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## Conference Paper

# Polynomics telecommunication regulation index 2012

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# Polynomics Telecommunication Regulation Index 2012<sup>1</sup>

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## Abstract

In order to study the effect of sector-specific regulation on industry behavior and market outcome, regulatory density must be measured. The «Polynomics Telecommunication Regulation Index 2012» aims to provide such a measure for telecommunications. It is based on coded answers to almost 30 questions regarding sector specific regulations. All questions were selected by the criterion that they potentially relate to investment and innovation activity by telecommunication companies. Each question either concerns fixed network, the mobile network and/or NGA networks or multiple networks. This procedure results in more than 40 regulatory indicators per country and year. The indicators are evaluated and gathered for 32 countries (EU-27, Australia, Japan, Switzerland, Singapore, USA) for a period of 14 years (1997 until 2010). Based on the regulatory indicators various sub-indices and indices can be constructed.

The data set is available from Polynomics upon request. Visit <http://www.polynomics.ch/rdi>.

*Keywords:* Empirical research, index, innovation, regulatory density, telecommunication sector

*JEL:* C01, C80, G28, G38, L43, L5

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## 1. Background

Economic theory has focused on (sector-specific) government interventions and their effects on the behavior of market participants and market performance for a long time. In addition to analyzing the privatization of public enterprises, the focus has also turned to the effects of government regulation on the behavior of companies. Studies have also examined the influence interventions in the market have on a sector's ability to produce better production processes and new products.

Over-investment is a problem that has often been observed on regulated markets. One of the best-known articles on regulatory economics demonstrated in a static model that companies lean towards excessive capital expenditure when the profits to capital ratio is limited to a «fair rate of return» (Averch and Johnson, 1962). It should, however, be noted that the empirical evidence for this study is not without controversy (Viscusi, Harrington, and Vernon, 2000, p. 373). Problems associated with under-investment have been part of regulatory policy discussions following the failure of specific liberalization efforts, for example, the privatization of railways in Britain or the deregulation of California's electricity sector. Recent economic research suggests an inverted U-shaped relationship between competition and dynamic efficiency: Both, too little and too much competition – and the primary goal for regulation is to promote competition – can delay or even impede innovation (see Aghion, Bloom, Blundell, Griffith, and Howitt, 2005). Sector-specific regulations are especially relevant when influencing expected returns on planned infrastructure investment projects. In the telecommunications sector, sector-specific price regulations, quantity regulations as universal service obligations, market entry and exit regulations and miscellaneous regulations (e.g. the state's shares of the incumbent in percent, sector-specific environmental regulations) potentially have a major impact on investment.

Competition among network-based companies such as fixed networks, cable companies and mobile communication has increased substantially in the last few years. With the emergence of this so-called platform competition, various types of sector-specific regulation need to be viewed in a new light. In particular, the issue of «monopolistic bottlenecks» and, associated therewith, the question of market power regulation, must be re-examined.

The emergence of new platforms and the spread of (mobile) broadband have an impact on sector-specific regulation. For example, existing forms of regulation may be replaced, amended, or abolished. When assessing the regulation of new platforms in terms of their effect on investment, the impact on returns has to be revisited. This is true for horizontal regulations (e. g. unbundling of the local loop) and for vertical regulations, such as network neutrality rules that may impose varying restrictions regarding contractual freedom between service providers, content providers and network operators.

In order to assess the impact of regulation on innovation and investment, it is first necessary to have a proper measure of regulatory density and, secondly, to econometrically isolate the effect of regulation among other factors influencing firms' decisions (e.g. GDP, inflation, competition, etc.). This pa-

per focuses on the first step, the measurement of regulatory density. Our indicators on regulation in the telecommunication sector can then be used as an input for the second step.

Our data set updates and extends our earlier study «Plaut Economics Regulation Index» (Zenhausern et al., 2007). This data set has been applied, for example, by Grajek and Röller (forthcoming) who examine the extent to which there is a non-linear, inverted U-shaped relationship between the intensity of regulation and innovation activities or by Bacache, Bourreau, and Gaudin (2010) who assess the effectiveness of the so-called investment ladder (Cave, 2003). Based on our updated data set Bauer and Shim (2012) found that different types of innovation are facilitated by different legal and regulatory conditions, and that the best balance is not self-evident. It is thus beneficial to have institutional regulatory diversity, multi-pronged strategies and the willingness to experiment to detect superior regulatory regimes over time.

## **2. Measuring regulatory density in telecommunications**

Because regulation is always multi-dimensional and has many complex facets, it is helpful to have an aggregated and tractable indicator on regulations. Ratings offer such a simplified view. Institutions like OECD (2006); ECTA (2006, 2009); EURI (2004); WIK (2003) published telecommunication ratings that focused on specific issues. The best-known telecom regulation rating in Europe, the so-called «Ecta Regulatory Scorecard», for example, shows how EU member states are implementing the EU regulatory framework and compares progress rates within the EU.

The use of rating indicators to determine the influence of regulation on market performance (for example, investments in the telecom sector) has raised a new problem in recent years. Attempts to link market performance to such ratings indicators hide the fact that the rating indicators already assess regulation in certain areas. They often include market performance factors in addition to regulatory factors and thus blend input and output factors. Ratings like the «Ecta Regulatory Scorecard» are comprised of both inputs (such as sector regulation) and market outputs. Ratings resulting from a combination of inputs and outputs are not well suited for investigating the link between regulation and the market performance. In constructing our indicators we tried to avoid blending inputs and outputs and focussed on measuring inputs. Consequently, the «Polynomics Telecommunication Regulation Index 2012» intends to solely measure intensity of regulation without rating it. It is a measured value, comparable to a measure of length or weight. It reveals nothing about the effectiveness of regulation, but focusses on the quantitative dimension, i.e., the density or intensity of a regulation or a set of regulations.

We take recent OECD recommendations (OECD, 2008, 2011) regarding construction and composition of indices into account and, on this basis, extend the «Plaut Economics Regulation Index» (Zenhausern et al., 2007). Within the framework of the new index, 41 regulatory indicators are evaluated and gathered for 32 countries (EU-27, Australia, Japan, Switzerland, Singapore and USA) for a period

of 14 years (1997 until 2010), thus since liberalization of telecommunications markets in many of these countries.

Each indicator can attain values between 0 and 1. A value of «0» refers to the lowest regulatory density and a value of «1» refers to the highest comprehensive sector-specific regulation density. Most indicators such as, for example, «Is network access for MVNOs regulated?» or «Existence of regulated vertical separation?» can be answered by «0» (equals «no») or «1» (equals «yes»). Of course, some indicators attain values in between «0» and «1». With regard to price regulations for interconnection, for example, regulated incremental costing is assumed to be more severe (therefore score «1») than price-cap regulation (score «0.5»). The value the indicators are based on publicly available information.

### **3. Data**

Each indicator asks a question related to regulation in the telecommunication sector (see Table 2, Appendix). We answered these questions by consulting many different sources:

- BEREC [http://www.erg.eu.int/documents/berec\\_docs/index\\_en.htm](http://www.erg.eu.int/documents/berec_docs/index_en.htm).
- Cullen International, Telecommunications, Western Europe, Cross-Country Analysis, various editions up to 2011.
- Cullen International, Telecommunications, Central & Eastern Europe, Cross-Country Analysis, various editions up to 2011.
- European Radiocommunications Office (2005), Information Document on GSM Frequency Utilisation within Europe (<http://www.ero.dk>).
- Cable Europe, European Broadband Cable, Brussels, various editions up to 2010.
- European Federation of Journalists (2005), Media Power in Europe: The Big Picture of Ownership, Brussels (<http://www.ifj.org/pdfs/EFJOwnership2005.pdf>).
- European Commission, Reports on the Implementation of the Telecommunications Regulatory Package, Brussels, various editions up to 2010.
- International Comparative Legal Guide Series (ICLG), <http://www.iclg.co.uk>.
- ITU World Telecommunications Regulatory Database (from 2004 onwards), Geneva.
- OECD Communications Outlook (1999, 2001, 2003, 2005, 2007, 2009, and 2011), Paris.
- OECD (2005), Draft Report to Council on Experiences with Structural Separation, Working Party No. 2 on Competition and Regulation, DAF/COMP/WP2(2005)1/REV1, Paris.
- OECD (2003), Working Party on Telecommunications and Information Services Policies, De-

velopment in Local Loop Unbundling, DSTI/ICCP/TISP (2002)5/Final.

- Commission of the European Communities (2001), *The Introduction of Third Generation Mobile Communications in the European Union: State of Play and the Way Forward*, COM(2001)141 final, Brussels.
- Baker & McKenzie (2005), *Telecommunications Laws in Europe*, 5. Edition, Joachim Scherer, Tottel publishing, West Sussex.
- Websites of the national regulatory agencies.

The data consists of coded answers to a total of 29 questions regarding sector specific regulations. Table 2 (Appendix) lists all questions. Each question relates to one or possibly several networks: a question may be asked with regard to the traditional fixed line network, to the next generation access (NGA) fixed line network, to the traditional mobile network, the NGA mobile network or with regard to telecommunication companies in general. Table 4 (Appendix) shows which question is asked with regard to which network. Each combination of a question (numbers) and a network (letters) constitutes an indicator. For example, indicator 15B asks whether full unbundling is regulated (15) for traditional fixed line networks (B). This process leads to a total of 41 indicators: 28 indicators for 32 countries over 14 years plus 13 indicators for 32 countries over 4 years, amounting to a total number of 18,368 observations. Table 1 (Appendix) shows the mean values of all indicators for each year. Each value is the mean over 32 country observations.<sup>2</sup> For the coding of the answers to each question refer to Table 3 (Appendix). The data set is available from Polynomics upon request. Visit <http://www.polynomics.ch/rdi>.

#### 4. Selected results

In order to compress the wealth of information, the regulatory indicators can be aggregated to sub-indices and indices. Basically, our regulatory indicators for the telecommunication sector can be analyzed along two dimensions: along the dimension of «networks» (e. g. solely the indicators of the fixed network, or exclusively the indicators of the NGA-fixed network) and along the dimension of «entrepreneurial decision variables» (see Figure 1). Clearly, each indicator constituting the «Polynomics Telecommunication Regulation Index 2012» can also be used separately and independently of our categorization.

We propose to define four sub-indices based on «entrepreneurial decision variables»: price regulations, quantity regulations, entry and exit regulations and other regulations influencing entrepreneurial decisions. Within each sub-index all indicators are equally weighted. Specifically, we construct a sub-index for each subset of regulation for the three «networks» fixed net, mobile, and general (the bold-

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<sup>2</sup> 27 EU countries, Australia, Japan, Singapore, Switzerland, and USA.

faced indicators in Table 4, Appendix):

$$PriceReg = \frac{1}{5}(4B + 5D + 6B + 7B + 7D)$$

$$QuantReg = \frac{1}{4}(9B + 10B + 11B + 12D)$$

$$EntryReg = \frac{1}{11}(13A + 14A + 15B + 16B + 17B + 18B + 20B + 21D + 22D + 23D + 24D)$$

$$MiscReg = \frac{1}{4}(26A + 27A + 28D + 29A)$$

We thus get for each country in each year the four sub-indices price regulation, quantity regulation, entry regulation, and miscellaneous regulation. Averaging again over these four sub-indices we construct the overall regulatory density index (RDI)

$$RDI = 1/4 (PriceReg + QuantReg + EntryReg + MiscReg).$$

This is, of course, only one arbitrary way of creating an aggregate view on regulatory density in the telecommunication sector. Depending on the research question at hand, another procedure using different indicators may be appropriate.

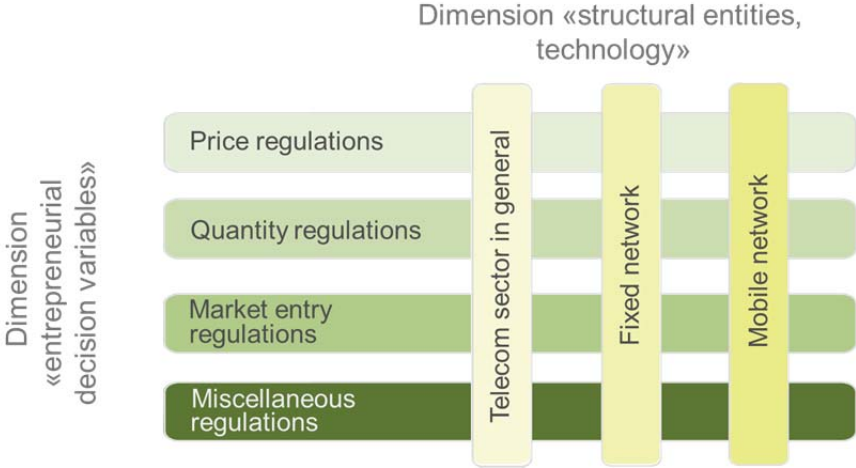


Figure 1: Regulatory density index along two dimensions

The regulatory density index (RDI) indicates how regulatory density changes over time and across countries. A higher index value for a one country compared to some other countries means that this country regulates its telecommunication sector more intensively than the other countries. Overall, the index identifies an increase in regulatory density over time for the EU-27-countries and Asia-Pacific. For the United States, on the other hand, the regulatory density index decreases over time. This tendency is particularly pronounced for fixed network regulations, but also shows up for mobile network regulations.

Figure 2 shows the evolution of the index' cross country distribution. A narrow distribution implies lower cross country variation in regulatory density while a wider distribution implies more variation in regulatory density across countries. The density function shows, that between 1997 and 2010, the regulatory density of the countries did not shift symmetrically «to the right». Instead, regulatory density in 1997 was initially concentrated along a specific range (approximately 0.3), around the year 2003 the variance has increased, and in the year 2010 the values were concentrated again along a higher index level (around 0.5 and 0.6). Essentially, the density functions reflect a kind of «catch-up-effect»: In 1997 only a few countries had a significantly higher regulatory density than 0.3. These countries are, in some sense, the «first movers». Some years later, in 2003, regulatory density increased in most countries; however, countries are spread over a wider range of regulatory densities (between less than 0.3 and almost 0.7). In 2010, the distribution narrows again. While in 1997 there were some «first movers», there are now a few «followers», catching up with the other countries in terms of regulatory density.

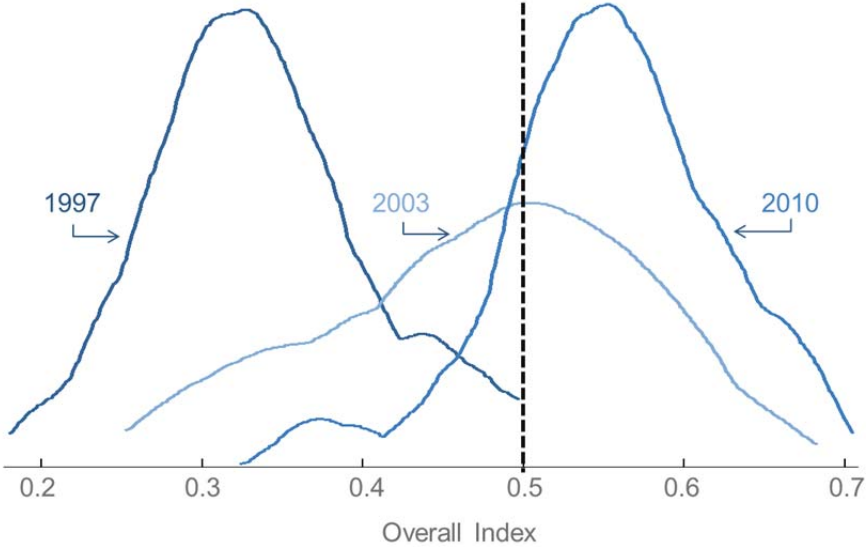


Figure 2: Evolution of cross country distribution

The rich data set allows for many more descriptive analyses and econometric applications. We hope that our panel data set on regulation in the telecommunication sector stimulates many interesting research projects shedding more light on the interaction between regulation, industry behavior and market outcome.

We conclude with a cautionary note: Even though the sub-indices and indicators used in the «Polynomics Telecommunication Regulation Index 2012» were all selected by the criterion, that they potentially influence investment and innovation activity by telecommunication companies, they do not make any direct statements about the quality of regulation. The indicators measure the intensity of regulation but do not rate it. The conclusion that countries with a high index value hamper investments



or innovations in the telecommunications sector through their regulatory regime is not valid. Such an effect – or the opposite of it – can only be assessed econometrically in a second step, estimating the relationship between investments or innovations in the telecommunication sector and regulatory density (as, e.g., measured by our indicators and sub-indices).

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## Appendix

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1A	0.22	0.50	0.50	0.53	0.66	0.69	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
2B	0.94	0.91	0.94	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.84	0.84
2C	0.94	0.91	0.91	0.91	0.91	0.91	0.91	0.92	0.92	0.92	0.92	0.92	0.92	0.89
3A	0.97	0.94	0.94	0.94	0.94	0.91	0.59	0.28	0.12	0.06	0.06	0.06	0.06	0.06
4B	0.90	0.89	0.94	0.93	0.92	0.92	0.88	0.88	0.91	0.91	0.91	0.86	0.84	0.84
4C											0.06	0.11	0.18	0.34
5D	0.08	0.08	0.09	0.11	0.11	0.12	0.10	0.13	0.31	0.65	0.74	0.76	0.79	0.79
6B	0.03	0.03	0.42	0.44	0.43	0.43	0.44	0.44	0.45	0.48	0.48	0.46	0.49	0.51
7B	0.78	0.81	0.81	0.78	0.78	0.78	0.78	0.78	0.75	0.75	0.78	0.81	0.78	0.72
7D	0.03	0.06	0.06	0.03	0.03	0.03	0.03	0.03	0.06	0.06	0.03	0.03	0.03	0.03
8C											0.02	0.02	0.02	0.02
8E											0.02	0.02	0.02	0.02
9B	0.12	0.12	0.19	0.19	0.22	0.19	0.22	0.22	0.22	0.22	0.22	0.25	0.22	0.19
9C											0.03	0.03	0.03	0.03
10B	0.12	0.12	0.16	0.16	0.16	0.16	0.22	0.22	0.25	0.28	0.28	0.31	0.31	0.31
10C											0.00	0.00	0.00	0.00
11B	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
11C											0.03	0.03	0.03	0.03
12D	0.03	0.03	0.03	0.22	0.56	0.62	0.66	0.69	0.78	0.84	0.84	0.84	0.84	0.84
13A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.09	0.09	0.09
14A	0.25	0.47	0.47	0.56	0.56	0.62	0.66	0.75	0.81	0.94	0.97	0.97	0.97	0.97
15B	0.09	0.22	0.31	0.38	0.62	0.66	0.66	0.75	0.94	0.94	0.97	0.97	1.00	1.00
16B	0.00	0.03	0.09	0.16	0.19	0.28	0.25	0.31	0.31	0.44	0.69	0.75	0.78	0.78
17B	0.03	0.03	0.19	0.22	0.28	0.47	0.44	0.44	0.44	0.44	0.44	0.50	0.56	0.62
18B	0.06	0.09	0.12	0.19	0.41	0.66	0.66	0.75	0.91	0.97	0.97	0.97	0.97	0.97
18C											0.25	0.41	0.53	0.72
18E											0.34	0.38	0.44	0.44
19C											0.41	0.44	0.53	0.53
19E											0.41	0.41	0.41	0.41
20B	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.84	0.81
20C											0.88	0.88	0.75	0.72
21D	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.03	0.16	0.19	0.19	0.19
22D	0.65	0.57	0.49	0.47	0.49	0.48	0.48	0.48	0.47	0.47	0.46	0.46	0.46	0.47
23D	0.00	0.00	0.02	0.03	0.21	0.28	0.31	0.33	0.39	0.47	0.41	0.43	0.38	0.34
24D	0.75	0.75	0.75	0.72	0.78	0.78	0.72	0.66	0.62	0.56	0.50	0.47	0.38	0.34
25C											0.02	0.02	0.02	0.02
25E											0.02	0.02	0.02	0.02
26A	0.71	0.67	0.58	0.53	0.52	0.50	0.48	0.43	0.41	0.36	0.35	0.36	0.36	0.35
27A	0.22	0.22	0.22	0.25	0.22	0.22	0.16	0.16	0.16	0.16	0.09	0.09	0.09	0.09
28D	0.47	0.47	0.47	0.50	0.69	0.75	0.78	0.81	0.81	0.81	0.84	0.84	0.84	0.84
29A	0.28	0.31	0.31	0.31	0.31	0.38	0.38	0.34	0.44	0.44	0.41	0.41	0.41	0.41

Table 1: Mean values for each indicator over time.

QID	Question
1	Is the sector-specific regulation generally applied «ex ante»?
2	Is the national sector-specific regulation based on a regionally differentiated market definition (with the goal of taking into account competition at regional level)?
3	Are there time-bound regulatory cycles (e. g. every two years) mandating periodic market analysis in order to reassess sector-specific regulations?
4	What regulation of network interconnection is applied to the incumbent's network?
5	What regulation of mobile communications is applied?
6	Amount of the weighted average cost of capital accepted by the NRA
7	Is there any retail price regulation for telecommunication services?
8	Is a net-neutrality price regulation in place (price regulation between Internet Service Providers and Content providers)?
9	Does the NRA recognize a USO burden?
10	Is there a sharing of USO cost between operators?
11	Is there an obligation to meet the demand for certain services at regulated prices?
12	Are there regulatory requirements regarding coverage of the population with 3G mobile communications technology?
13	Does regulation require a vertical separation of the incumbent telecommunication firm?
14	Is there an obligation to separate accounting to ensure non-discrimination?
15	Is full unbundling regulated?
16	Is bit stream access regulated?
17	Is sub-loop unbundling regulated?
18	Is there a sector-specific regulation forcing the incumbent to share infrastructure (e.g. «line sharing», «duct sharing», «mast sharing»)?
19	Is there a sector-specific regulation forcing other network operators (cable operators, utilities, city carriers, etc.) to share infrastructures like manholes, antenna locations etc.?
20	Is the telecommunications access regulation between DSL and cable network provider asymmetric?
21	Is there a regulated network access for mobile virtual network operators (MVNOs)?
22	Number of network-based mobile communications licenses of the 2nd generation?
23	Number of network-based mobile communications licenses of the 3rd generation?
24	Does the NRA restrict trading of already allocated frequencies?
25	To what degree is net neutrality mandated by means other than price regulation?
26	What is the state's ownership share in the incumbent telecommunication firm (in percent)?
27	Is there a «golden share» (i.e. the state's right to veto corporate decisions of the incumbent telecommunication firm)?
28	Is there a sector-specific environmental regulation (e.g., regarding radiation limits)?
29	Can the NRA issue fines that exceed 5% of the turnover of the regulated activity?

Table 2: List of questions.

QID refers to the identification number of the question. See Table 3 for the coding used for the answers to each question.

QID	Coding of Answers
1	1 Yes = 1; No = 0
2	Yes = 0; No = 1; regionally differentiated market definition = 0.5
3	Yes = 0; No = 1
4, 5, 8	Regulated monopoly or incremental cost regulation = 1; general cost regulation or some mixture of all other regulations = 0.8; price cap regulation or rate of return regulation = 0.5; no regulation = 0
6	0%-6.9% = 1; 7%-9.9% = 0.8; 10%-13.9% = 0.5; otherwise=0
7	Yes = 0; No = 1
9	Yes = 0; No = 1
10	Yes = 0; No = 1
11	Yes = 0; No = 1
12	Yes = 0; No = 1
13	Yes = 0; No = 1
14	Yes = 0; No = 1
15	Yes = 0; No = 1
16	Yes = 0; No = 1
17	Yes = 0; No = 1
18	Yes = 0; No = 1
19	Yes = 0; No = 1
20	Yes = 0; No = 1
21	Yes = 0; No = 1
22, 23	1 license = 1; 2 licenses = 0.8; 3-4 licenses = 0.5; more licences = 0
24	Yes = 1; No = 0
25	Yes = 1; exclusivity restrictions for content not allowed = 0.5; No = 0
26	Less than 21% = 0; 21%-50.9% = 0.5; 51%-79.9% = 0.8; more than 80% = 0
27	Yes = 1; No = 0
28	Yes = 0; No = 1
29	Yes = 0; No = 1

Table 3: Coding of the answers

See Table 2 for the questions asked by each indicator.

	QID	Network				
		general A	fixed net B	fixed net NGA C	mobile D	mobile NGA E
Design	1	1A				
	2		2B	2C		
	3	3A				
Price	4		<b>4B</b>	4C		
	5				<b>5D</b>	
	6		<b>6B</b>			
	7		<b>7B</b>		<b>7D</b>	
	8			8C		8E
Quantity	9		<b>9B</b>	9C		
	10		<b>10B</b>	10C		
	11		<b>11B</b>	11C		
	12				<b>12D</b>	
Entry - Exit	13	<b>13A</b>				
	14	<b>14A</b>				
	15		<b>15B</b>			
	16		<b>16B</b>			
	17		<b>17B</b>			
	18		<b>18B</b>	18C		18E
	19			19C		19E
	20		<b>20B</b>	20C		
	21				<b>21D</b>	
	22				<b>22D</b>	
	23				<b>23D</b>	
	24				<b>24D</b>	
Miscellaneous	25			25C		25E
	26	<b>26A</b>				
	27	<b>27A</b>				
	28				<b>28D</b>	
	29	<b>29A</b>				
Total		7	12	10	8	4

Table 4: Overview over all indicators in the data set.

The number in the indicator ID refers to the question (see Table 2) it answers and the letter of the indicator ID refers to the network for which the question is answered. For example, 10B answers the question whether USO cost are shared between operators on the traditional fixed net. The boldfaced indicators are used to construct the aggregate indices.