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Computing an overall Index for regulatory reforms required in the fixed telecommunication segment over the world

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ABSTRACT: This paper provides a review and classification of the main regulatory reforms required in the fixed telecommunication segment. It also describes the methodology of the construction of a relevant measure of regulation. Precisely, we provide a description of the method of scoring of the individual regulatory reforms, as well as, the computation method of the overall regulatory index which aggregates the most applied regulatory reforms in the fixed telecom sector over the world. We collect data information from public sources including the regulatory data base of the International telecommunication Union (ITU) published in the year 2012 and contains regulatory information data for developed and developing countries in the world during the period from 2004 to 2011, as well as the database of the Plaut Economics. We complete the missing information data from the official reports that came from the regional and international organizations and the web sites of the National Regulatory Authorities (NRAs) of different countries considered. We are based on the scoring methodology of Zenhäeusern et al. (2007, 2012 a, 2012 b) to construct individual measures for the regulatory reforms adopted since the opening of telecommunication markets to competition. Our overall regulatory index, which aggregates these individual measures of regulatory reforms, permits to measure the intensity of regulation in the fixed telecom sector for 107 developed and developing countries[1] during the period of 2004-2011.

KEYWORDS: Privatization, Accounting and Functional separation, local loop Unbundling, Interconnection price and agreements, Regulatory autonomous decision.

1 INTRODUCTION

Several institutions published scores or indicators measuring telecom regulation reforms. The most used in empirical studies are the OECD Regulatory Index and the European Competitive Telecommunication Association (ECTA) Regulatory Scorecard published in 2006. For example, London Economics (2006) uses both the OECD and the ECTA indexes, and Heimeshoff (2007) uses the OECD index. However, there is a doubt regarding the quality of these scores and the ability of

[1] *Countries are: Albania, Algeria, Andorra, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahrain, Bangladesh, Barbados, Belarus, Belgium, Belize, Bosnia and Herzegovina, Botswana, Brazil, Brunei Darussalam, Bulgaria, Cambodia, Canada, Chile, China, Colombia, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Dominica, Ecuador, Egypt, Estonia, Finland, France, Georgia, Germany, Ghana, Greece, Grenada, Guatemala, Haiti, Honduras, Hungary, Iceland, India, Indonesia, Iraq, Ireland, Italy, Jamaica, Japan, Jordan, Kenya, Kyrgyz Republic, Latvia, Lebanon, Liechtenstein, Lithuania, Luxembourg, Malaysia, Maldives, Mali, Malta, Mexico, Monaco, Mongolia, Montenegro, Morocco, Mozambique, Namibia, Nepal, Netherlands, New Zealand, Nicaragua, Nigeria, Norway, Oman, Pakistan, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, Rwanda, Saudi Arabia, Serbia, Singapore, Slovenia, Spain, Sudan, Sweden, Switzerland, Thailand, Tunisia, Turkey, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Yemen, Zambia, Zimbabwe.*

these rating to measure regulation in telecom industry. According to Weeks and Williamson (2006), Edwards and Waverman (2006) and Zenhäusern et al. (2007), these scores are subjective, arbitrary weighting and mostly incorporate telecom market performances, which calls into question their use in empirical studies analyzing regulation-telecom market performances relationship. More recently, Zenhäusern et al. (2007) has constructed the Plaut Economics Regulation Index for 27 European countries over the period of 1997-2006. This data is publicly available since 2007, and then updated and extended to further include the period from 2007-2010 and other countries (Australia, Japan, Singapore, Switzerland and the USA). Compared to earlier existing index, Plaut Economics Regulation Index has the three following advantages:

- First, it consists of 41 indicators measuring different regulatory reforms introduced in telecom industry such as accounting and vertical separation, infrastructure sharing, the three kinds of local loop unbundling (full local loop unbundling, bitstream, sub-loop), interconnection regime etc.
- Second, the relative simplicity in coding regulation reform to construct indicator is another important advantage of Plaut Economics regulatory index. In general, these indicators are binary variables. Each one takes the value of « 1 » if corresponding regulatory reform is required in a given country for a given year and the value of « 0 » otherwise. Only the indicator for access pricing regime reform is not a binary variable. It takes value between « 0 » and « 1 », ranged from the least to the most severe regulation regime as follows. The value of « 0 » corresponds to the case where there is no control for access price. The value of « 0.5 » corresponds to the case where the regulator sets an access price that exceeds the marginal costs permitting some mark up for incumbent (e.g., price cap, rate of return, retail minus or benchmark access pricing model). The value of « 0.8 » corresponds to the case where the determination of access price follows Fully Distributed Cost (FDC) methodology. This last model of access pricing regime is considered more restrictive than regimes such as price cap or rate of return because it is based on cost, and therefore, it reduces the margin over the marginal cost earned by the infrastructure owner operator. The value of «1 » refers to the case where the model followed to price access is the Long Run Incremental costs (LRIC, LRAIC), which corresponds to the most severe access price regulation since it leads to price access at cost or let very small mark up over the cost for incumbent.
- Third, the weighting methodology is simple and clear. It simply consists in aggregating some or all indicators and then computing arithmetic means to construct sub-indexes or an overall index. Consequently, each indicator is equally weighted within the sub-index or the overall index.

Given the quality and the availability of Plaut Economics Regulation Index database, several recent empirical studies use it. We cite Friederiszick, Grajek and Röller (2008), Bauer and Shim (2012), Grajek and Röller (2012), Baccache, Brourreau and Gaudin (2013) and Briglauer, Ecker and Gugler (2013).

However, as noted above, Plaut Economics regulatory indicators are available only for 32 developed countries: 27 European countries, and others which are the following: the Australia, Japan, Singapore, Switzerland and the United States American (USA). In addition, these data are not updated for year 2011. Furthermore, regulatory indicators of Zenhäeusern et al. (2012 a, 2012 b) contain more items including questions relative to mobile sector. In consequence, to construct our regulatory data, only a part of the Plaut Economics Regulation database is used. In particular, this paper suggests computing an overall index for regulation in fixed telecommunication segment. For this purpose, we first compute individual measures for regulatory reforms adopted in the fixed telecom sector following the same methodology of scoring adopted by Zenhäeusern et al. (2012 a, 2012 b). Then, we add these measures to compute an overall index. Our measures for regulatory reforms concern 107 developed and developing countries during a period of eight years from 2004 to 2011. The different values, taken by the overall index, measure the intensity of regulation in the fixed telecom sector.

The rest of this paper is organized as follows. In section 2, we provide an extensive review of the regulatory reforms required in the fixed telecom segment. In section 3, we give a description of the methodology of collecting data information and scoring to construct the regulatory indicators and the overall index of regulation. In section 4, we conclude.

2 THE REGULATORY REFORMS IN THE FIXED TELECOM SEGMENT

In the beginning of 1990s, a large number of countries have partially or wholly privatized the historical public monopoly (the incumbent), and established an independent regulatory authority to prevent and control the discriminatory behaviors of the dominant operators in order to promote and ensure competition in the fixed telecommunication markets. The main focus of policy makers over the three last decades has consisted to reduce market power of incumbent firms through mandating various access pricing regimes and entry regulation measures. Precisely, a number of access pricing models are suggested to control the access to the incumbent's existent infrastructure. Further, some countries have also chosen to introduce entry regulatory measures such as the "unbundling policies" and "separation models" which are argued to have a

great role in ensuring competition by permitting more controls of discriminatory behaviors of the significant market power operators (generally the incumbent firms).

2.1 THE ACCESS PRICING POLICIES

According to the theory of access pricing[2], price of access services, which is an important part of the access accords, must verify two conditions: (1) covering the fixed costs of building infrastructure networks incurred by the incumbent (cost-oriented) and avoiding inefficient entry. In particular, the theory of access pricing recommends that the price of access service must cover the loss of incumbent profits (the opportunity costs) due to providing facilities to entrants. This implies the respect of allocative efficiency principle, which consists in maximizing the industry surplus (2) not discriminating the new entrants and promote market competition. This implies the respect of efficiency productive principle, which consists to minimize the production costs of the industry. However, in practice and even if theoretically, it is difficult to satisfy both conditions simultaneously (see Valleti and Estache 1998). Regulatory frameworks based on the economic pricing approaches suggest various access price models.

Following Zenhäeusern et al. (2012 a, 2012 b) and Mihevc (2010), we classify these approaches from the lowest to the strongest price policy imposed to incumbent operator (the regulated firm): (1) the non-cost based approaches (Retail minus, price cap, benchmark, rate of return) (2) the Fully distributed cost (FDC) (3) the Long Run Incremental costs (LRIC).

2.1.1 THE NON-COST BASED APPROACHES

The non-cost based approaches are the least intensive price regulation because they permit to regulated firm (the incumbent) to earn more mark-ups (above marginal costs of access service) by providing more flexibility in setting its access price. The well-known models are retail minus, price cap, international benchmark and rate of return.

1) The Retail Minus: The wholesale (access) price is computed as the difference (called the Minus) between the price and the estimated costs of the provision of the retail service. Compared to cost-based approaches, this method is simple to apply for regulators because it requires less information. Furthermore, this method has the advantage to provide more flexibility to incumbent to align its retail tariffs with respect to market changes. This approach also grants a sufficient access margin for incumbent and therefore prevents "margin squeeze" problem (anti-competitive behavior) (TATT 2009), which occurs when incumbent sets too high access price or too low retail price in the way that the costs of providing the retail service exceed the margin between retail price and wholesale price) (Padilla 2004).

2) The Price Cap: The regulatory authorities set a maximum rate or limit on price changes (price ceilings) for each service or for a packet of services during a given period. This limit is adjusted continuously each period to reflect market and environment changes (inflation, productivity, technologies, etc.). Price cap method provides the infrastructure owners a great flexibility to earn sufficient margin to cover their costs and to face to changes in market conditions (Briglauer and Vogelsang 2011).

3) The International Benchmark: This approach suggests determining both the maximum and the minimum prices for wholesale service based on price of similar service in comparable countries (that have close characteristics: demographic, economic… etc.) (AITI 2013).

4) The Rate of Return: (known also as "cost-plus" regime): This method permits incumbent to cover their costs of infrastructures and to benefit from margin computed as rate of return of their amount of investment (the asset). This regime covers the incumbent's fixed costs but it has the disadvantage that it does not encourage the incumbent to be more efficient (OFWAT 2010).

[2] *For a review of the access pricing theory see for e.g. Ben Dkhil (2014 a) : « Competition in fixed telecommunication market segments: challenges and theories ». Available at SSRN.*

2.1.2 THE COST-BASED APPROACHES (THE COST ACCOUNTING MODELS)

The cost accounting models differ in the types of costs considered in calculating the price of access service and the accounting techniques used to allocate these different costs. (ITU 2009) distinguishes four categories of costs: (1) the direct variable costs(the marginal costs): are the costs generated by variation due to the provision of a given service. (2) The direct fixed costs are the initial costs specific to this service (assets and operating costs) that do not vary in the level of its production. (4) The joint costs are the costs generated by the provision of group of services and that are not affected if the provision of a single service among these decreases or ceased. (5) The common costs represent the costs resulting from provision of all services and that are not affected if the provision of one or more services decreases or ceased.

There are two cost accounting models that are generally used to price the wholesale services: the Fully Distributed costs (FDC) and the Long Run Incremental cost (LRIC).

1) Fully Distributed Costs (FDC): The FDC method suggests allocating these four categories of costs using different methods. It consists in determinating of the uniform mark-up by production unit or proportional to revenues or price of access service considered. This method is practical and simple to apply and permits to incumbent to cover its fixed costs. However, economists reject the FDC approach. They mainly reproach the arbitraries ways of costs allocation (determination of the proportion of joint and common costs for a given access service). They argue that the FDC approach does not respect the production efficiency principle (cost minimization) and does not take into account the demand characteristics. Furthermore, FDC is generally based on the backward-looking costs (the historical costs) of infrastructures facilities, which give entrants wrong information about costs which lead to inefficient entry or discourages the efficient entry (Valleti and Estache 1998).

2) Long Run Incremental cost (LRIC): The LRIC measures the additional costs that regulated firm incurs in the long term to provide additional unit of access service based on forward-looking costs, which are the current costs of construction of facilities to provide the same service using the best available technologies (Guthrie, Small, and Wright 2006). If the incremental costs are equal to one unit, LRIC is equal to marginal costs (ITU 2009). The incremental costs are more appropriate to price telecom service than marginal costs because of the importance of economies of scale in this industry (ERG 2005). There are different versions of LRIC (Long-Run Average Incremental Cost LRAIC, Total Service Long Run Incremental Cost (TSLRIC), etc.). The difference is that LRIC does not take into account the fixed costs. The other versions of LRIC include some mark-up to cover the fixed costs (see ITU 2009 and Valleti and Estache 1998). Engineering network software is used to compute the advanced calculations of LRIC that use advanced accounting methods. LRIC is recommended if the objective consists to promote competition. It is considered the most intensive regulation because it lets zero (the "pure LRIC") or small mark-ups (the other version of LRIC) to incumbent to cover its fixed investment costs (see Valleti and Estache1998 and Guthrie, Small and Wright 2006).

2.2 THE UNBUNDLING POLICIES

There are two ways to enter telecom markets before constructing new networks infrastructures (facilities-based entry): (1) Carrier selection (CS): the entrant leases lines from incumbent at regulated terms (access agreements and prices). In this case, the entrant does not invest in any type of technology. (2) Unbundling access: entrant also leases lines from incumbent at regulated access conditions but it invests in some technologies and has the advantage to offer differentiated services relatively to those offered by incumbent. Therefore, unbundling access is an intermediate form of entry between CS and full facilities-based entry (Valleti 2003; Bijl and Peitz 2005).

According to OECD (2003 a), Local loop unbundling (LLU) is the technical process required by regulator that permits to new entrants a wholesale access by leasing a part or entire local loop circuits of the incumbent firm (mainly pairs of copper wire). Compared to simple line resale (CS), the unbundling policies require that entrant installs some technologies and thereby it is permitted to diversify its services relatively to incumbent products. In particular, in many countries, LLU is introduced as a remedy to duplication of local networks which is constrained by several difficulties including the high costs of infrastructure building compared with the revenue that can be generated from such investment (high sunk costs) and the difficulty to capture clients of the historical monopoly (the incumbent) given the high switching costs . Some regulators consider that LLU promote competition OECD (2003 a).

OECD (2003 a) distinguishes four main types of unbundling regulations: Full Local loop, Line sharing, Bitstream and Sub-Loop Unbundling. These different forms can be ranged from the lowest to the strongest unbundling policy requirement with respect to the incumbent operator as follows: (1) Full Local Loop Unbundling (Full LLU), (2) Line sharing (3) bitstream (4) Sub-Loop Unbundling (SLU) (Wallsten 2006).

2.2.1 THE FULL LOCAL LOOP UNBUNDLING (FULL LLU)

This form of unbundling requires that incumbent leases its entire copper loop to entrants. This form corresponds to the lowest unbundling regulation because it provides to entrant the advantage to fully control the incumbent's copper pairs and therefore, the entrant is permitted to offer all end-user services (both voice and broadband Internet access services). Although that the incumbent is still the exclusive owner of the unbundled local loop and it is therefore the sole responsible to its maintenance, the entrants have the possibility to ameliorate the incumbent's local loop by introducing the Digital Subscriber Access Lines (DSLAM) that sends customers' data signals from the "last mile" (customer's premises) of the incumbent's copper loop lines to the Internet backbones. This gives entrants a complete control for the incumbent's local loop infrastructures that permits more innovation and service differentiation (OECD 2003 a; Wallsten 2006)

2.2.2 THE LINE SHARING

This kind of unbundling is an intermediate unbundling regulation that permits to entrants a partial access to copper loop lines that are stilled controlled and modernized fully by the incumbent. Sharing a same copper loop lines, entrants only provide the broadband Internet access services while incumbent also offer the voice services for the same customer. This form of unbundling requires entrants to be invest in some wholesale equipment such as Splitter which must be installed at the premises of end-users in order to share the copper lines with the incumbent (see OECD 2003 a, and Bijl and Peitz 2005).

2.2.3 THE BIT-STREAM ACCESS (BSA)

According to Wallsten (2006), Bit-Stream unbundling regulation implies more requirements to incumbent than full LLU or line sharing. In particular, it requires the most cooperation from the incumbent operator by providing all necessary technologies, ADSL equipment and modems, which permit entrants to provide their retail services through incumbents' local loops (OECD 2003 a). Entrants can use entire technologies of incumbent to offer end-uses services. They do not invest in wholesale technologies. Otherwise, they do not need to install additional technologies.

2.2.4 THE SUB-LOOP UNBUNDLING (SLU)

This form is the most extensive unbundling regulation imposed to incumbent. It implies more technical obligations for incumbent while it provides more advantages techniques to new firms. Compared to other forms of unbundling, SLU permits to entrants to benefit from large market share and invest in advanced wholesale technologies such as the VDSL that must to be installed closer to the end-user premise to provide very high quality retail services (Wallsten 2006). According to OECD (2003 a), it is the most technical complicated unbundling policy for incumbent.

2.3 THE SEPARATION POLICIES

In 2001, OECD published a recommendation for its country members, in which it suggests various separation models of the dominant integrated operator firm as solutions to these persistent anti-competitive discriminatory behaviors. It is argued that this entry regulation tools may have a great role in limiting the market power of the integrated dominant operator, by separating non-competitive activities from competitive activities in telecom industry. Non-competitive activities consist in the wholesale activities and access network activities (the so-known the "last mile network") including maintenance and modernization of network infrastructures (copper local loop, fiber optic local loop, wholesale broadband access, ..) while competitive activities refer mainly to the retail activities including the provision of end-users services (long-distance services, value-added services, broadband services, local loop services, etc.) (OECD, 2003 b, 2006, 2011 a).

There are different levels (or degrees) of separation of the vertical integrated incumbent company, which can be ranged from the weakest to the strongest form with respect to "the regulatory intensity": (1) Accounting separation (2) Operational separation (3) Functional separation (4) Ownership (or structural separation) (Partner and Lawyer 2011; Cave 2006; Malcolm 2008; OECD, 2003 b, 2006, 2011 a).

2.3.1 THE BEHAVIORAL (OR THE VIRTUAL) SEPARATIONS

By opposition to the full structural separation, in which wholesale and retail activities are controlled by separated owners (see next paragraphs), these models of behavioral separations such as accounting, operational or functional separation, permit to historical integrated dominant operator (the incumbent) to control both wholesale and retail units.

1) The Accounting Separation: This model corresponds to the weakest degree of separation of the dominant operator. It simply consists in imposing to the integrated incumbent firm to provide in the end of every fiscal year separated accounts in which revenues, costs and capital are detailed and disaggregated by types of activities and services. In particular, wholesale and network access activities which consist on the modernization and maintenance of essential infrastructures (e.g., fixed-line bottleneck) and the other activities of telecommunications including provision of retail services are grouped in separated accounts. This regulation measure permits more transparency of information costs that serve in determination of efficient interconnection prices by providing a robust accounting data to regulators. This may explain the strong link between this form of separation and interconnection price model adopted by NRA. Indeed, if accounting separation is required, interconnection price regime adopted is generally a cost-based model. However, the implementation of accounting separation presents the difficulty to control information data of accounting costs provided by incumbent to regulator given the complexity of methods of cost allocations between wholesale and retail activities in incumbent firm (Malcolm 2008). Further, according to Cave (2006), accounting separation may be a solution for price discrimination but not for non-price discrimination. A combination of accounting and other types of separation may be therefore a good remedy to both price and non-price discriminations.

2) The other forms of behavioral separations: There are others intermediate forms of separation, between the weakest model, accounting separation, and the strongest model ownership separation. Legislations usually confuse them. These forms qualified as behavioral or virtual separation require dividing incumbent's business into wholesale and retail different entities retaining a same ownership (the incumbent's company). According to international telecom legislations, there are two intermediate forms of separations:

- The Operational Separation: This model is the weakest form, where dominant operator must create separate divisions for wholesale and retail business in its company. This model of separation does not deal with price discrimination problems. It is usually recommended to be coupled with accounting separation reform.
- The Functional Separation: This model is stronger than operational separation because it consists in separating both management and financial functions of wholesale and retail divisions. This separation of functions within divisions may address price discrimination behaviors because it permits internal transactions (sales and buys) between the wholesale and retail units.

Operational and functional separations are argued to permit to limit the ability and the incentive of incumbent to discriminate its rivals by facilitating the control of anti-competitive discriminatory behaviors of incumbent by both regulators and competitors through creating virtual separated wholesale and retail divisions. By opposition to full structural separation, these forms of separations have the benefits to keep the advantages of vertical integrated structure in telecom industry (e.g. economics of scope).

However, Malcolm (2008) notes that additional enforcement regulatory tools are necessary to ensure that the application of these virtual separations by incumbent follows the principle of non-discrimination. He cites the examples of Wholesale divisions, Openreach in the United Kingdom and Chorus in New Zealand, where additional regulatory tools, such as incentive remuneration to staff of wholesale divisions and establishment of independent oversight group that supervises incumbent's behaviors, are used after operational virtual separations to ensure the independency of wholesale divisions from retail divisions in order to permit equivalent access conditions for incumbent's retail division and competitors.

2.3.2 THE FULL STRUCTURAL SEPARATION (THE OWNERSHIP SEPARATION)

This form corresponds to the strongest level of the separation requirement of the dominant operator. In this model, wholesale and access network business and retail business must be owned and controlled by two separated (different) companies. Hence, this regulation reform modifies completely the structure of telecom industry by breaking up the historical integrated structure of the dominant telecom operator firm. Some analysts consider that full structural separation may undermine innovation and investment in local loops and the integrated structures are more convenient in industries characterized by rapid technology changes like the telecommunication industry. They argued that this form of separation of infrastructure owner is not a guarantee to avoid access price discrimination since access revenues became in this case the unique source of income for the separated infrastructure owner.

3 METHODOLOGY OF SCORING AND COMPUTING OF REGULATORY MEASURES

Table 1 reports regulation reform questions, codes of answers and main information sources. In this table, we describe main information sources, which came from ITU database and the Plaut Economics database. However, other sources are

used to complete information about the regulatory reforms. They consist in reports that contain information by groups of countries for one or more regulatory reforms, and academic papers, as well as, reports and Law texts provided by NRAs of countries (see the Appendix).

Table 1. Regulations reform questions, Answers coding and Main Information Sources

Regulation reform indicators : (Regulation reform question and corresponding answers coded)	**Main Information Sources**		
	ITU World Telecommunications Regulatory Database (Replies by National Regulatory Authorities[1] to :		**Plaut Economics Regulation database[2]**
	Question in « ITU survey on tariff policies 2012 »[3]:	**Question in « ITU world telecommunication regulatory survey 2012[4] »**	**Corresponding question / code of indicator in Zenhäusern et al. (2012 a, 2012 b)**
Accounting separation: Is accounting Separation required? (Yes=1; No=0.)	« 3.7 Is Accounting Separation applied in your country? »	« 79) c) Is accounting separation required? »	"14) Is there an obligation to separate accounting to ensure non-discrimination?" (indicator 14 A)
Functional separation[5] Is functional separation required? (Yes=1; No=0.)		« 79) Does functional separation of SMP/dominant network operator(s) required by law in your country? »	"13) Does regulation require a vertical separation of the incumbent telecommunication firm?" (indicator 13 A)
Infrastructure sharing Is infrastructure sharing is mandated? (Yes=1; No=0.)	« 8.1Is infrastructure sharing Mandated "8.3 Is there a regulatory obligation to share infrastructures, or is it agreed directly between the operators? »	« 31)a) Line sharing »	"18) Is there a sector-specific regulation forcing the incumbent to share infrastructure (e.g. "line sharing", "duct sharing", "mast sharing")?(18B ,18C)
Full LLU Is full Local Loop unbundling (LLU) is required? (Yes=1; No=0.)		« 31) Is unbundled access to the local loop required? (a) What type of local loop unbundling is required? »	"15) Is full unbundling regulated?"(Indicator 15B)
Bitstream Is bit stream unbundling (LLU) is required?			"16) Is bit stream access regulated?"(Indicator 16 B)
Sub-loop Is sub-loop unbundling is required? (Yes=1; No=0.)			"17) Is sub-loop unbundling regulated?" (Indicator 17B)
Interconnection regime (Long Run Incremental Costs LRIC, LRAIC= 1 ; Fully di Benchmarking, Price ceiling s approach, Rate of return regu	« 2.2 Please indicate, which Wholesale telecommunication services provided in your country are subject to price control and which are not?" "3.1 Do you use a Cost Model to determine prices of regulated services?" "3.2 Please indicate the type of costs on which it is based?" "3.3 How are the prices of regulated services determined in your country?"		4) What regulation of network interconnection is applied to the incumbent's network? Indicator 4B

	"3.4Which concept do you use as the basis for calculating telecommunication service tariffs?" "3.5Which approach do you use to calculate telecommunication service tariffs?" "5.1 Which approach do you use to regulate interconnection prices? »		
Transparency of Interconnection Agreements: Is interconnection agreements made public? (Yes=1; No=0.)		« 32) Are interconnection agreements made public? »	
Transparency of Interconnection Price: Is interconnection price made public? (Yes=1; No=0.)		« 33) Are interconnection prices made public? »	
Status of SMP (Incumbent): « Is the main fixed-line operator (the incumbent) 100% state-owned ? » (Yes=1; No=0.)		« 80) Is the main fixed-line operator (the incumbent) 100% state-owned? »	« 26) What is the state's ownership share in the incumbent telecommunication firm (in percent)?" (indicator 26 A)
Regulatory autonomous decision (Yes=1; No=0.)		« 20) Is the regulatory Authority autonomous in its decision-making? »	

Notes:

(1) We downloaded dynamic reports (as Excel files) containing replies by NRAs from 2004-2012 for each question of ITU survey on tariff policies from the following website: http://www.itu.int/ITU-D/ICTEYE. We use Windows Access and Excel to organize data.
(2) Data (as SQL file) is obtained by request addressed to Patrick Zenhäusern. (We are grateful to Patrick Zenhäeusern for sending this database.)
(3)ITU (2012 a). Survey On Tariff Policies.
Available at: http://www.itu.int/ITU-D/finance/work-cost-tariffs/sg1/2012/Tariff_Policies_Survey_2012-en.pdf
(4) ITU(2012b). World Telecommunication Regulatory Survey.
Available at: http://www.itu.int/ITU-D/treg/Events/Survey/ITU_TREGsurvey12_E.pdf
(5) Given the non- availability of precise information because usually NRA confuse between different forms of separations, we mean by "Functional separation" here the all forms of separation (including functional, operational and structural separations of incumbent), except accounting separation.

Following Zenhäeusern et al. (2012 a, 2012b), we define the two following aggregated measures:

- **Entry-regulation** as the variable that aggregates our entry regulation reform indicators, which consists in accounting separation, functional separation, infrastructure sharing, full local loop unbundling, bitstream and sub-loop access.
- **Overall Regulation** as the sum of all reforms listed above in table 1.

Compared to Zenhäeusern and al. (2012), we add the following aggregated measurement:

Interconnection Market Transparency -that aggregates transparency of interconnection agreements and transparency of interconnection price.

The following Table summarizes these definitions

Table 2. Aggregated measurements of regulation reform indicators

Aggregated measurement of regulation reform	Values of aggregated measurement	Definition
Entry − regulation	{0,1,2,3,4,5,6}	$\sum^{\text{Entry − Regulation Reform indicator}}$ = Accounting separation + Functional separation+ Infrastructure sharing + Full LLU+ Bitstream+ Sub-loop
Market transparency	{0,1,2}	Transparency of Interconnection Agreements + Transparency of Interconnection Price
Overall Regulation	{0,1,2,3,4,5,6,7,8,9,10,11}*	$\sum^{\text{Regulation Reform indicators}}$ = Entry − regulation + Interconnection regime + Market transparency + Status of SMP (Incumbent) + Regulatory autonomous decision

Notes: The maximum value that *overall Regulation* measurement can reach is 11 since it aggregate 11 reforms (dummies). However, in our case, there is no country that applies the 11 reforms in the same year. The maximum value taken is 10.

We deduce then the sub-indexes and the overall index by applying simple averages (or an arithmetic means) as follows:

Table 3. Indexes of regulation reforms

Index	Value	Definition
Entry-regulation index	[0,1]	$\sum^{\text{Entry − Regulation Reform indicator}}$ /6
Market transparency index	[0,1]	Market transparency/2
Overall index	[0,1]	$\sum^{\text{Regulation Reform indicators}}$ /11

It results from these above definitions of the aggregated measurements that the higher the value of these measures is, the higher the intensity of regulation is. These measures can be seen as indirect measurements of intensity of competition in telecom market since these regulatory reforms are imposed to incumbent in order to reduce its market power and discriminatory behaviors against its rivals.

4 CONCLUSION

In this paper, we have provided an extensive review of the regulatory reforms required in the fixed telecommunication segment. Furthermore, we have descripted the methodology of the construction of the indicators, the sub-index and the overall index of the regulatory reforms in the fixed telecommunication sector[3]. These measures have permitted to study the role of regulation in driving or delaying the development of the fixed telecommunication markets, which presents a crucial concern nowadays[4]. One major difficulty to conduct a robust analysis on this question is to obtain relevant measures for telecom regulatory reforms. In particular, using these different measurements and following a robust econometric methodology, Ben Dkhil (2014 c) finds an original result: the relationship between regulation and broadband deployment is an inverted U shape in the developed countries, but it takes a U form in the developing countries. This means that policymakers should follow a moderate regulatory regime to encourage investment in fixed telecommunication infrastructures in the developed countries. However, the regulators should stop the regulation in the fixed telecommunication segment in order to promote innovation. Indeed, as argued by Ben Dkhil (2014 c), in the developing countries, the infrastructures is already not sufficiently developed compared to those in rich countries. Therefore, the poor

[3] *These data can be obtained by adressing a request to author.*

[4] *For a recent litturature review on this concern, please see Ben Dkhil (2014 b): « Regulation and Investment in Telecom Network Infrastructure Facilities : the recent developments and debates », Available at SSRN.*

countries should encourage the foreign investment to promote innovation in the advanced telecommunication infrastructures (the broadband networks) by reducing regulation.

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APPENDIX: DATA INFORMATION SOURCES

Table A. 1 : The Main data Source

Data Source	Details
ITU regulatory database 2012 The integrality of reforms & sample considered in this study , data contain important missing information for some countries and some years)	We downloaded dynamic reports (as Excel files) containing replies by NRAs from 2004-2011 for each question of ITU survey on tariff policies in November 2012 from the following website: http://www.itu.int/ITU-D/ICTEYE Regulatory information Data are downloaded by author at the beginning of 2013 from this last link. This We use Windows Access and Excel to organize data. (see table 4.2 for more details)
Plaut Economy data 2012 (for the integrality of the regulatory reforms considered in this study, except the transparency of access agreements & prices, data available from 2004-2010 for 32 countries: 27 EU and Australia, Japan, Singapore, Switzerland and USA)	Data (as SQL file) is obtained by e-mail request addressed to Patrick Zenhäusern. (We are grateful to Patrick Zenhäeusern for sending this database.)

Table A. 2: Regulatory data Sources by group of countries

Group of countries Information	Sources
OECD countries All type of regulatory reforms	OECD Communication Outlooks 2004-2011 (publicly available at the web site of the OECD)
OECD countries Sub-loop Unbundling	Australian Competition and Consumer Commission, 2007. Unconditioned Local Loop Service ACCC Inquiry into Possible Variation of The Service Declaration for the Unconditioned Local Loop Service Position Paper, December. Available at: <http://www.accc.gov.au/system/files/ACCC%20position%20paper%20on%20possible%20ULLS%20variation%20-%20Dec%2007.pdf>.
Latin American and Caribbean countries Access tariffs	Baltra, R. 2008. Efficient Operator: Methodologies, Modelling and Application for Tariff Regulation, Guide for Regulators of Countries. ITU. Available at: <http://www.itu.int/ITUD/finance/Studies/Efficient%20operator/Empresa_Eficiente_final_en.pdf>.
Europe & the USA Full LLU & Bitstream unbundling	Bauer, J., M. et al 2006. Local Loop Unbundling and Bitstream Access: Regulatory Practice in Europe and the U.S. Available At: <http://www.diw.de/documents/publikationen/73/diw_01.c.44714.de/diwkompakt_2006-020.pdf>.
African Countries Cost-based tariffs Privatization Independency of the regulatory authority	Bezzina, J . 2004. Does Dominant Regulatory Telecom. Model Fit With African Specificities? Discretion in Forward-Looking Cost-Based Pricing of Interconnection. *Communications & Strategies*, No. 55, 3rd quarter. Available at: <http://www.comstrat.org/fic/revue_telech/89/C%26S55_BEZZINA.pdf>.
MENA Countries Privatization Full LLU	Blominvest Bank 2010. Telecommunications in the MENA Region. Available at: <http://www.blominvestbank.com/Library/Files/Uploaded%20Files/telecommunicationswebsite_.pdf>. EC 2012. Telecommunications: Middle East and North Africa. Available at: < http://www.cullen-international.com/ressource/3778/0/>.
Latin American and Caribbean countries Access tariffs Accounting separation Unbundling policies	Body of European Regulators for Electronics Communications (BEREC) 2011. Next Generation Access–Collection of Factual Information and New Issues of NGA roll-out. Available at: <http://www.irg.eu/streaming/BoR%20%2811%29%2006%20BEREC%20Report%20NGA%20Country%20Cases%20Study_final.pdf?contentId=547141&field=ATTACHED_FILE>. Body of European Regulators for Electronics Communications (BEREC) 2011. Annex 3: Wholesale physical network infrastructure access. Available at: <http://berec.europa.eu/files/document_register/2012/8/bor_12_41_coin_report_annex3_final.pdf >.
OECD Countries Unbundling policies	CESifo 2009. Development of Local Loop Unbundling. Available at: http://www.cesifo-group.de/ifoHome/facts/DICE/Infrastructure/Communication-Networks/Regulation/dev-loc-loop-unbund_0/fileBinary/dev-loc-loop-unbund_0.pdf.
Arab Countries Privatization Independency of regulatory authorities	Dahel, R. 2001. Telecommunications Privatization in Arab Countries: An Overview. Available at: <http://core.kmi.open.ac.uk/download/pdf/6337390.pdf>.
Albania,Croatia, Bosnia & Herzegovina, Macedonia , Montenegro, Serbia and Kosovo, Turkey. Privatization Independency of regulatory authority Unbundling policies Separation policies Access pricing policies	EC 2010. Analysis of Relevant Electronic Communications Markets in the Enlargement Countries. Cullen International monitoring report 4 for the European Commission, December 2010. Available at: <http://www.culleninternational.com/cullen/projects/balkan2/Analysis_of_relevant_electronic_communications_markets_in_the_Enlargement_countries.pdf>. EC 2010. Enlargement Countries Monitoring Report IV, December. Available at: <http://www.culleninternational.com/asset/?location=/content/assets/research/studies/2008/09/enlargement-countries-monitoring-report-4.pdf/enlargement-countries-monitoring-report-4.pdf>.
Latin American countries Privatization	Estache A., Manacorda M., Valleti T., M. 2002. Telecommunications Reform, Access Regulation, and Internet Adoption in Latin America. *Economia*, Spring. Available at:

Accounting Separation Access Pricing Models Unbundling	<http://rcirib.ir/articles/pdfs/cd1%5CIngenta_Sage_Articles_on_194_225_11_89/Ingenta890.pdf>.
MENA Countries Unbundling Separation policies Privatization Independency of regulatory authorities Access pricing models	European Investment Bank (EIB) 2011. Summary Report Evaluation of the Market, Business and Financial Aspects for the Development of Broadband Access for FEMIP Countries,. Analysis Mason[5]. Hall, R., & Higham, N. 2011. Benchmark of regulatory activities 2011.Report for the Euro-Mediterranean Regulators' Group (EMERG).
Integrality of countries considered in this study Separation policies Unbundling policies Access pricing policies	ITU 1999. Statescitel Guidelines and Practices for Interconnection Regulation, *Organizacion De Los Estados Americanos Organization of American*, available at: <http://www.itu.int/ITU-D/treg/Legislation/CITEL/co-462_e.pdf>.
Integrality of countries considered in this study 2002-2006 Accounting separation Access pricing policies	ITU 2004. Report on interconnection- Study Group 13rd Study Period (2002-2006), available at: <http://www.itu.int/itudoc/itu-d/question/studygr1/q6-1-1.pdf>.
The adoption of Functional, operational or structural separation in the World	Malcolm, W. 2008. Breaking Up is Hard to Do: The Emergence of Functional Separation as a Regulatory Remedy, ITU Report. Available At: <http://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR08/discussion_papers/Malcolm_Webb_session3.pdf>.
Integrality of countries considered in this study 2006-2010 Accounting separation Access pricing policies	ITU 2010. Report: Question 12-2/1: Tariff policies, Tariff Models and Methods of Determining the Costs of Services of National Telecommunication Networks, Including Next-Generation Networks, Study Group 14th Study Period (2006-2010). Available at: <http://www.itu.int/dms_pub/itu-d/opb/stg/D-STG-SG01.12.2-2010-MSW-E.docx>.
Several countries included in our worldwide sample Transparency of interconnection agreements and prices Access pricing policies Unbundling policies	ITU 2012. Interconnection and Access: Assessment Report, available at: <http://www.itu.int/ITUD/projects/ITU_EC_ACP/hipcar/reports/wg2/docs/HIPCAR_2-2-A_Assessment_Report_Interconnection-and-Access.pdf>.
Structural separation in the world	ITU 2012. Structural Separation Explained and Applied, ICT Regulation Toolkit, Practice Note. Available at: <http://www.ictregulationtoolkit.org/en/PracticeNote.3149.html>.
Algeria, Egypt, Israel, Jordan, Lebanon, Malta, Morocco, Syria, Tunisia and Turkey Privatization Independency of regulatory authorities	Kauffmann C., & Wegner L. 2007. Privatization in the MEDA Region: Where Do We Stand? OECD, available at: <http://www.oecd.org/dev/39145511.pdf>.
Latin American and Caribbean Countries Access pricing policies Accounting separation	Klein, G. 2007. Study on the Application of Cost Models in Latin American and Caribbean Countries. ITU. Available at: <http://www.itu.int/ITU-D/finance/costmodels/Klein%20study-EN.PDF>.
Sub-Saharan Africa Privatization Independency of regulatory authorities	Noll, R., G., & Shirlely M., M., .Telecommunications Reform in Sub-Saharan Africa: Politics, Institutions And Performance. Available at: <http://dev.wcfia.harvard.edu/sites/default/files/656__nollshirley.pdf>.
OECD countries Separation policies Access pricing policies	OECD 2001. Interconnection and Local Competition. Available at: <http://www.oecd.org/sti/1894706.pdf>.
OECD Countries Unbundling policies	OECD 2003. Developments in Local Loop Unbundling. Available at: <http://www.oecd.org/sti/6869228.pdf>
Arab countries Independency of regulatory authorities	OECD 2005. Arab Country Experience in Establishing Independent Regulatory Authorities. Special session of the OECD working party on Regulatory Management and Reform in the Framework of Good Governance for Development Initiative in Arab Countries, Paris, 28 September 2005. Available at: <http://www.oecd.org/mena/governance/35553858.pdf>.
OECD Countries Separation policies Unbundling policies Access pricing policies	OECD 2011. Next Generation Access Networks and Market Structure. Available at: <http://www.oecd.org/sti/ieconomy/48460232.pdf>. OECD 2013. Broadband Networks and Open Access. *OECD Digital Economy Papers*, No. 218, OECD Publishing. Available at: <http://dx.doi.org/10.1787/5k49qgz7crmr-en>.
European countries, USA, Japan, Canada, Australia LRIC models	OFTEL, 2002. The use of Long Run Incremental Cost (LRIC) as a costing methodology in regulation, available at: <http://www.ofcom.org.uk/static/archive/oftel/publications/mobile/ctm_2002/lric120202.pdf>.

Functional Separation in the world	Olsen O., J., Henten, A. and Falch, M. 2008. Functional Separation in Telecommunications: A comparative Analysis of Infrastructural areas. 17thBiennial ITS Conference Montreal, 24-27 June. Available at: <http://www.canavents.com/its2008/abstracts/104.pdf>.
Argentina, Belize, Bolivia, Brazil, Bulgaria, Costa Rica, Czech Republic, Ecuador, El Salvador, Ghana, Honduras, Jamaica, Jordan, Kenya, Malawi, Mongolia,Pakistan, Panama, Peru, Slovak Republic, South Africa, Tanzania, Uganda, Romania, Ivory Coast, Mexico and others Access pricing policies, see table I. p. 20	Perez A., H., ,and Rangel., L. 2006.Institutions, Regulatory Policy Choice and Efficiency in the Telecommunications Industry. Available at: <http://epge.fgv.br/files/2141.pdf>.
MENA Region Independency of regulatory authority Privatization	Shehadi, K., S. 2002. Challenges to Telecommunications Regulation in the MENA Region. Available at: < http://www.oecd.org/sti/broadband/1810112.pdf>.
Some European & African countries LRIC models	Stork C. 2009. Interconnection Benchmarking in Namibia. Available at: <http://www.cprsouth.org/wp-content/uploads/2010/03/Christoph-Stork-1.pdf>.
Several countries across the world Unbundling policies	Sutherland, E. 2007. Unbundling local loops: global experiences. Link Centre. Available at SSRN: http://ssrn.com/abstract=1468906
Operational, Functional, Structural Separation in the world	Telecom Italia 2012. Annual Report. Available at <http://organodivigilanza.telecomitalia.it/pdf/Relazione_annuale_2012_eng.pdf>.
Several countries across the word Cost-based access tariff Privatization Independency of regulatory authority	United States Agency for International Development 2009. Trade in Telecommunication Services in the Lao PDR. Available at: <http://egateg.usaid.gov/sites/default/files/Trade%20in%20Telecommunication%20Services.pdf>.
Several countries in the world Privatization	Viani, B., E. 2006. Vertical Separation, Monopoly, and its Consequences: Evidence from Tele Com Privatizations. *International Industrial Organization Conference*. Boston, April 7-9. (see table p.8)Available at: <http://editorialexpress.com/cgi-bin/conference/download.cgi?db_name=IIOC2006&paper_id=486>.
Several countries in the world Privatization	Wallsten, S. 2002. Does Sequencing Matter? Regulation and Privatization in Telecommunications Reforms. Development Research Group, The World Bank, February ((table p. 18). Available at: <http://info.worldbank.org/etools/docs/voddocs/152/334/sequencing.pdf>.

Table A 3: Regulatory data sources by country

Country Information	Sources
Nepal -Price cap since 2004 -LRIC 2008 -Privatization 1992 p.10	Guidelines Issued by the Authority as per the Telecommunication Act 1997. Documents available at : http://www.nta.gov.np/en/legislation/guidelines Nepal Telecommunications Authority 2010. Interconnection Regime in Nepal. Available at: http://www.apt.int/sites/default/files/SATRC-WG-NET01-11_Nepal_Interconnection_regime_in_Nepal.ppt ITU, 2012. Wireless broadband master plan for the Federal Democratic Republic of Nepal. Available at: http://www.itu.int/ITU-D/tech/broadband_networks/WirelessBDMasterPlans_ASP/WBB_MasterPlan_Nepal.pdf
Rwanda Interconnection regulation (accounting system, cost based charge)	Rwanda Utilities Regulatory Agency, 2004. Interconnection guidelines. Available at: http://www.rura.gov.rw/docs/Interconnect_guidlines.pdf
Bolivia Interconnection agreement (made public).p12.	Inter-American Telecommunication Commission, 2006. Citel Guidelines and Practices For Interconnection Regulation. Available at: http://www.itu.int/ITU-D/treg/Legislation/CITEL/co-462_e.pdf
Yemen Interconnection rate.	http://tel-eco.com.ar/downloads/Three_hats.pdf
Thailand - "Interconnection charges are to be negotiated privately. No method for calculating interconnection fees is prescribed, but the law requires that the interconnection rates be reasonable and fair to all the licensees concerned".	Nikomborirak, D. and Rueanthip , K., 2011. Telecom Regulatory and Policy Environment in Thailand: Results and Analysis of the 2011 Telecom Regulatory Environment Survey. Available at: http://lirneasia.net/wp-content/uploads/2010/07/TH_First-Draft_8-Apr-2011.pdf
Cambodia - "The interconnection charge established by the MPTC has been revised several times. While the MPTC had authorized negotiations	Telecommunications in Cambodia. Available at: http://www.winne.com/asia/cambodia/2004/cr06.php

between operators to establish cost-based interconnection charges the Ministry abruptly changed its mind in mid-2001".	
Saudi Arabia -Telecom privatization in 2002.	Homoud Al-Kussayer, 2003. Evolution of Saudi Telecom During Sector Reform, 3rd Annual Private Sector Cooperation Meeting in the Arab Region. Available at: http://www.ituarabic.org/PreviousEvents/2003/Priv2003/11.ppt
Zambia LRIC 2009.	Speech By The Director General Of The Zambia Information And Communications Technology Authority, Ms. Margaret K.Chalwe On The Occussion To Announce The Determination of Interconnection Rates For Mobile And Fixed Network Providers. Available at: http://www.zicta.zm/index.php?option=com_jdownloads&Itemid=36&view=finish&cid=81&catid=9
Grenada Cost-oriented (LRIC) 2003.	National Telecommunications Regulatory Commission Grenada.Telecommunications (Interconnection) Regulations 2003. Available at: http://www.ntrc.gd/Documents/Legislations/Legislation%20-%20Interconnection%20Regulations%20SRO%2033%20of%202003.pdf National Telecommunications Regulatory Commission Grenada.Telecommunications (Interconnection) Regulations 2009. Available at: http://www.ntrc.gd/Documents/Legislations/Legislation%20-%20Interconnection%20Regulations%20SRO%2014%20of%202009.pdf
Brunei Darussalem - Interconnection regime -Privatization 2006	- Interconnection Handbook 2006 and public consultation 2012. Available at: www.aiti.gov.bn/downloadables/Downloadables%20Library/Public%20Consultation%20Paper%20on%20Unified%20Licensing_April2012.pdf Digital Review of Asia Pacific 2007/2008 - Page 117. Available at: http://idl-bnc.idrc.ca/dspace/bitstream/10625/34958/1/127081.pdf
China -LLU amandated -LRIC and Accounting separation 2003 P55 -telecom privatisation started in 1990	Chunghwa Telecom Co., Ltd, Republic of China. Annual Repport 2004. Available at: http://www.cht.com.tw/en/ir/upload/content/200420F.pdf Zheng S., Ward M., R. 2010. The Effects of Market Liberalization and Privatization on Chinese Telecommunications. *China Economic Review*, Volume 22, Issue 2, June 2011, Pages 210–220.Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1741271
Haiti Privatization 2010	- http://en.wikipedia.org/wiki/Telecommunications_in_Haiti
Egypt - "Interconnection charges should be cost-based with a reasonable profit margin. Cost models should be approved by NTRA" - Account separation is required: "The licensee enjoying the significant market power shall **separate the accounts** of its different services and activities. NTRA enjoys the right to audit these data" -Structural separation can be imposed to SMP operator: "In cases of cross subsidization that result in harming or curbing competition, **structural separation** (on the financial and organizational level) shall be considered, NTRA is the decision maker in this case"	- According to Law No. 10/ 2003. Available at: http://www.tra.gov.eg/english/dpages_dpagesdetails.asp?ID=230&Menu=1 - http://www.tra.gov.eg/english/dpages_dpagesdetails.asp?ID=231&Menu=1
Indonesia -2004:revenu sharing since 2005 LRIC applied -Functional separation required / infrastructure sharing (tower) /LLU required (Telecommunications Law, 1999)	-Zita, K. 2012. Indonesia Telecom Brief , Network Dynamics Associates LLC, Available at :http://www.ndaventures.com/nda/docs/Indonesia_Telecom_Brief.pdf - Meurling N., Grainger T., Sawitri D., and Redfordi A. 2012. An overview of regulation in 46 jurisdictions worldwide. Indonesia, chapter writed by, pp 237-244. Available at: http://www.oentoengsuria.com/wp-content/uploads/2012/05/T2012-Indonesia.pdf
Philippine - Agreement between players	-http://pdf.usaid.gov/pdf_docs/PDACJ806.pdf -http://www.itu.int/ITU-D/tech/NGN/CaseStudies/NGN_CaseStudy_IND_PHIL_SLKA_V2.pdf
Maldives -Interconnection :agreement between operators (the regulator can intervene) - obligation share facilities 2003 - Accounting separation not mandated Local loop unbundling	-http://lirneasia.net/wp-content/uploads/2009/07/TRE_Maldives_2008Dec29.pdf http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1554755 MALDIVES TELECOMMUNICATIONS REGULATION 2003, available at: - http://www.agoffice.gov.mv/pdf/subrege/Telecom.pdf -http://www.connect-world.com/~cwiml/index.php/magazine/asia-pacific/item/2488-regulation-in-the-philippines-in-the-era-of-convergence http://pdf.usaid.gov/pdf_docs/PDACJ806.pdf -http://pdf.usaid.gov/pdf_docs/PNADJ654.pdf
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