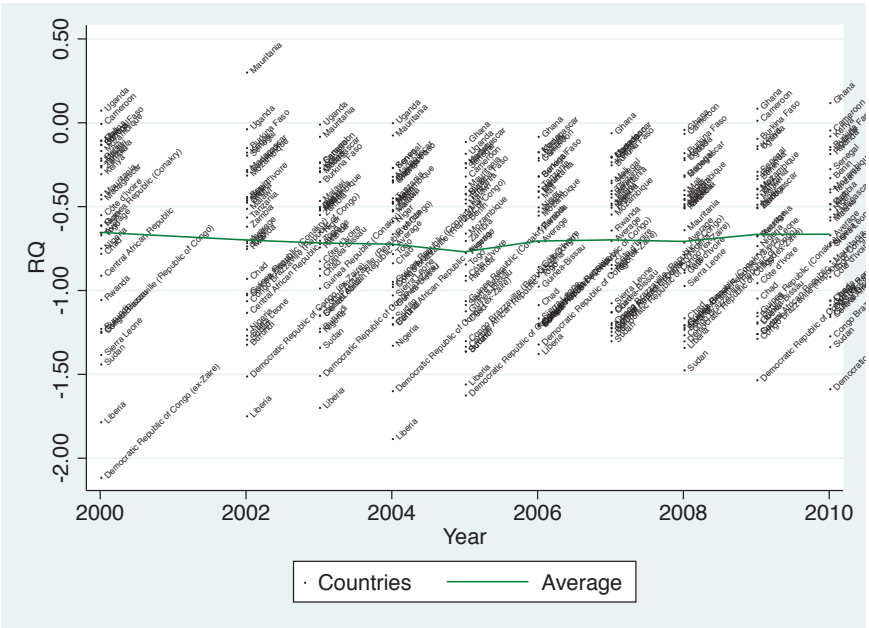
WGI - Evolution of Political Stability & Absence of Violence (PV) over 2000-2010



WGI - Evolution of Government Effectiveness (GE) over 2000-2010

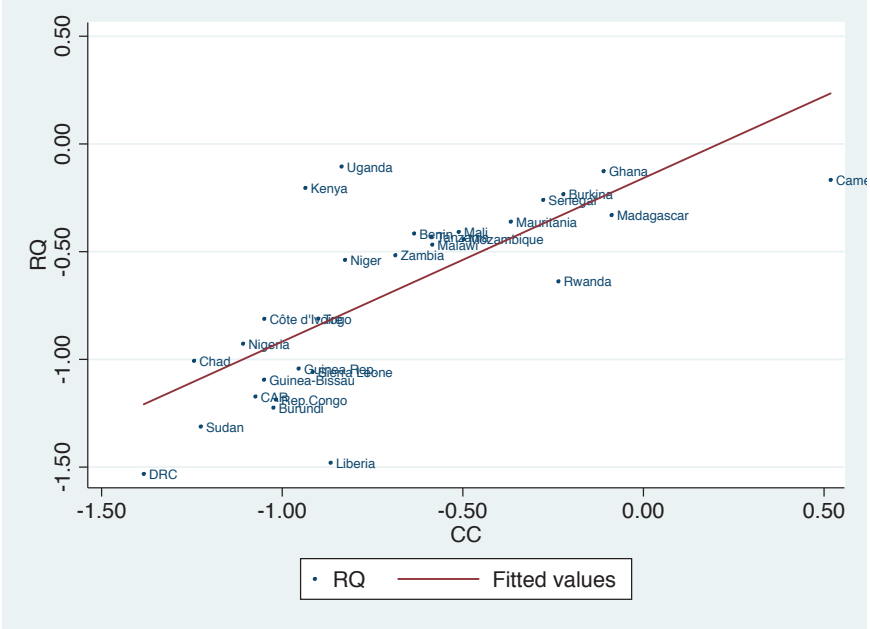


WGI - Evolution of Regulatory Quality (RQ) over 2000-2010

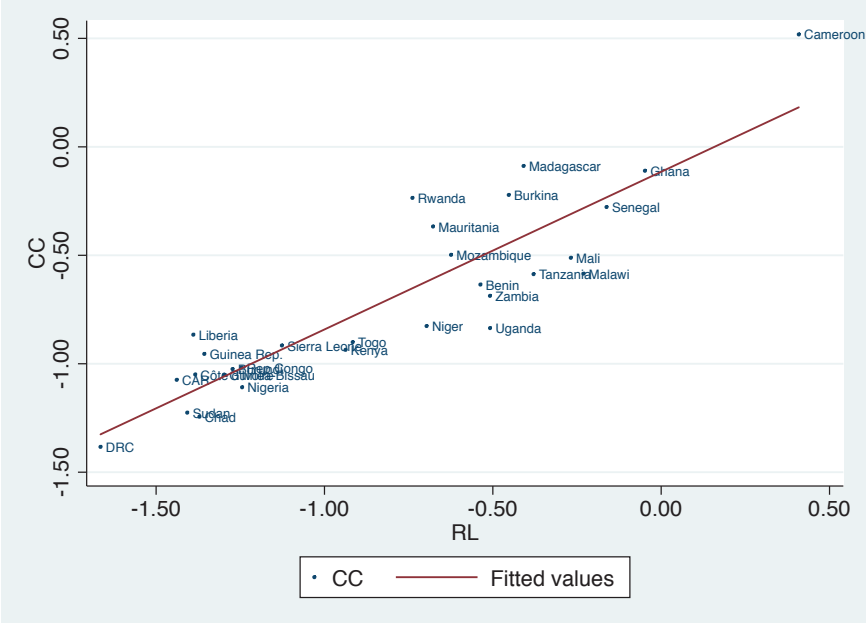


Bivariate correlations between WGI

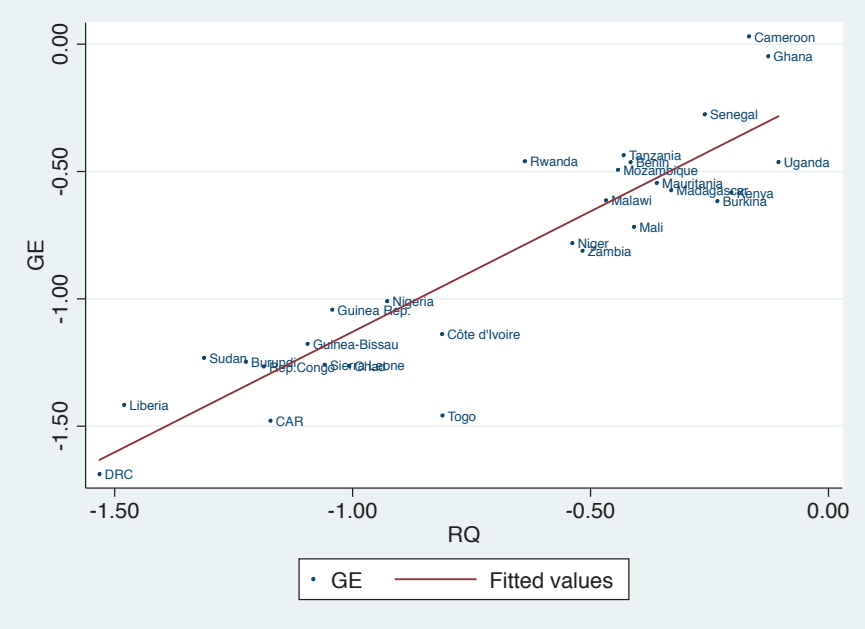
WGI. Bivariate correlation between CC and RQ



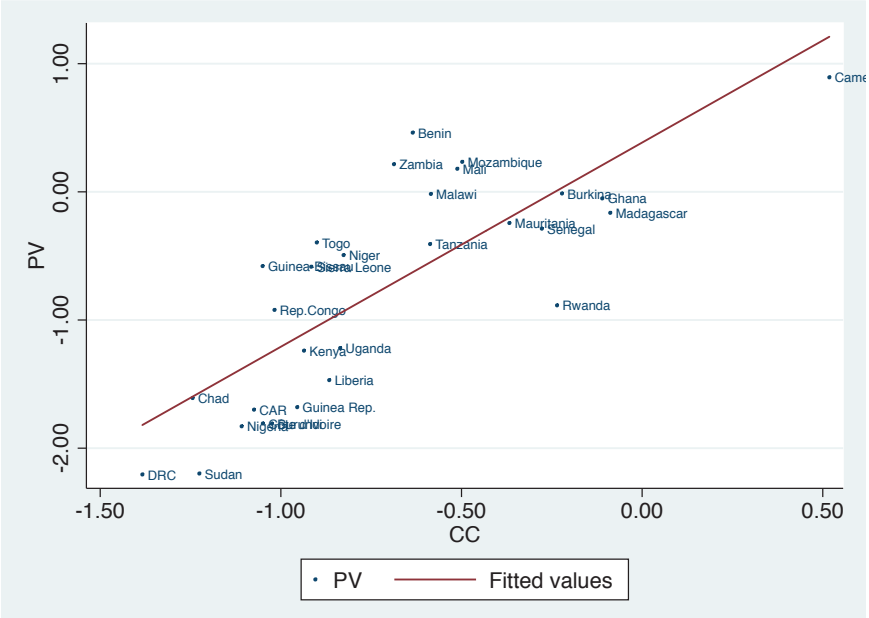
WGI. Bivariate correlation between CC and RL



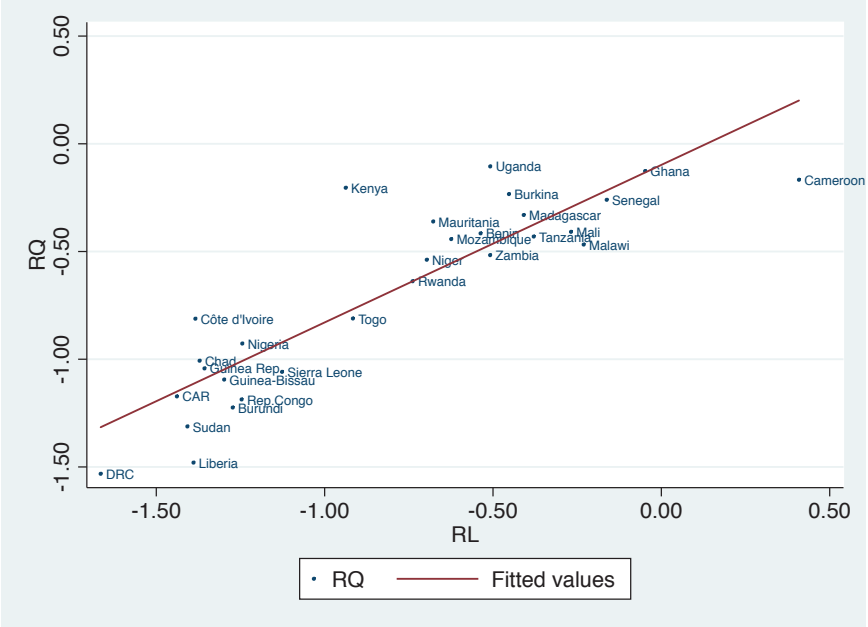
WGI. Bivariate correlation between GE and RQ



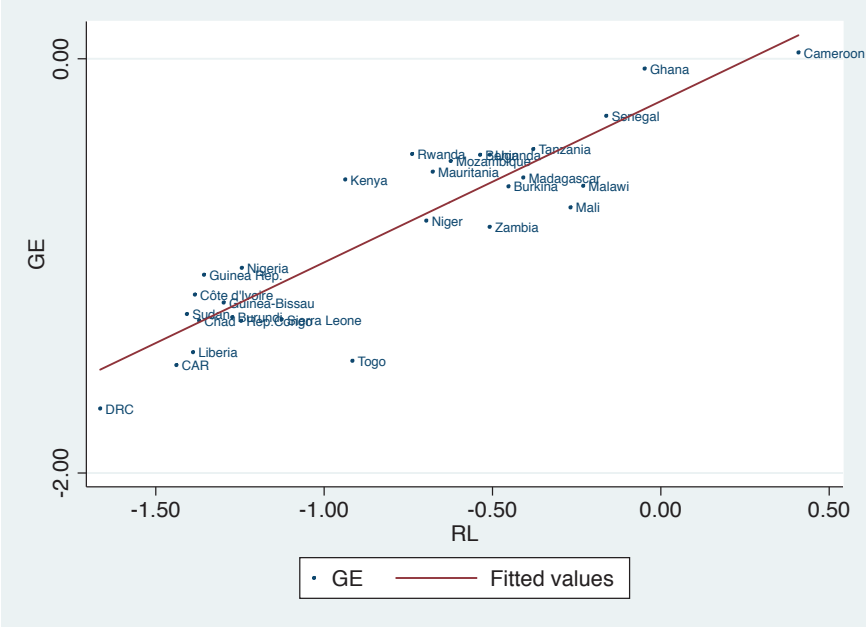
WGI. Bivariate correlation between PV and CC



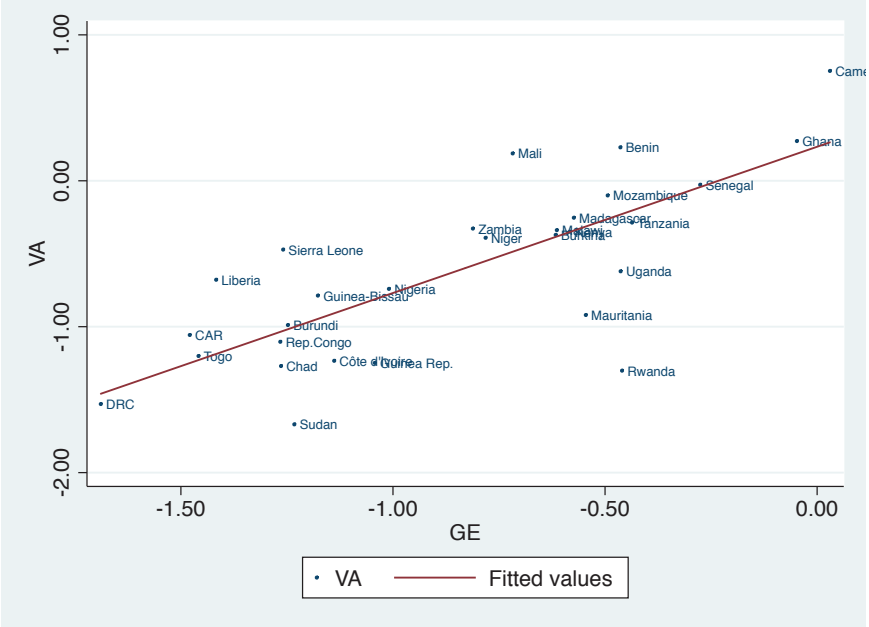
WGI. Bivariate correlation between RL and RQ



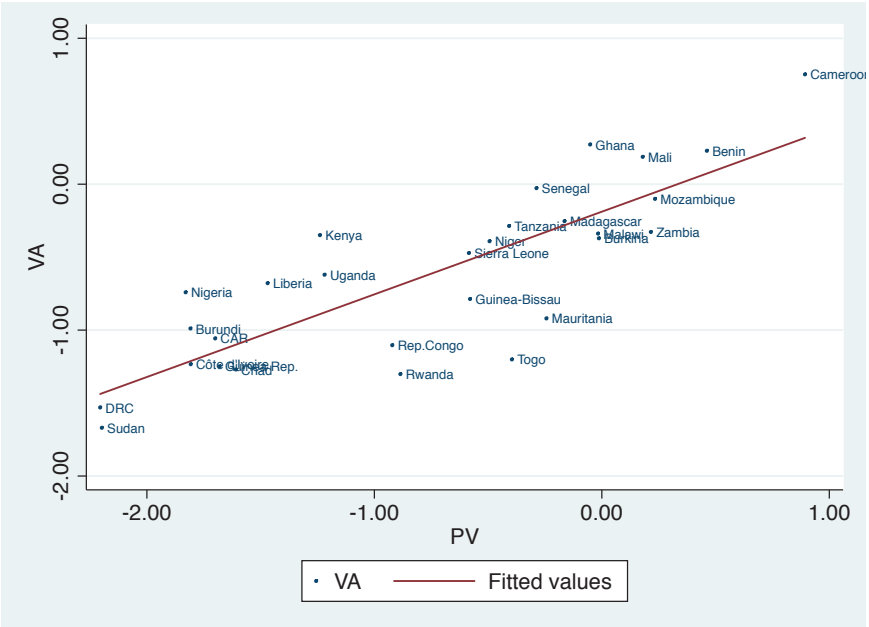
WGI. Bivariate correlation between RL and GE



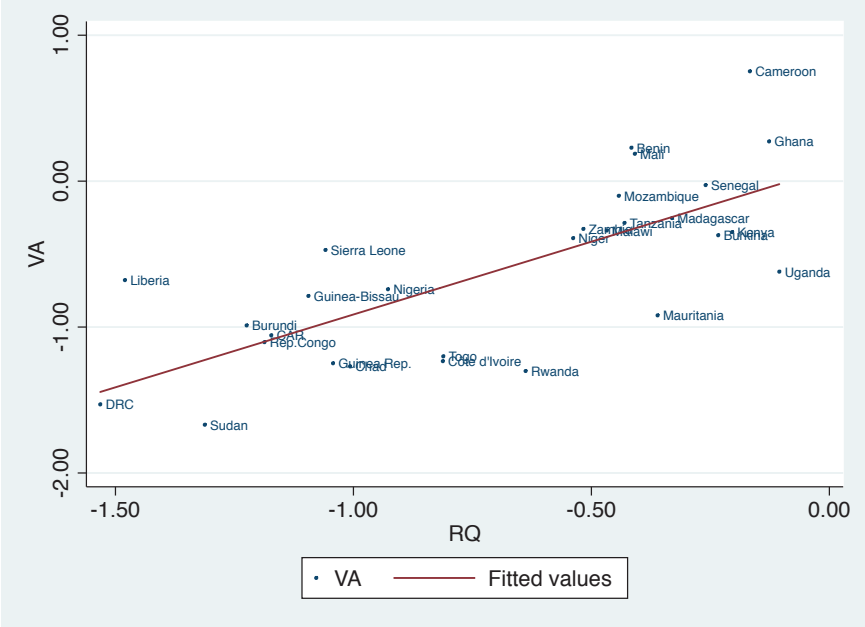
WGI. Bivariate correlation between GE and VA



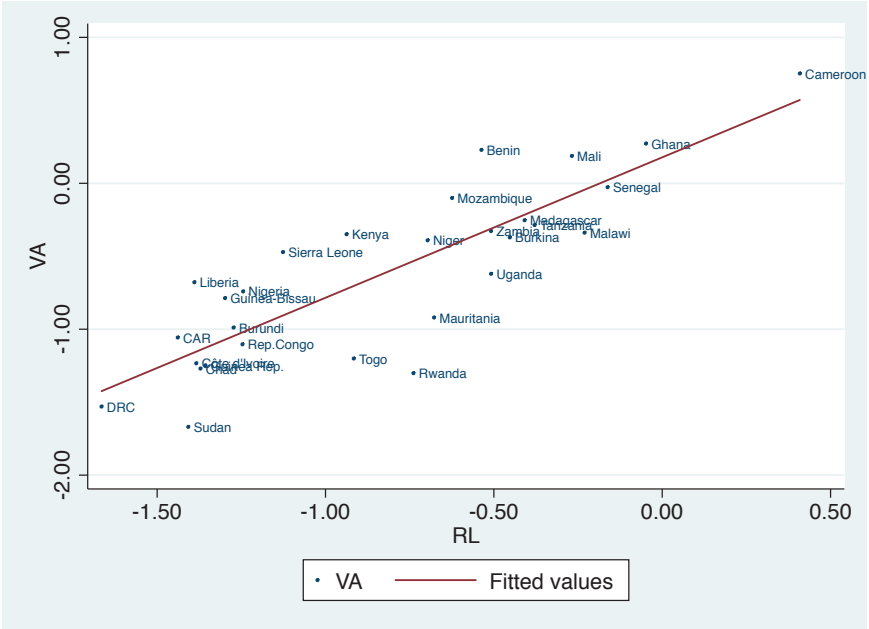
WGI. Bivariate correlation between PV and VA



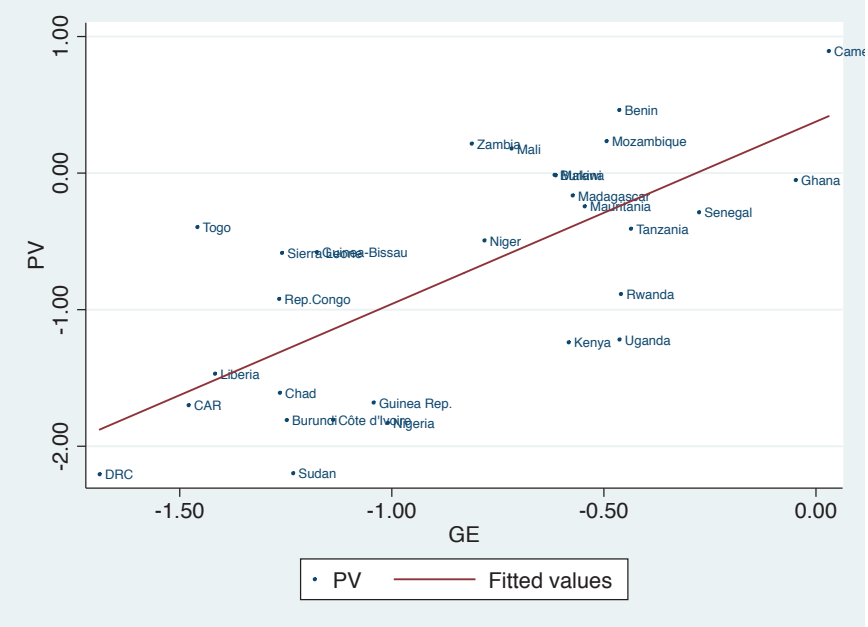
WGI. Bivariate correlation between RQ and VA



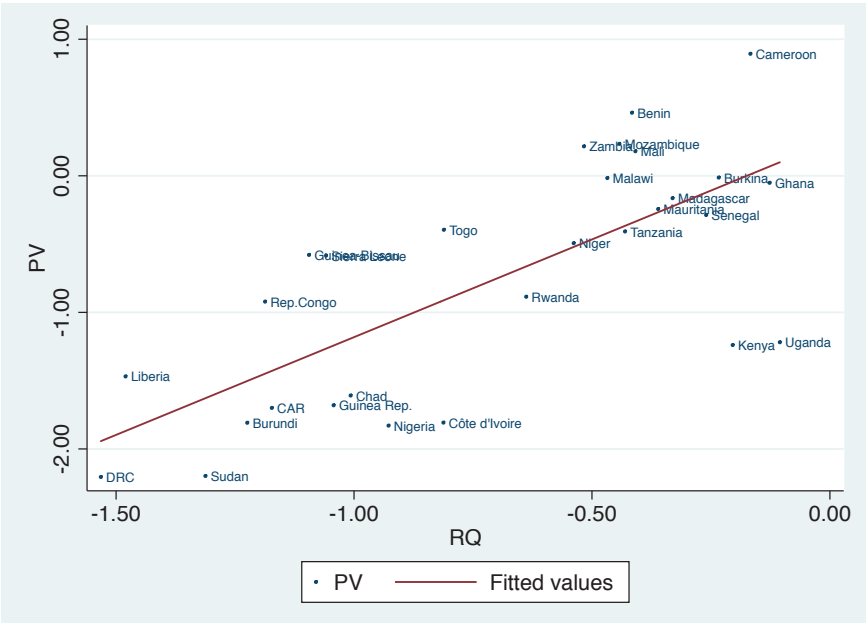
WGI. Bivariate correlation between RL and VA



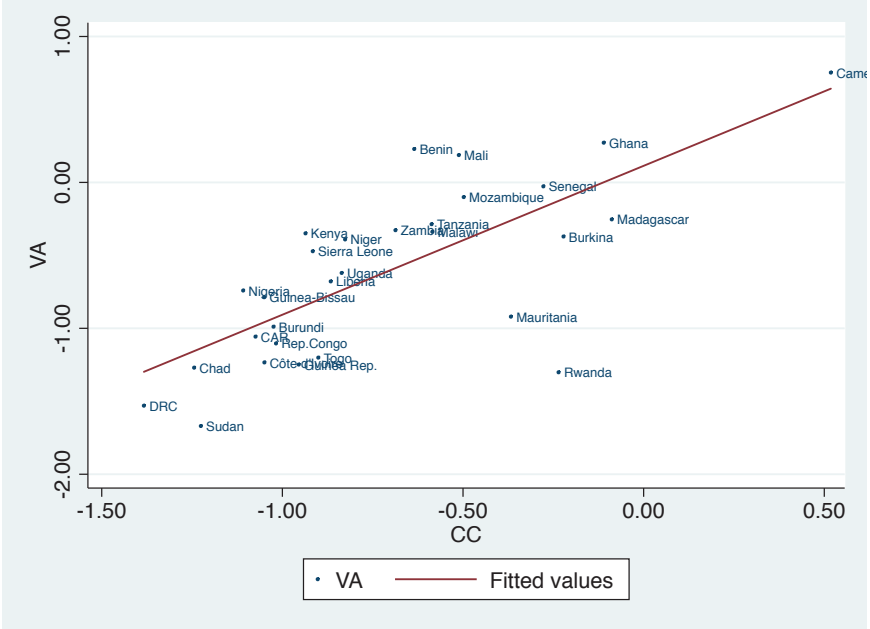
WGI. Bivariate correlation between PV and GE



WGI. Bivariate correlation between PV and RQ

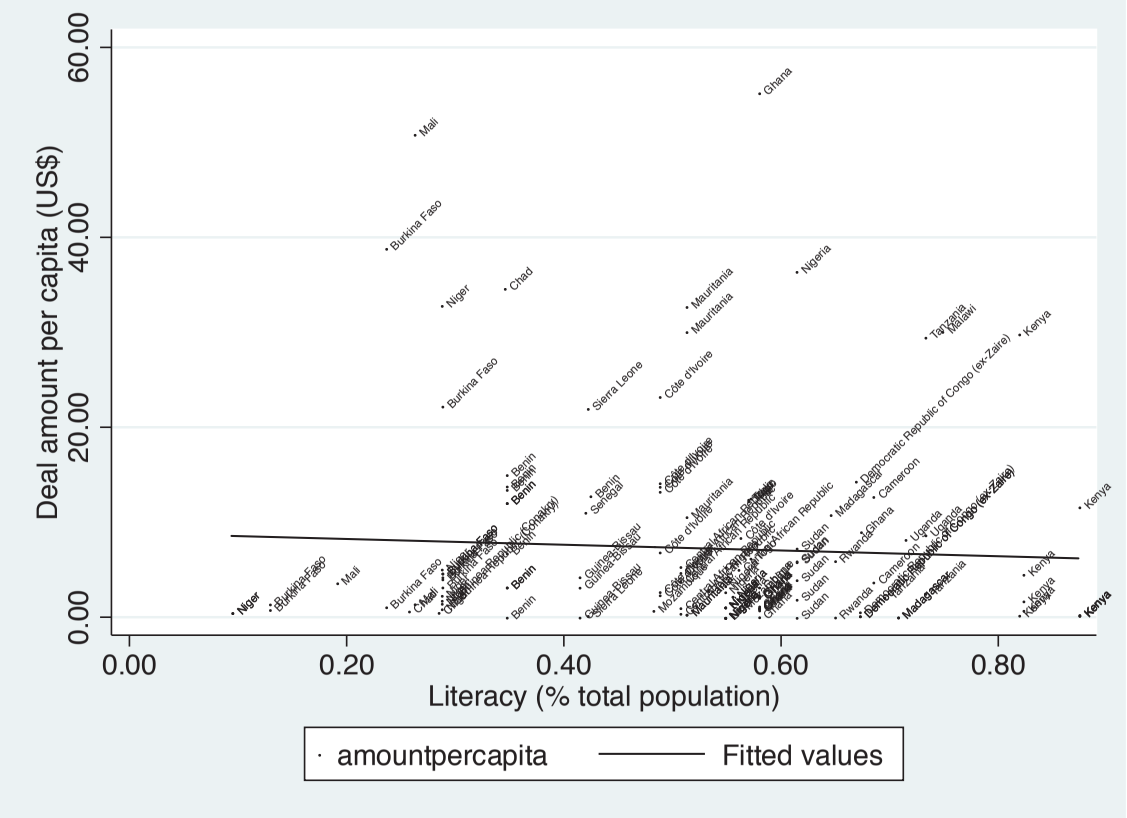


WGI. Bivariate correlation between CC and VA



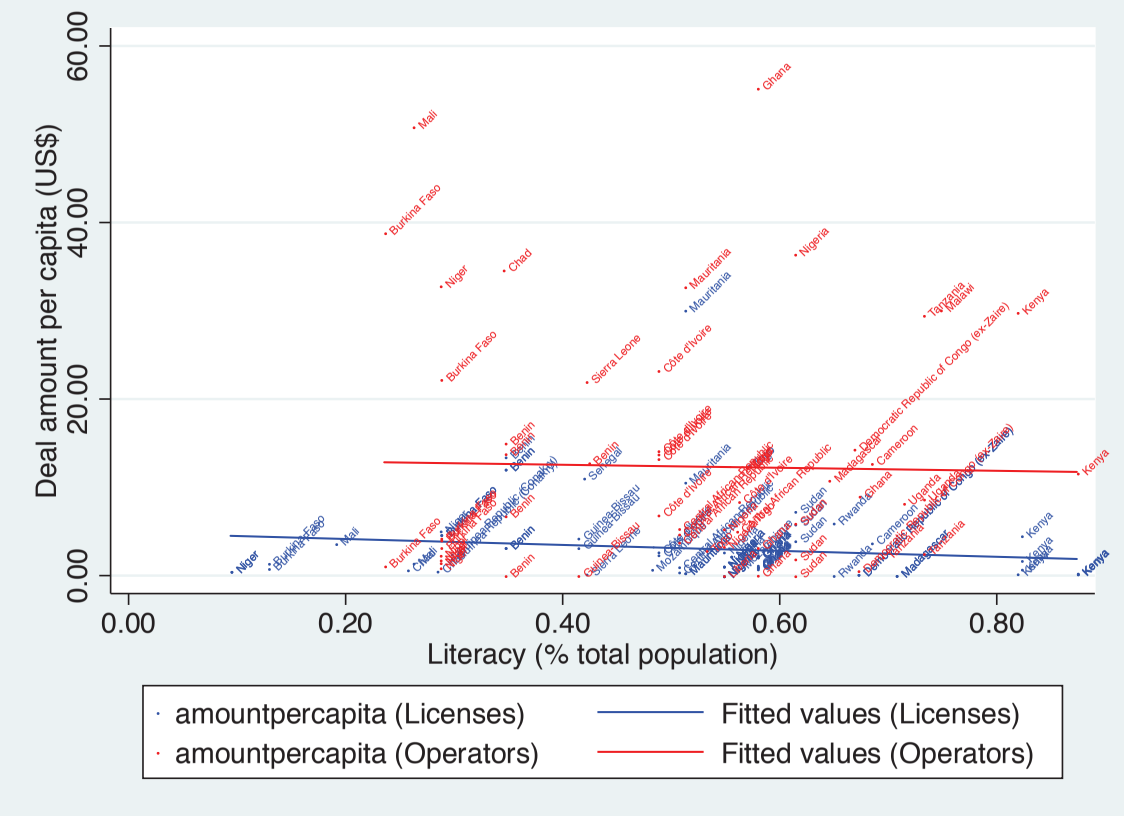
Appendix 6. Additional descriptive analyses

Graph 44. Deal amounts per capita vs. literacy rate (all deals) Excl. Congo Brazza & Zambia



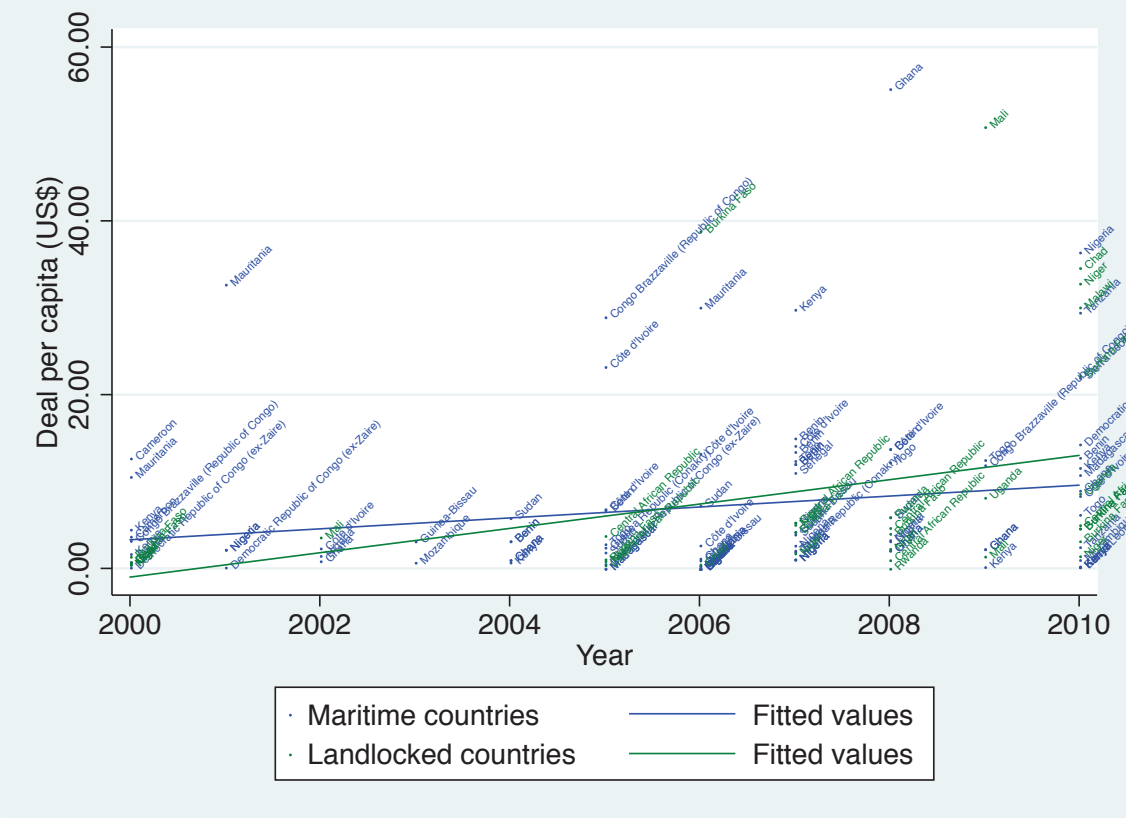
Note: Literacy unit is % of population over 15.

Graph 45. Deal amounts per capita vs. literacy rate (split operators and licenses) Excl. Congo Brazza & Zambia
- Split Licences vs. Operators

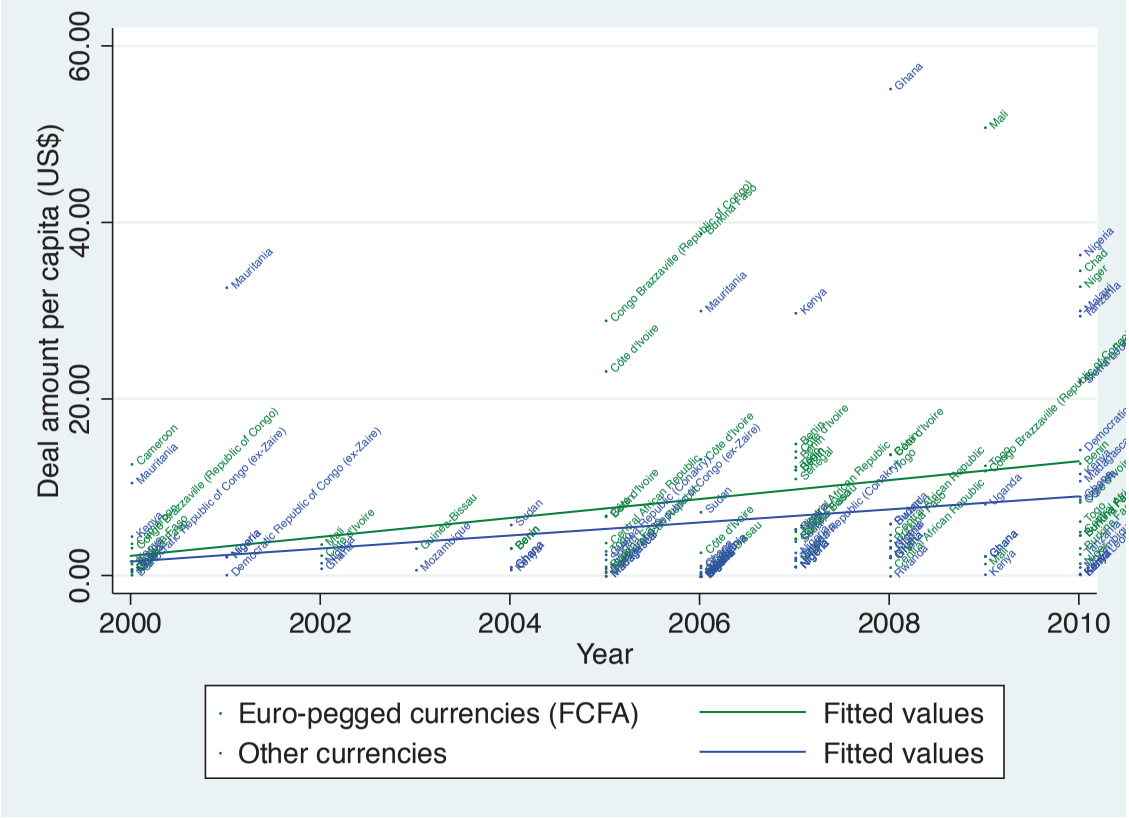


Note: Literacy unit is % of population over 15.

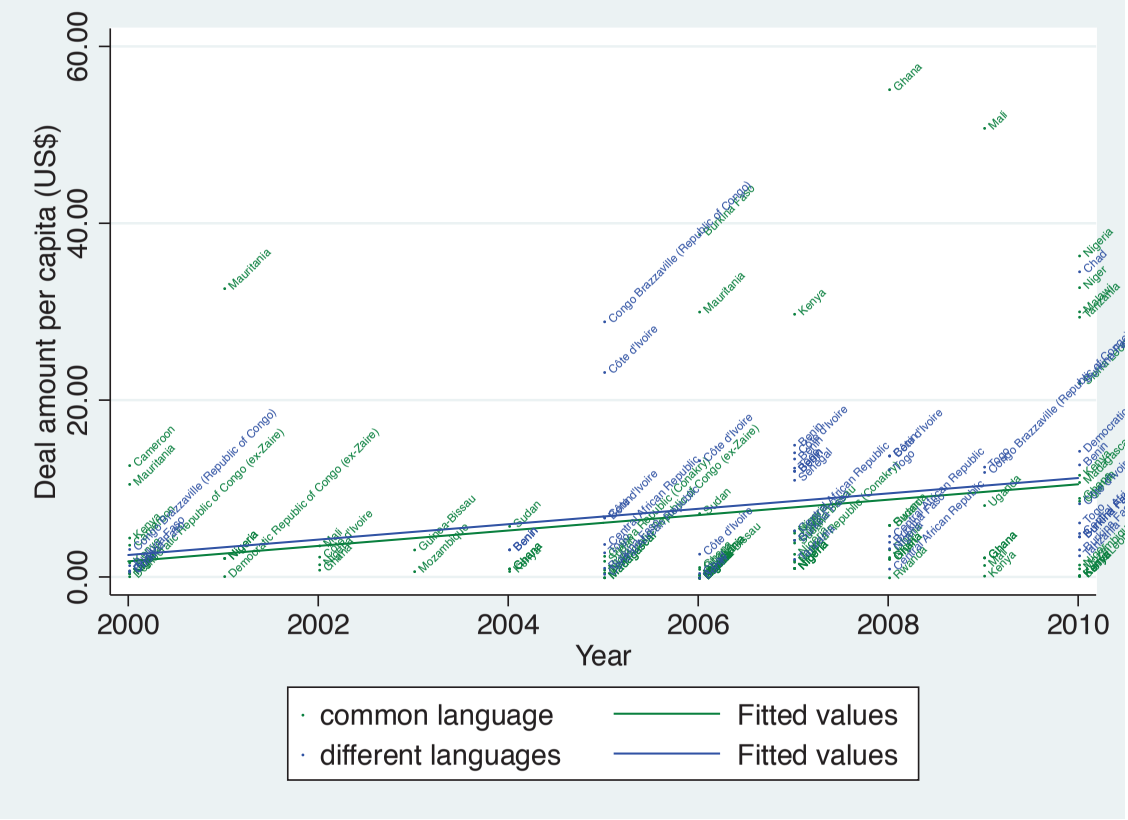
Graph 46. Differentiation between deals made in maritime and in landlocked countries



Graph 47. Local currency: Euro-pegged (FCFA) vs. other currencies



Graph 48. Languages



Appendix 7. Regressions – Results

Regression 1 – Results

Licences: regression 1a

```
. Licenses MS0,01% (fichier 3006)

. regress logdealpercapita logWGI logr logt logG logn logd

      Source |       SS       df       MS              Number of obs =      71
-------------+------------------------------           F(  6,    64) =    2.89
       Model |  36.2173454     6  6.03622424            Prob > F      =  0.0149
    Residual |  133.893527    64  2.09208635            R-squared     =  0.2129
-------------+------------------------------           Adj R-squared =  0.1391
       Total |  170.110872    70  2.43015531            Root MSE      =  1.4464

------------------------------------------------------------------------------
logdealper~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      logWGI |   .5147833   .7875428     0.65   0.516    -1.058514    2.088081
        logr |   .2467855   .0765963     3.22   0.002     .0937668    .3998042
        logt |  -.0789614   .1104699    -0.71   0.477    -.2996504    .1417277
        logG |   .8760355   .4489704     1.95   0.055     -.020886    1.772957
        logn |  -.2716447    .494523    -0.55   0.585    -1.259568    .7162785
        logd |  -.1709358   .1942942    -0.88   0.382    -.5590831    .2172116
       _cons |  -2.428998    2.96053    -0.82   0.415    -8.343337    3.485341
```

Operators: regression 1b

```
Opé MS0,01% (fichier 3006)

regress logdealpercapita logWGI logr logt logG logn logd

      Source |       SS       df       MS              Number of obs =      62
-------------+------------------------------           F(  6,    55) =    2.47
       Model |  43.3889068     6  7.23148446            Prob > F      =  0.0347
    Residual |  161.084493    55  2.92880897            R-squared     =  0.2122
-------------+------------------------------           Adj R-squared =  0.1263
       Total |    204.4734    61  3.35202295            Root MSE      =  1.7114

------------------------------------------------------------------------------
logdealper~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      logWGI |   .9637982   .9852054     0.98   0.332    -1.010597    2.938194
        logr |   .0208075   .1490171     0.14   0.889    -.2778295    .3194445
        logt |   .7051853   .2890992     2.44   0.018     .1258175    1.284553
        logG |   .8698172   .4690833     1.85   0.069    -.0702468    1.809881
        logn |  -.5503528   .6289577    -0.88   0.385    -1.810812    .7101066
        logd |  -.2894563   .2476026    -1.17   0.247     -.785663    .2067504
       _cons |  -1.027748   3.319639    -0.31   0.758    -7.680453    5.624957
```

All deals: regression 1c

```
ALL DEALS MS0,01% (fichier 3006)

regress logdealpercapita logWGI logr logt logG logn logd

      Source |       SS       df       MS              Number of obs =     133
-------------+------------------------------           F(  6,   126) =    8.44
       Model |  130.733511     6  21.7889185            Prob > F      =  0.0000
    Residual |  325.166005   126  2.58068258            R-squared     =  0.2868
-------------+------------------------------           Adj R-squared =  0.2528
       Total |  455.899516   132  3.45378421            Root MSE      =  1.6065

------------------------------------------------------------------------------
logdealper~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      logWGI |   .6588887   .6031358     1.09   0.277    -.5346993    1.852477
        logr |   .2185715   .0403007     5.42   0.000     .1388177    .2983254
        logt |   .0094307   .1053074     0.09   0.929    -.1989695    .2178309
        logG |    1.03331   .3252487     3.18   0.002     .3896524    1.676968
        logn |   -.166899   .3739995    -0.45   0.656     -.907033     .573235
        logd |  -.1832389    .149464    -1.23   0.222    -.4790236    .1125459
       _cons |   -3.45805   2.148824    -1.61   0.110    -7.710509    .7944098
```

Regression 2 – Results

Licences: regression 2a

```
. regress logdealpercapita logG logn logr logm logu logWGI

      Source |       SS       df       MS              Number of obs =      71
-------------+------------------------------           F(  6,    64) =    3.51
       Model |  42.1340044     6  7.02233406            Prob > F      =  0.0046
    Residual |  127.976868    64  1.99963856            R-squared     =  0.2477
-------------+------------------------------           Adj R-squared =  0.1772
       Total |  170.110872    70  2.43015531            Root MSE      =  1.4141

------------------------------------------------------------------------------
logdealper~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        logG |   .6353505   .4585492     1.39   0.171    -.2807068    1.551408
        logn |  -.9423376   .4339843    -2.17   0.034    -1.809321   -.0753542
        logr |   .2330207     .0743     3.14   0.003     .0845894    .3814521
        logm |  -.0649293   .1082679    -0.60   0.551    -.2812194    .1513607
        logu |   1.197905   .6195851     1.93   0.058     -.039859    2.435668
       logWGI |   .1223045   .7420142     0.16   0.870    -1.360039    1.604648
       _cons |   .6136498   3.383008     0.18   0.857    -6.144686    7.371986
------------------------------------------------------------------------------
```

Operators: regression 2b

```
. regress logdealpercapita logG logn logr logm logu logWGI

      Source |       SS       df       MS              Number of obs =      62
-------------+------------------------------           F(  6,    55) =    2.48
       Model |  43.5059014     6  7.25098356            Prob > F      =  0.0342
    Residual |  160.967499    55  2.92668179            R-squared     =  0.2128
-------------+------------------------------           Adj R-squared =  0.1269
       Total |    204.4734    61  3.35202295            Root MSE      =  1.7108

------------------------------------------------------------------------------
logdealper~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        logG |   1.142139   .5301467     2.15   0.036     .0797013    2.204577
        logn |  -.6160949   .6121826    -1.01   0.319    -1.842936    .6107465
        logr |   .0066664   .1481334     0.05   0.964    -.2901995    .3035323
        logm |   .6331553    .277614     2.28   0.026     .0768044    1.189506
        logu |  -.7974118   .6927258    -1.15   0.255    -2.185665    .5908417
       logWGI |   .2607608   .9774019     0.27   0.791    -1.697996    2.219518
       _cons |  -3.848142   3.802139    -1.01   0.316     -11.4678    3.771514
------------------------------------------------------------------------------
```

All deals: regression 2c

```
regress logdealpercapita logWGI logr logm logG logn logu

      Source |       SS       df       MS              Number of obs =     133
-------------+------------------------------           F(  6,   126) =    6.35
       Model |  105.877458     6  17.646243             Prob > F      =  0.0000
    Residual |  350.022058   126  2.77795284            R-squared     =  0.2322
-------------+------------------------------           Adj R-squared =  0.1957
       Total |  455.899516   132  3.45378421            Root MSE      =  1.6667

------------------------------------------------------------------------------
logdealper~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      logWGI |   .5256819   .6117804     0.86   0.392    -.6850135    1.736377
        logr |    .785691   .1753197     4.48   0.000     .4387385    1.132643
        logm |   .0769329   .1069709     0.72   0.473    -.1347592    .2886251
        logG |   1.012559   .3684231     2.75   0.007     .2834603    1.741658
        logn |  -.1974179   .3628186    -0.54   0.587    -.9154253    .5205896
        logu |  -.2679417   .4673751    -0.57   0.567    -1.192863    .6569799
       _cons |  -3.369972   2.612723    -1.29   0.199    -8.540473    1.800529
------------------------------------------------------------------------------
```

Regression 3 – Results

Licences: regression 3a

```
.
. regress logdealpercapita logG logn logr logm logu logWGI logp

      Source |       SS       df       MS              Number of obs =      71
-------------+------------------------------           F(  7,    63) =    3.69
       Model |  49.4933294     7  7.07047563             Prob > F      =  0.0021
    Residual |  120.617543    63  1.91456417            R-squared     =  0.2909
-------------+------------------------------           Adj R-squared =  0.2122
       Total |  170.110872    70  2.43015531            Root MSE      =  1.3837

------------------------------------------------------------------------------
logdealper~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        logG |   .8479538   .4616065     1.84   0.071    -.0744933    1.770401
        logn |  -.2297169   .5589663    -0.41   0.682    -1.346722    .8872881
        logr |    .20475   .0741185     2.76   0.008      .056636    .3528639
        logm |  -.1169659   .1092139    -1.07   0.288    -.3352125    .1012808
        logu |   .7549848   .6469853     1.17   0.248    -.5379122    2.047882
      logWGI |   .1740592   .7265379     0.24   0.811    -1.277811    1.625929
        logp |  -.3905096   .1991809    -1.96   0.054    -.7885408    .0075217
       _cons |   4.133995   3.765885     1.10   0.276    -3.391524    11.65952
------------------------------------------------------------------------------
```

Operators: regression 3b

```
. regress  logdealpercapita logG logn logm logu logWGI logp logr

      Source |       SS       df       MS              Number of obs =      62
-------------+------------------------------           F(  7,    54) =    2.09
       Model |  43.6044006     7  6.22920009            Prob > F      =  0.0602
    Residual |  160.868999    54  2.97905555            R-squared     =  0.2133
-------------+------------------------------           Adj R-squared =  0.1113
       Total |    204.4734    61  3.35202295            Root MSE      =   1.726

------------------------------------------------------------------------------
logdealper~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        logG |   1.124788   .5433146     2.07   0.043      .0355075    2.214068
        logn |  -.6816072   .7150381    -0.95   0.345     -2.115172    .7519578
        logm |   .6339109   .2801178     2.26   0.028      .0723085    1.195513
        logu |  -.7543649   .7379027    -1.02   0.311     -2.233771    .7250409
      logWGI |   .2876872   .9971651     0.29   0.774     -1.711509    2.286883
        logp |   .0521637   .2868742     0.18   0.856     -.5229844    .6273119
        logr |   .0092479   .1501257     0.06   0.951     -.2917361    .3102319
       _cons |  -4.491846   5.219856    -0.86   0.393     -14.95703    5.973335
------------------------------------------------------------------------------
```

All deals: regression 3c

```
. regress logdealpercapita logG logn logr logm logu logWGI logp

      Source |       SS       df       MS              Number of obs =     133
-------------+------------------------------           F(  7,   125) =    7.21
       Model |  131.06647     7  18.7237814            Prob > F      =  0.0000
    Residual |  324.833047   125  2.59866437            R-squared     =  0.2875
-------------+------------------------------           Adj R-squared =  0.2476
       Total |  455.899516   132  3.45378421            Root MSE      =   1.612

------------------------------------------------------------------------------
logdealper~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        logG |   1.124784   .3624284     3.10   0.002      .4074936    1.842075
        logn |    -.02981   .4299194    -0.07   0.945     -.8806738    .8210539
        logr |   .2099914    .041007     5.12   0.000      .1288335    .2911493
        logm |  -.0118584   .1073972    -0.11   0.912     -.2244107    .2006939
        logu |  -.1953671   .4732698    -0.41   0.680     -1.132027    .7412925
      logWGI |   .3935852   .5925879     0.66   0.508     -.7792197     1.56639
        logp |  -.2197213   .1726999    -1.27   0.206     -.5615158    .1220732
       _cons |  -1.300355   3.174919    -0.41   0.683     -7.583913    4.983203
------------------------------------------------------------------------------
```

Regression 4 – Results

Licences: regression 4a

```
regress logdealpercapita logG logn logr logm logu logp

      Source |       SS       df       MS              Number of obs =      71
-------------+------------------------------           F(  6,    64) =    4.36
       Model |  49.3834422     6  8.2305737             Prob > F      =  0.0009
    Residual |   120.72743    64  1.88636609            R-squared     =  0.2903
-------------+------------------------------           Adj R-squared =  0.2238
       Total |  170.110872    70  2.43015531            Root MSE      =  1.3735

------------------------------------------------------------------------------
logdealper~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        logG |   .8433594    .457799     1.84   0.070    -.0711993    1.757918
        logn |  -.2631452     .53727    -0.49   0.626    -1.336465    .8101751
        logr |   .2073405   .0727835     2.85   0.006     .0619387    .3527423
        logm |  -.1097843   .1042432    -1.05   0.296    -.3180341    .0984655
        logu |     .77632   .6360904     1.22   0.227    -.4944166    2.047057
        logp |  -.3887758   .1975781    -1.97   0.053    -.7834835    .0059319
       _cons |   4.372096   3.605526     1.21   0.230     -2.83077    11.57496
```

Operators: regression 4b

```
. regress logdealpercapita logG logn logr logm logu logp

      Source |       SS       df       MS              Number of obs =      62
-------------+------------------------------           F(  6,    55) =    2.47
       Model |  43.3564383     6  7.22607305             Prob > F      =  0.0348
    Residual |  161.116962    55   2.9293993            R-squared     =  0.2120
-------------+------------------------------           Adj R-squared =  0.1261
       Total |    204.4734    61  3.35202295            Root MSE      =  1.7115

------------------------------------------------------------------------------
logdealper~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        logG |   1.134394   .5377547     2.11   0.039     .0567099    2.212079
        logn |  -.6450603   .6978379    -0.92   0.359    -2.043559     .753438
        logr |   .0050437   .1481663     0.03   0.973    -.2918882    .3019755
        logm |   .6352464   .2777355     2.29   0.026      .078652    1.191841
        logu |  -.8234863   .6920842    -1.19   0.239    -2.210454    .5634814
        logp |    .039873   .2813191     0.14   0.888     -.523903    .6036489
       _cons |   -4.25728   5.112995    -0.83   0.409    -14.50395     5.98939
------------------------------------------------------------------------------
```

All deals: regression 4c

```
. regress logdealpercapita logG logn logr logm logu logp

      Source |       SS       df       MS              Number of obs =     133
-------------+------------------------------           F(  6,   126) =    8.37
       Model |  129.920106     6  21.6533511            Prob > F      =  0.0000
    Residual |   325.97941   126  2.58713817           R-squared     =  0.2850
-------------+------------------------------           Adj R-squared =  0.2509
       Total |  455.899516   132  3.45378421           Root MSE      =  1.6085

------------------------------------------------------------------------------
logdealper~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        logG |    1.126232   .3616173     3.11   0.002     .4106022    1.841862
        logn |    -.027839   .4289547    -0.06   0.948    -.8767277    .8210498
        logr |    .2077685   .0407794     5.09   0.000     .1270672    .2884698
        logm |    .0003044   .1055894     0.00   0.998     -.208654    .2092628
        logu |   -.2440115   .4665303    -0.52   0.602    -1.167261    .6792383
        logp |   -.2303734   .1715718    -1.34   0.182     -.569909    .1091622
       _cons |   -.8696838   3.101098    -0.28   0.780    -7.006665    5.267298
------------------------------------------------------------------------------
```

Regression 5 - Results

Licences: regression 5a

```
regress logdealpercapita logG logr logm logu logp

      Source |       SS       df       MS              Number of obs =      71
-------------+------------------------------           F(  5,    65) =    5.25
       Model |  48.9309287     5  9.78618575            Prob > F      =  0.0004
    Residual |  121.179943    65  1.86430682           R-squared     =  0.2876
-------------+------------------------------           Adj R-squared =  0.2328
       Total |  170.110872    70  2.43015531           Root MSE      =  1.3654

------------------------------------------------------------------------------
logdealper~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        logG |   .9021526   .4391903     2.05   0.044      .025029    1.779276
        logr |   .2054769   .0722578     2.84   0.006     .0611682    .3497856
        logm |  -.1321322   .0931772    -1.42   0.161    -.3182199    .0539555
        logu |    .602213   .5243968     1.15   0.255    -.4450798    1.649506
        logp |   -.452895   .1471143    -3.08   0.003    -.7467025   -.1590875
       _cons |   4.513118   3.572935     1.26   0.211    -2.622526    11.64876
------------------------------------------------------------------------------
```

Operators: regression 5b

```
. regress logdealpercapita logG logr logm logu logp

      Source |       SS       df       MS              Number of obs =      62
-------------+------------------------------           F(  5,    56) =    2.80
       Model |  40.8533848     5  8.17067696            Prob > F      =  0.0253
    Residual |  163.620015    56  2.92178599            R-squared     =  0.1998
-------------+------------------------------           Adj R-squared =  0.1284
       Total |    204.4734    61  3.35202295            Root MSE      =  1.7093

------------------------------------------------------------------------------
logdealper~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        logG |    1.20608   .5314414     2.27   0.027     .1414752    2.270685
        logr |   .0369221   .1439095     0.26   0.798    -.2513633    .3252076
        logm |   .5364783   .2560263     2.10   0.041     .0235959    1.049361
        logu |  -.8759048   .6888601    -1.27   0.209    -2.255857    .5040479
        logp |  -.0877237   .2448065    -0.36   0.721      -.57813    .4026825
       _cons |  -3.583381   5.054172    -0.71   0.481     -13.7081    6.541343
------------------------------------------------------------------------------
```

All deals: regression 5c

```
. regress logdealpercapita logG logr logm logu logp

      Source |       SS       df       MS              Number of obs =     133
-------------+------------------------------           F(  5,   127) =   10.12
       Model |  129.909209     5  25.9818419            Prob > F      =  0.0000
    Residual |  325.990307   127  2.56685281            R-squared     =  0.2850
-------------+------------------------------           Adj R-squared =  0.2568
       Total |  455.899516   132  3.45378421            Root MSE      =  1.6021

------------------------------------------------------------------------------
logdealper~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        logG |   1.131421    .351283     3.22   0.002     .4362952    1.826546
        logr |   .2078233   .0406106     5.12   0.000     .1274623    .2881842
        logm |  -.0026732   .0947268    -0.03   0.978    -.1901204    .1847739
        logu |  -.2546375   .4351399    -0.59   0.559    -1.115701    .6064258
        logp |  -.2371958   .1350625    -1.76   0.081    -.5044602    .0300685
       _cons |  -.8398226   3.054727    -0.27   0.784    -6.884576    5.204931
------------------------------------------------------------------------------
```

Regression 6 – Results

All deals – Regression 6c

```
. regress logdealpercapita logG logr logm logp fixincl1mobileonly2 Ptrolier2non1 Islamique2non1 landlock_n

      Source |       SS       df       MS              Number of obs =     133
-------------+------------------------------           F(  8,   124) =    7.67
       Model |  150.859369     8  18.8574212            Prob > F      =  0.0000
    Residual |  305.040147   124  2.46000118           R-squared     =  0.3309
-------------+------------------------------           Adj R-squared =  0.2877
       Total |  455.899516   132  3.45378421           Root MSE      =  1.5684

------------------------------------------------------------------------------
logdealpercapita |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------+------------------------------------------------------------
             logG |    1.13068   .3804711     2.97   0.004     .3776211    1.883739
             logr |     .17909   .0416402     4.30   0.000     .0966724    .2615076
             logm |   .0136857   .0940019     0.15   0.884    -.1723704    .1997418
             logp |  -.2751767   .1368493    -2.01   0.047    -.5460398   -.0043135
fixincl1mobileonly2 |  -1.650148   .6302047    -2.62   0.010      -2.8975   -.4027967
      Ptrolier2non1 |   .1672703   .3219586     0.52   0.604    -.4699759    .8045165
    Islamique2non1 |  -.2323004   .3600056    -0.65   0.520    -.9448524    .4802516
         landlock_n |  -.4930471   .3456733    -1.43   0.156    -1.177231    .1911371
              _cons |   4.151071   3.543216     1.17   0.244    -2.861946    11.16409
------------------------------------------------------------------------------
```

All deals – Regression 6c without extreme points

```
. regress logdealpercapita logG logr logm logp landlock_n Ptrolier2non1 Islamique2non1 fixincl1mobileonly2

      Source |       SS       df       MS              Number of obs =     130
-------------+------------------------------           F(  8,   121) =    6.55
       Model |  126.828699     8  15.8535874            Prob > F      =  0.0000
    Residual |  292.924883   121  2.4208668            R-squared     =  0.3022
-------------+------------------------------           Adj R-squared =  0.2560
       Total |  419.753583   129  3.25390374           Root MSE      =  1.5559

------------------------------------------------------------------------------
logdealpercapita |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------+------------------------------------------------------------
             logG |   .9530036   .3893076     2.45   0.016     .1822665    1.723741
             logr |   .1826131   .0417876     4.37   0.000     .0998835    .2653427
             logm |  -.0037163   .0937099    -0.04   0.968    -.1892397    .1818072
             logp |  -.2180165   .1397918    -1.56   0.121    -.4947712    .0587383
       landlock_n |  -.3979173   .3462827    -1.15   0.253    -1.083475    .2876406
    Ptrolier2non1 |   .1743271   .3238778     0.54   0.591    -.4668745    .8155286
   Islamique2non1 |  -.1393283   .3650934    -0.38   0.703     -.862127    .5834704
fixincl1mobileonly2 |  -1.693585   .6257049    -2.71   0.008    -2.932333   -.4548371
             _cons |   3.907306   3.526813     1.11   0.270    -3.074951    10.88956
------------------------------------------------------------------------------
```

Regression 7 - Results

All deals - Regression 7c

```
. regress logdealpercapita logG logr logm EFI_n landlock_n Ptrolier2non1 Islamique2non1  fixincl1mobileonly2

      Source |       SS       df       MS              Number of obs =     124
-------------+------------------------------           F(  8,   115) =    8.87
       Model |  155.225805     8  19.4032256            Prob > F      =  0.0000
    Residual |  251.519379   115  2.18712503           R-squared     =  0.3816
-------------+------------------------------           Adj R-squared =  0.3386
       Total |  406.745184   123  3.30687141           Root MSE      =  1.4789

------------------------------------------------------------------------------
logdealpercapita |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------+------------------------------------------------------------
             logG |   1.127418   .4268044     2.64   0.009      .2820006    1.972835
             logr |   .2409761   .0402946     5.98   0.000      .1611603    .3207918
             logm |  -.0377589   .0920932    -0.41   0.683     -.2201778     .14466
            EFI_n |  -.5358311   2.839221    -0.19   0.851     -6.159782    5.08812
       landlock_n |  -.5356894   .3816522    -1.40   0.163     -1.291669    .2202902
     Ptrolier2non1 |    .127292   .3192805     0.40   0.691     -.5051412    .7597251
     Islamique2non1 |  -.1089851   .3725566    -0.29   0.770     -.8469481    .6289779
fixincl1mobileonly2 |  -1.378627   .5965956    -2.31   0.023     -2.560368   -.196886
              _cons |  -.4388599    3.22523    -0.14   0.892      -6.82742    5.9497
------------------------------------------------------------------------------
```

All deals - Regression 7c without extreme points

```
. regress  logdealpercapita logG logr logm EFI_n landlock_n Ptrolier2non1 Islamique2non1  fixincl1mobileonly2

      Source |       SS       df       MS              Number of obs =     121
-------------+------------------------------           F(  8,   112) =    8.08
       Model |  136.136648     8  17.017081            Prob > F      =  0.0000
    Residual |  236.023367   112  2.10735149           R-squared     =  0.3658
-------------+------------------------------           Adj R-squared =  0.3205
       Total |  372.160015   120  3.10133346           Root MSE      =  1.4517

------------------------------------------------------------------------------
logdealpercapita |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------+------------------------------------------------------------
             logG |    .842054    .438425     1.92   0.057     -.026629    1.710737
             logr |   .2422838   .0398366     6.08   0.000      .1633527     .321215
             logm |  -.0557855   .0906586    -0.62   0.540     -.2354139    .1238428
            EFI_n |   .2629131   2.881963     0.09   0.927     -5.447327    5.973153
       landlock_n |  -.3873565   .3798019    -1.02   0.310     -1.139885    .3651722
     Ptrolier2non1 |   .1640155   .3162771     0.52   0.605      -.462647    .7906779
     Islamique2non1 |   -.075232   .3710352    -0.20   0.840     -.8103906    .6599267
fixincl1mobileonly2 |  -1.460612   .5865368    -2.49   0.014      -2.62276   -.2984644
              _cons |   .4857966   3.184552     0.15   0.879     -5.823986    6.795579
------------------------------------------------------------------------------
```

Regression 8 – Results

Licences: regression 8

```
. regress logdealpercapita logG logr logp

      Source |       SS       df       MS              Number of obs =      71
-------------+------------------------------           F(  3,    67) =    7.74
       Model |  43.7610046     3  14.5870015            Prob > F      =  0.0002
    Residual |  126.349867    67  1.88581892           R-squared     =  0.2572
-------------+------------------------------           Adj R-squared =  0.2240
       Total |  170.110872    70  2.43015531           Root MSE      =  1.3733

------------------------------------------------------------------------------
logdealper~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        logG |    .775729   .3723178     2.08   0.041     .0325796    1.518878
        logr |   .1874306   .0707803     2.65   0.010     .0461525    .3287086
        logp |  -.4609166   .1473903    -3.13   0.003     -.755109   -.1667243
       _cons |    5.01234   2.986049     1.68   0.098    -.9478384    10.97252
------------------------------------------------------------------------------
```

Licences: regression 8 DJTTEL

```
.
. regress logdealpercapita logG logr logp IndiceDJTTELCR

      Source |       SS       df       MS              Number of obs =      71
-------------+------------------------------           F(  4,    66) =    6.56
       Model |  48.3857284     4  12.0964321            Prob > F      =  0.0002
    Residual |  121.725144    66  1.84432036           R-squared     =  0.2844
-------------+------------------------------           Adj R-squared =  0.2411
       Total |  170.110872    70  2.43015531           Root MSE      =  1.3581

------------------------------------------------------------------------------
logdealperca~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------+----------------------------------------------------------------
          logG |   .6977636   .3714758     1.88   0.065    -.0439117    1.439439
          logr |   .1825875    .070064     2.61   0.011     .0427002    .3224747
          logp |   -.463526   .1457689    -3.18   0.002    -.7545631   -.1724889
IndiceDJTTELCR |   .2383912   .1505447     1.58   0.118     -.062181    .5389635
         _cons |   5.443649   2.965546     1.84   0.071    -.4772538    11.36455
------------------------------------------------------------------------------
```

Licences: regression 8 landlock

```
. generate logdealpecapita=log(dealpercapita)

. generate logG=log(GDPpercapita)

. generate logr=log(marketshare)

. generate logp=log(pop)

. generate landlock_n=real(landlock)

. regress logdealpecapita logG logr logp landlock_n

      Source |       SS       df       MS              Number of obs =      71
-------------+------------------------------           F(  4,    66) =    5.74
       Model |  43.9086537     4  10.9771634            Prob > F      =  0.0005
    Residual |  126.202218    66  1.91215482           R-squared     =  0.2581
-------------+------------------------------           Adj R-squared =  0.2132
       Total |  170.110872    70  2.43015531           Root MSE      =  1.3828

------------------------------------------------------------------------------
logdealpec~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        logG |   .7291813   .4106295     1.78   0.080    -.090667    1.549029
        logr |   .1875334   .0712738     2.63   0.011     .0452307    .3298361
        logp |  -.4695745   .1516511    -3.10   0.003    -.7723558   -.1667933
  landlock_n |   .1265427   .4553899     0.28   0.782    -.7826726    1.035758
       _cons |   5.202058   3.083366     1.69   0.096    -.9540796    11.3582
```

Licences: regressions 8oil and 8islam

```
. regress  logdealpercapita logG logr logp  Ptrolier2non1

      Source |       SS       df       MS              Number of obs =      71
-------------+------------------------------           F(  4,    66) =    6.21
       Model |  46.5266326     4  11.6316581            Prob > F      =  0.0003
    Residual |  123.584239    66  1.87248848            R-squared     =  0.2735
-------------+------------------------------           Adj R-squared =  0.2295
       Total |  170.110872    70  2.43015531            Root MSE      =  1.3684

------------------------------------------------------------------------------
logdealperc~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------+---------------------------------------------------------------
         logG |   .6491749   .3853367     1.68   0.097    -.1201746    1.418524
         logr |   .1814806   .0706994     2.57   0.013     .0403247    .3226365
         logp |  -.5074087    .151769    -3.34   0.001    -.8104252   -.2043922
Ptrolier2non1 |   .4310917   .3547173     1.22   0.229    -.2771242    1.139308
        _cons |   5.800757   3.045377     1.90   0.061    -.2795332    11.88105
------------------------------------------------------------------------------

. regress  logdealpercapita logG logr logp  Islamique2non1

      Source |       SS       df       MS              Number of obs =      71
-------------+------------------------------           F(  4,    66) =    6.05
       Model |  45.6216174     4  11.4054044            Prob > F      =  0.0003
    Residual |  124.489255    66  1.88620083            R-squared     =  0.2682
-------------+------------------------------           Adj R-squared =  0.2238
       Total |  170.110872    70  2.43015531            Root MSE      =  1.3734

------------------------------------------------------------------------------
logdealperca~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------+--------------------------------------------------------------
          logG |   .7738028   .3723606     2.08   0.042     .0303609    1.517245
          logr |   .1962713   .0713449     2.75   0.008     .0538266    .3387161
          logp |   -.465598   .1474806    -3.16   0.002    -.7600526   -.1711435
Islamique2non1 |   .3271735   .3294156     0.99   0.324    -.3305259     .984873
         _cons |   4.692508   3.003663     1.56   0.123    -1.304499    10.68951
------------------------------------------------------------------------------
```

Regression 9 - Results

```
regress logdealpercapita logG logm landlock_n fixincl1mobileonly2

      Source |       SS       df       MS              Number of obs =      62
-------------+------------------------------           F(  4,    57) =    5.83
       Model |  59.3929208     4  14.8482302            Prob > F      =  0.0005
    Residual |  145.080479    57  2.54527157            R-squared     =  0.2905
-------------+------------------------------           Adj R-squared =  0.2407
       Total |    204.4734    61  3.35202295            Root MSE      =  1.5954

------------------------------------------------------------------------------
logdealpercapita |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------+------------------------------------------------------------
            logG |    1.270285   .4662985     2.72   0.009     .3365382    2.204031
            logm |    .5590762   .2342496     2.39   0.020     .0899994    1.028153
       landlock_n |   -1.209426   .4797254    -2.52   0.015     -2.17006   -.2487927
fixincl1mobileonly2 |   -1.103721   .6418646    -1.72   0.091    -2.389032    .1815911
            _cons |   -.380101   3.045761    -0.12   0.901    -6.479132    5.71893
------------------------------------------------------------------------------
```

Operators: regression 9DJTTEL

```
regress logdealpercapita logG logm landlock_n fixincl1mobileonly2 IndiceDJTTELCR

      Source |       SS       df       MS              Number of obs =      62
-------------+------------------------------           F(  5,    56) =    4.70
       Model |  60.4560719     5  12.0912144            Prob > F      =  0.0012
    Residual |  144.017328    56    2.571738            R-squared     =  0.2957
-------------+------------------------------           Adj R-squared =  0.2328
       Total |    204.4734    61  3.35202295            Root MSE      =  1.6037

------------------------------------------------------------------------------
logdealpercapita |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------+------------------------------------------------------------
            logG |    1.263537   .4688341     2.70   0.009     .3243491    2.202724
            logm |    .5590534   .2354644     2.37   0.021     .0873616    1.030745
       landlock_n |   -1.201463   .4823721    -2.49   0.016    -2.167771   -.2351558
fixincl1mobileonly2 |   -1.158196   .6507324    -1.78   0.081    -2.461769    .1453777
    IndiceDJTTELCR |   -.1470913    .228772    -0.64   0.523    -.6053766    .3111941
            _cons |   -.2623911   3.067024    -0.09   0.932    -6.406379    5.881596
------------------------------------------------------------------------------
```

Regression 10 - Results

```
. generate logG=log(GDPpercapita)

. generate logm=log(marketmaturity)

. generate landlock_n=real(landlock)

. generate logdealpercapita=log(dealpercapita)

.
.
. regress  logdealpercapita logG logm
```

Source	SS	df	MS		
Model	35.8982385	2	17.9491192	Number of obs	= 62
Residual	168.575162	59	2.85720613	F(2, 59)	= 6.28
Total	204.4734	61	3.35202295	Prob > F	= 0.0034
				R-squared	= 0.1756
				Adj R-squared	= 0.1476
				Root MSE	= 1.6903

logdealper~a	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
logG	.8566885	.4534316	1.89	0.064	-.050626	1.764003
logm	.508449	.2472812	2.06	0.044	.0136404	1.003258
_cons	-2.167173	2.870213	-0.76	0.453	-7.910457	3.576111

Operators : regression 10-landlock

```
. regress logdealpercapita logG logm landlock_n

      Source |       SS       df       MS              Number of obs =      62
-------------+------------------------------           F(  3,    58) =    6.57
       Model |  51.8668975     3  17.2889658            Prob > F      =  0.0007
    Residual |  152.606503    58  2.63114659           R-squared     =  0.2537
-------------+------------------------------           Adj R-squared =  0.2151
       Total |    204.4734    61  3.35202295           Root MSE      =  1.6221

------------------------------------------------------------------------------
logdealper~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        logG |    1.315702   .4733383     2.78   0.007     .3682126    2.263192
        logm |    .5585827   .2381684     2.35   0.022     .0818369    1.035328
  landlock_n |   -1.201545   .4877287    -2.46   0.017    -2.17784    -.2252499
       _cons |    -2.74122   2.764169    -0.99   0.325    -8.274305    2.791865
------------------------------------------------------------------------------
```

Operators : regression 10-oil

```
. regress logdealpercapita logG logm  Ptrolier2non1

      Source |       SS       df       MS              Number of obs =      62
-------------+------------------------------           F(  3,    58) =    4.62
       Model |  39.4076847     3  13.1358949            Prob > F      =  0.0058
    Residual |  165.065715    58  2.84596061           R-squared     =  0.1927
-------------+------------------------------           Adj R-squared =  0.1510
       Total |    204.4734    61  3.35202295           Root MSE      =   1.687

------------------------------------------------------------------------------
logdealperc~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------+----------------------------------------------------------------
         logG |    1.146063   .5222046     2.19   0.032     .1007574    2.191369
         logm |    .4976571   .2469854     2.01   0.049     .0032621    .9920521
Ptrolier2non1 |   -.5567888   .5014015    -1.11   0.271    -1.560453    .4468754
        _cons |   -3.036967   2.969716    -1.02   0.311    -8.981499    2.907566
------------------------------------------------------------------------------
```

Operators : regression 10-islam

```
. regress logdealpercapita logG logm  Islamique2non1

      Source |       SS       df       MS              Number of obs =      62
-------------+------------------------------           F(  3,    58) =    4.14
       Model |  36.0387032     3  12.0129011            Prob > F      =  0.0100
    Residual |  168.434697    58   2.9040465            R-squared     =  0.1763
-------------+------------------------------           Adj R-squared =  0.1336
       Total |    204.4734    61  3.35202295            Root MSE      =  1.7041

------------------------------------------------------------------------------
logdealperca~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------+--------------------------------------------------------------
          logG |   .8399783   .4634045     1.81   0.075    -.0876266    1.767583
          logm |   .5017652   .2511455     2.00   0.050    -.0009571    1.004488
Islamique2non1 |  -.1027906   .4673817    -0.22   0.827    -1.038357    .8327755
         _cons |  -1.944046   3.066345    -0.63   0.529    -8.082003     4.19391
------------------------------------------------------------------------------
```

Operators : regression 10-fix

```
. regress logdealpercapita logG logm   fixincl1mobileonly2

      Source |       SS       df       MS              Number of obs =      62
-------------+------------------------------           F(  3,    58) =    5.18
       Model |  43.2155678     3  14.4051893            Prob > F      =  0.0031
    Residual |  161.257832    58  2.78030745            R-squared     =  0.2114
-------------+------------------------------           Adj R-squared =  0.1706
       Total |    204.4734    61  3.35202295            Root MSE      =  1.6674

------------------------------------------------------------------------------
  logdealpercapita |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------+--------------------------------------------------------------
               logG |   .8089387   .4482555     1.80   0.076    -.0883422    1.70622
               logm |   .5086114   .2439309     2.09   0.041     .0203306    .9968921
fixincl1mobileonly2 |   -1.08826   .6708153    -1.62   0.110    -2.431043    .2545223
              _cons |   .1645862   3.175263     0.05   0.959    -6.191394    6.520566
------------------------------------------------------------------------------
```

Regression 5 - Results

All deals : regression 5c

```
. regress logdealpercapita logG logr logm logu logp

      Source |       SS       df       MS              Number of obs =     133
-------------+------------------------------           F(  5,   127) =   10.12
       Model |  129.909209     5  25.9818419            Prob > F      =  0.0000
    Residual |  325.990307   127  2.56685281           R-squared     =  0.2850
-------------+------------------------------           Adj R-squared =  0.2568
       Total |  455.899516   132  3.45378421           Root MSE      =  1.6021

------------------------------------------------------------------------------
logdealper~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        logG |    1.131421    .351283     3.22   0.002     .4362952    1.826546
        logr |    .2078233   .0406106     5.12   0.000     .1274623    .2881842
        logm |   -.0026732   .0947268    -0.03   0.978    -.1901204    .1847739
        logu |   -.2546375   .4351399    -0.59   0.559    -1.115701    .6064258
        logp |   -.2371958   .1350625    -1.76   0.081    -.5044602    .0300685
       _cons |   -.8398226   3.054727    -0.27   0.784    -6.884576    5.204931
------------------------------------------------------------------------------
```

Regression 11 - Results

All deals : regression 11

```
. regress  logdealpercapita logG logr

      Source |       SS       df       MS              Number of obs =     133
-------------+------------------------------           F(  2,   130) =   23.57
       Model |  121.340354     2  60.6701771            Prob > F      =  0.0000
    Residual |  334.559162   130  2.57353202           R-squared     =  0.2662
-------------+------------------------------           Adj R-squared =  0.2549
       Total |  455.899516   132  3.45378421           Root MSE      =  1.6042

------------------------------------------------------------------------------
logdealper~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        logG |   .9796318   .2920989     3.35   0.001      .401749    1.557515
        logr |   .2197712   .0360621     6.09   0.000     .1484266    .2911158
       _cons |  -3.552273   1.708789    -2.08   0.040    -6.932908   -.1716379
------------------------------------------------------------------------------
```

All deals : regressions 11-islam and 11-fix

```
. regress  logdealpercapita logG logr Islamique2non1

      Source |       SS       df       MS              Number of obs =     133
-------------+------------------------------           F(  3,   129) =   15.65
       Model |  121.635737     3  40.5452456            Prob > F      =  0.0000
    Residual |  334.263779   129  2.59119209           R-squared     =  0.2668
-------------+------------------------------           Adj R-squared =  0.2498
       Total |  455.899516   132  3.45378421           Root MSE      =  1.6097

------------------------------------------------------------------------------
logdealperca~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------+--------------------------------------------------------------
          logG |   .9905905   .2948911     3.36   0.001     .4071412     1.57404
          logr |   .2222094   .0368992     6.02   0.000     .1492034    .2952154
Islamique2non1 |   .0978428    .289792     0.34   0.736    -.4755177    .6712033
         _cons |  -3.741947   1.804326    -2.07   0.040    -7.31185    -.1720434
------------------------------------------------------------------------------

.
.
. regress  logdealpercapita logG logr fixincl1mobileonly2

      Source |       SS       df       MS              Number of obs =     133
-------------+------------------------------           F(  3,   129) =   18.08
       Model |  134.926666     3  44.9755552            Prob > F      =  0.0000
    Residual |  320.972851   129  2.48816163           R-squared     =  0.2960
-------------+------------------------------           Adj R-squared =  0.2796
       Total |  455.899516   132  3.45378421           Root MSE      =  1.5774

------------------------------------------------------------------------------
  logdealpercapita |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------+--------------------------------------------------------------
              logG |   .9414855   .2876768     3.27   0.001     .3723099    1.510661
              logr |   .2085844   .0357807     5.83   0.000     .1377914    .2793773
fixincl1mobileonly2 |  -1.446287   .6189321    -2.34   0.021    -2.67086    -.2217147
             _cons |  -.5740442   2.108909    -0.27   0.786    -4.746573    3.598484
------------------------------------------------------------------------------
```

All deals : regressions 11-landlock

```
. generate logdealpecapita=log(dealpercapita)

. generate logG=log(GDPpercapita)

. generate logr=log(marketshare)

. generate landlock_n=real(landlock)

. regress  logdealpecapita logG logr landlock_n

      Source |       SS       df       MS              Number of obs =     133
-------------+------------------------------           F(  3,   129) =   17.18
       Model |  130.145613     3  43.3818711            Prob > F      =  0.0000
    Residual |  325.753903   129  2.52522405           R-squared     =  0.2855
-------------+------------------------------           Adj R-squared =  0.2689
       Total |  455.899516   132  3.45378421           Root MSE      =  1.5891

------------------------------------------------------------------------------
logdealpec~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        logG |   1.239283   .3210216     3.86   0.000     .6041334    1.874432
        logr |   .2082813   .0362481     5.75   0.000     .1365635    .2799991
  landlock_n |  -.6516139   .3489548    -1.87   0.064     -1.34203    .0388018
       _cons |  -3.996589   1.709317    -2.34   0.021    -7.378516   -.6146631
------------------------------------------------------------------------------
```

All deals : regressions 11-oil

```
. regress  logdealpercapita logG logr  Ptrolier2non1

      Source |       SS       df       MS              Number of obs =     133
-------------+------------------------------           F(  3,   129) =   15.66
       Model |  121.728208     3  40.5760694            Prob > F      =  0.0000
    Residual |  334.171308   129  2.59047525           R-squared     =  0.2670
-------------+------------------------------           Adj R-squared =  0.2500
       Total |  455.899516   132  3.45378421           Root MSE      =  1.6095

------------------------------------------------------------------------------
logdealperc~a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------+----------------------------------------------------------------
         logG |   1.030095   .3207679     3.21   0.002     .3954483    1.664742
         logr |   .2187682   .0362734     6.03   0.000     .1470004     .290536
Ptrolier2non1 |  -.1188495   .3071515    -0.39   0.699    -.7265563    .4888574
        _cons |  -3.668739   1.740626    -2.11   0.037    -7.112611   -.2248668
------------------------------------------------------------------------------
```

All deals : regression 11-fix-DJTTEL

```
. regress  logdealpercapita logG logr fixincl1mobileonly2 IndiceDJTTELCR

      Source |       SS       df       MS              Number of obs =     133
-------------+------------------------------           F(  4,   128) =   13.57
       Model |  135.784931     4  33.9462328            Prob > F      =  0.0000
    Residual |  320.114585   128   2.5008952            R-squared     =  0.2978
-------------+------------------------------           Adj R-squared =  0.2759
       Total |  455.899516   132  3.45378421            Root MSE      =  1.5814

------------------------------------------------------------------------------
logdealpercapita |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------+------------------------------------------------------------
             logG |   .9306986   .2889992     3.22   0.002     .3588643    1.502533
             logr |   .2104045   .0360064     5.84   0.000     .1391597    .2816494
fixincl1mobileonly2 |  -1.423623   .6217188    -2.29   0.024      -2.6538   -.193446
     IndiceDJTTELCR |   .0805965   .1375793     0.59   0.559    -.1916277    .3528208
            _cons |  -.5472958   2.114792    -0.26   0.796    -4.731773    3.637181
------------------------------------------------------------------------------
```

Regression 12 - Results

All deals - Regression 12

```
.
. regress logdealpercapita logG logr logm logp landlock_n Islamique2non1  fixincl1mobileonly2

      Source |       SS       df       MS              Number of obs =     133
-------------+------------------------------           F(  7,   125) =    8.77
       Model |  150.195362     7  21.4564803            Prob > F      =  0.0000
    Residual |  305.704154   125  2.44563323            R-squared     =  0.3294
-------------+------------------------------           Adj R-squared =  0.2919
       Total |  455.899516   132  3.45378421            Root MSE      =  1.5639

------------------------------------------------------------------------------
logdealpercapita |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------+------------------------------------------------------------
             logG |   1.188141   .3629767     3.27   0.001     .4697645    1.906517
             logr |   .1800824   .0414747     4.34   0.000     .0979988     .262166
             logm |   .0081036   .0931127     0.09   0.931     -.176178    .1923852
             logp |  -.2557517   .1312578    -1.95   0.054    -.5155272    .0040237
       landlock_n |  -.4648791   .3403965    -1.37   0.174    -1.138566    .2088078
     Islamique2non1 |  -.2612501    .354627    -0.74   0.463    -.9631009    .4406007
fixincl1mobileonly2 |  -1.603425   .6219308    -2.58   0.011    -2.834304   -.3725472
            _cons |   3.655595   3.402478     1.07   0.285    -3.078331    10.38952
------------------------------------------------------------------------------
```

Regression 13 - Results

All deals - Regression 13

```
. regress logdealpercapita logG logr logp fixincl1mobileonly2

      Source |       SS       df       MS              Number of obs =     133
-------------+------------------------------           F(  4,   128) =   14.74
       Model |  143.757032     4  35.939258             Prob > F      =  0.0000
    Residual |  312.142484   128  2.43861316            R-squared     =  0.3153
-------------+------------------------------           Adj R-squared =  0.2939
       Total |  455.899516   132  3.45378421            Root MSE      =  1.5616

------------------------------------------------------------------------------
logdealpercapita |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------+------------------------------------------------------------
            logG |    1.001789   .2865557     3.50   0.001     .4347895    1.568789
            logr |     .195059   .0361287     5.40   0.000     .1235723    .2665458
            logp |   -.2468557   .1297255    -1.90   0.059    -.5035396    .0098283
fixincl1mobileonly2 |  -1.509456   .6136371    -2.46   0.015    -2.723641   -.2952697
           _cons |    3.228386   2.889951     1.12   0.266    -2.489876    8.946648
------------------------------------------------------------------------------
```

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