Beyond Broadband Access: Developing Data-Based Information Policy Strategies

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CHAPTER

5 Data and Modeling Challenges in International Comparisons

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Abstract

This chapter examines two particularly testing problems affecting cross-national comparisons of advanced communication services: the increasing importance of service and price differentiation, particularly the reliance on multipart self-selection tariffs, and the challenges created by institutional diversity for making sense of comparative observations. It introduces a new metric, known as the lowest expenditure frontier (LEF), to address some of the challenges of designing good metrics, and advocates methodological pluralism to mitigate the latter. The chapter first considers the use of benchmarking to periodically assess the effects of policy and regulation on broadband before turning to a discussion of the challenges arising from the increasing heterogeneity and differentiation of advanced communication services. It then describes three approaches used to compare the prices of advanced communication services: selection of a representative price (for example, for a three-minute call) or a representative plan; reliance on an average aggregate measure, such as the average revenue per user (ARPU); and the use of a basket of calls whose cost is then calculated for different countries. Finally, it illustrates the LEF using the case of mobile voice communications.

Keywords: advanced communication services, service differentiation, price differentiation, self-selection tariffs, lowest expenditure frontier, metrics, benchmarking, broadband, average revenue per user, mobile voice communications

Subject: Museums, Libraries, and Information Sciences

A growing number of regulatory agencies, policy making institutions, and intergovernmental organizations rely on some form of benchmarking to periodically assess the effects of policy and regulation. The design and calculation of such metrics is facilitated by a more systematic and abundant information base. However, daunting conceptual and empirical issues have to be overcome before international comparisons can inform practical policy decisions. Furthermore, better and more reliable empirical data is only one precondition for utilizing internationally comparative information. A sometimes even bigger obstacle is the meaningful interpretation of findings. This chapter addresses two particularly testing problems affecting cross-national comparisons of advanced communication services: the increasing importance of service and price differentiation, and the challenges created by institutional diversity for making sense of comparative observations. A new metric, the lowest expenditure frontier (LEF) is introduced to address some aspects of the first issue; methodological pluralism is advocated to mitigate the latter.

Background

Good policy and regulation demand regular evaluation of effects. A growing number of regulatory agencies, policy making institutions, and intergovernmental organizations have thus begun to rely on historical and comparative benchmarking. In 2008 the US Congress instructed the Federal Communications Commission (FCC) to include international comparisons in its broadband reports. In the context of developing the
p. 89 National Broadband ↳ Plan, the FCC has commissioned several studies with the explicit intent to draw lessons from the international experience.[1] For more than a decade, the European Union (EU) has documented the evolution of important industry performance statistics in its *Implementation Reports*. Several international organizations, first and foremost the International Telecommunication Union (ITU) and the Organisation for Economic Co-operation and Development (OECD), have been collecting comparative data for decades. The information is used to assess the performance of telecommunication industries operating under different legal and regulatory regimes. More recently, single performance indicators and composite indexes are also regularly released by other organizations, each with a slightly different methodological approach and focus. Examples include the ITU's Digital Opportunities Index,[2] the E-Readiness index published by the Economist Intelligence Unit until 2009,[3] the Networked Readiness index released by the World Economic Forum,[4] and the Connectivity Scorecard.[5]

The design and calculation of this plethora of metrics is stimulated by increasingly abundant information about the ICT sector. However, careful international comparisons have to overcome daunting conceptual and empirical obstacles that are often glossed over by policy makers who base decisions on simple and potentially misleading metrics. It is not as straightforward as often presumed to make sense of comparative observations let alone draw lessons from them.[6] This is, for example, evident from the fact that the existing metrics often yield quite different ranks for individual countries. While this is, to a certain degree, a function of the diverging objectives of alternative metrics, lacking robustness should also serve as a flag of caution. Many of the available performance indicators fall short of reflecting the diversity of services and the multitude of options available to subscribers.

Better and more reliable empirical data is only one precondition for utilizing internationally comparative information. An even bigger obstacle is the interpretation of findings. Institutional arrangements are highly diverse and their effect on performance metrics is only partially understood.[7] Such arrangements, including sectoral laws and regulations, typically affect performance in dynamic constellations rather than as individual factors. This is frequently ignored in cross-national empirical work. Taking advantage of computing power and available statistical software, econometric studies based on panel data have flourished but their theoretical foundations are often weak. For example, institutional and regulatory instruments are often modeled as dichotomous variables, grossly simplifying the richness of institutional arrangements.

This chapter addresses two challenges of international benchmarking. First, it discusses one particularly
p. 90 testing problem affecting cross-national ↳ comparisons of advanced communication services: the increasing importance of service and price differentiation, in particular the reliance on multipart self-selection tariffs.[8] Such pricing models were first introduced in mobile voice markets but are now spreading to other services, including traditional voice services, Voice over Internet Protocol (VoIP), cable television, Internet TV, and mobile data. With the increasing concern about high-volume uses, similar pricing models are tested in many markets for Internet access services.. This is a remarkable change as only recently many experts saw flat pricing as the successor model to per-minute or other volume-dependent charges. Second, the chapter explores the challenges created by institutional diversity for cross-national empirical comparisons.

In both areas this chapter recommends alternative approaches. To address some of the challenges of heterogeneity, a new measure—the lowest expenditure frontier (LEF)—is introduced. With regard to empirical approaches, this chapter encourages the utilization of new techniques in addition to traditional statistical models. The second through fourth sections are dedicated to a discussion of the challenges created by the increasing heterogeneity and differentiation of advanced communication services. The issues are illustrated using mobile voice communications. The fifth section is dedicated to methodological problems of making sense of comparative data. It proposes methodological pluralism as one way to overcome these challenges. The final section reiterates key points and insights of the chapter.

The Challenges of Service and Price Differentiation

During the past two decades, the pricing of communications services has changed greatly both with regard to its regulatory treatment and the degree of price differentiation introduced by service providers. As fewer services were subject to price regulation, a general shift away from cost-based forms of pricing to demand-based approaches occurred. Throughout most of the twentieth century, the supply of basic telecommunication services was considered a natural monopoly and hence subject to some form of price regulation. Moreover, basic communication services were historically seen as a necessity for which prices should be kept at an affordable level. Pricing was thus influenced by equity as well as by efficiency considerations. Even under cost-of-service regulation, telecommunication service providers offered a wide range of tariffed services using many different rate structures. In the United States, as in other countries, prices for basic voice services were typically differentiated by location, call duration, time of day, and the type of user (e.g., residential or business). Long-distance prices were also differentiated by distance-bands and international calls by destination. In North ↳ America subscribers typically elected flat-priced local service, although in most locations measured service was also available.[9] Outside of North America local service was typically priced at measured rates. As recently as in the 1990s, due to declining costs of measuring network use, a shift to measured pricing was expected also for North America. However, the emergence of high capacity backbone networks, broadband access, and the increasing reliance on IP networking shifted attention to flat pricing, perhaps with some component to address congestion issues. With arguments such as the "death of distance," flat pricing was seen as the future model. Nonetheless, only a few years later, it seems most likely that combinations of these approaches will continue to be offered simultaneously. Many experiments and innovations in the pricing of communications services were facilitated by a gradual deregulation of prices. They have both simplified and complicated prices and price structures. Most services are now sold under some form of multipart pricing scheme, often combined with a menu of options from which consumers can select their preferred plan.

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These developments can be illustrated using the example of mobile markets. In mobile voice and mobile data markets, consumers can typically choose from menus that include measured service, combinations of flat and measured components, and pure flat rates. Considerable differences exist between countries in price levels and structures. Take mobile voice services, for example. Prepaid service was introduced during the 1990s in European nations and soon thereafter in other regions of the world, particularly in developing countries. In North America it was offered much later, possibly because service providers there did not want to undermine their historical pricing models. Prepaid service is essentially a measured service. It offers low-volume users an affordable plan but is more expensive for higher-volume users. Another innovation, postpaid "buckets" of minutes, was introduced in the US market by AT&T and subsequently diffused to other regions. In this pricing scheme, a flat monthly payment gives the subscriber an allotment of minutes, with additional minutes charged on a per-minute basis. Higher monthly flat charges buy more minutes and typically reduce the per-minute charge for overages.

The policies of service providers differ with regard to unused peak minutes: some allow roll-over to the subsequent period whereas others do not permit such carry-forward (i.e., the minutes are lost). As competition intensified, American service providers introduced free minutes during off-peak periods. Initially, subscribers were allotted a high but limited number of minutes but most plans now provide unlimited off-peak calling. Although the details vary between carriers, off-peak periods typically are late evening and nights on weekdays and weekends. Carriers typically also differentiate between on-net and off-net calls. European service providers started to introduce ↳ unlimited evening and weekend calling plans later but typically charge an additional fee. As a result of these multipart pricing structures, the average price for a minute of mobile service varies dramatically depending, among others, on the chosen plan, the usage level, and the flexibility of a subscriber to time-shift use to off-peak periods. The same variability does not affect expenses, a feature that is used in designing the lowest expenditure frontier, described below.

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Cross-national differences also exist with regard to the bundling of service components. In the United States and in most European nations, mobile voice plans bundle voice service, voice mail, and caller ID into the basic service. Many plans also include a limited number of SMS messages (initially contributing to fast growth of SMS usage), call forwarding, and three-way calling. In some countries these features are priced separately and need to be added to the basic rate. Further differences emerge from variations in which party actually pays for a call. In the United States most service providers use the mobile-party-pays (MPP)

approach, in which both the calling and the called party pay some of the total cost of a call. However, since late 2005, a few carriers have increased price competition by moving to a calling-party-pays (CPP) approach. Outside of the United States, the calling-party-pays principle is generally employed. This has the potential disadvantage that no straightforward market mechanism exists to put downward pressure on termination charges (in the MPP model the level of termination charges affects a subscriber's decision). European regulators and the European Union have thus regulated international mobile call termination rates, where the problem was perceived as particularly pressing. Cross-national differences exist, lastly, also in the taxation of mobile voice services and the collection of universal service surcharges.

Beyond Traditional Metrics for International Price Comparisons

This section briefly reviews three approaches used to compare the prices of advanced communication services and then introduces a new method, the lowest expenditure frontier (LEF), which avoids some of the weaknesses of the prevailing approaches and is best seen as a complementary tool to existing metrics. The most common methods used in international price comparisons are the selection of a representative price (e.g., for a three-minute call) or a representative plan; reliance on an average aggregate measure, such as the average revenue per user (ARPU); and the use of a basket of calls whose cost is then calculated for different countries. The first method is, among others, used by the International Telecommunication Union
p. 93 (ITU) and by the World Bank; both institutions publish prices for ↳ three-minute fixed or cellular phone calls. This approach is only accurate for services using a strictly linear pricing scheme, as is often the case for prepaid service. If services are priced using multipart self-selection tariffs, it may not be evident which plan to choose. In this case, picking one particular plan may introduce unknown biases and may not reflect the overall pricing level and structure. In comparison, the ARPU, used in the second approach, is relatively easy to calculate but does not allow distinguishing whether it is high because prices are low and calling volumes are high or vice versa. This could be overcome by calculating the ARPU per minute of calls but the latter data is rarely available. All these possible problems have contributed to the development of a basket methodology for advanced communication services.

A basket is a weighted index of different service components. Given the multipart nature of communication prices, baskets need to reflect at least the main aspects of differentiation. A choice has to be made with regard to the number of calls included in the basket as well as the duration of calls. Once these basic selections are made, a distribution of calls over various time-of-day and day-of-the-week periods will have to be determined. Calls may furthermore have to be differentiated to reflect distance-sensitive price structures, origination and termination charges, roaming charges for national and international calls, as well as taxes and fees. Lastly, calls made and received may have to be distinguished to allow comparisons between countries using the calling-party-pays and countries using the mobile-party-pays approach. The widely used OECD mobile price basket, for example, distinguishes three usage levels (low, medium, and high), differentiates calls by destination (calls to the local and national fixed network, on-net mobile, off-net mobile, and voicemail), and distributes them by time of day (peak, off-peak, and weekends). Ideally baskets would be constructed to reflect an average or representative caller in a user group or a nation. At the same time, this is one of the greatest disadvantages: artificial user profiles are used that may not reflect any particular market.

This disadvantage can, to a certain degree, be overcome with the lowest expenditure frontier (LEF) method. This metric has two roots: statistically, it is rooted in frontier analysis, a tool that has wide uses in benchmarking; conceptually, it is inspired by a capabilities approach[10] to the role of information and communications technology in social and economic development because it maps the enabling role of a service across a broad range of uses. The LEF algorithm determines the minimal expenditures at varying usage levels. LEF can be applied to the pricing plans of a single carrier to identify the best plan for each usage level. It can also be used to compare products of multiple service providers and find the lowest costs of
p. 94 a service at the national level. Finally, it can be employed to conduct international ↳ price comparisons. A mathematical expression of the LEF, defined for usage levels ranging from 0 through an upper limit T is:

$$LEF_0^T = min C_t, \forall t = 0, \ldots T \tag{1}$$

Ct denotes the total cost at usage level t=0 .... T, factoring in all costs relevant in a particular pricing plan. For example, in case of a prepaid plan this may simply be the price per minute times the usage level. In case of a postpaid plan, this is equal to the monthly cost of the plan up to the maximum allowed usage. For usage level above the allowed maximum, it equals the monthly cost plus the overage fee, typically a linear or step function of excess usage. The simple formula allows calculating the lowest expenditure for each usage level within the range that is being considered. In other words, the lowest expenditure frontier indicates the minimal expenditures a user has to incur in order to consume a specific number of units (e.g., minutes of voice service, megabytes of data). The LEF method is based on two simplifying assumptions: users do not face any switching costs and therefore can change plans so as to move along the lowest expenditure frontier; consumers have full information and make rational choices by selecting a pricing plan that minimizes costs at the desired usage level.

The first assumption is more accurate for the carrier-specific LEF than for the national LEF. Most service providers nowadays allow their subscribers to modify their calling plans without any additional charge. Some service providers, such as Sprint Nextel in the United States and Korea Telecom in South Korea, experimented with gliding-scale plans, automatically adjusting the user's plan to past calling patterns, which would move them along the carrier-specific LEF. The assumption is less justified for the national LEF as it assumes that the cost of switching service providers is zero or negligible. Nonetheless, this is not entirely unrealistic. Whereas presently carriers charge fees for porting a customer, competition for existing subscribers may reduce the associated transaction costs. Moreover, in the medium and long-run subscribers do have the flexibility to select plans from different carriers. The second assumption also implies that a consumer is actively and constantly seeking to find the lowest cost plan, which may not be true for everyone. Acquiring all the relevant information to pick the lowest cost plan is typically time-consuming and individuals may follow simple heuristics rather than rational calculations to identify a least-cost plan. In practice, most users will likely incur expenditures that are above the LEF. It therefore is justified to interpret the LEF as the lower boundary of expenditures for different volumes of calls.

One of many advantages of the LEF approach is its flexibility. The most distinct advantage of LEF is its
p. 95 ability to reflect the level of prices over an ↳ entire usage range. Particular features of pricing structures that may distort the basket method will become visible and a more reliable measure of a nation's communications prices can be obtained. While it is most directly applicable to compare prices during pay periods, it can easily integrate forms of price differentiation. The LEF offers a number of other advantages. It could, for example, be mapped into a scalar measure and used as an endogenous variable in causal analysis of the determinants of mobile prices. Moreover, LEF is not limited to mobile prices but may be utilized for any service sold under multipart tariffs. One challenge to the approach is the increased use of complex service bundles, as they complicate determining a meaningful LEF. Nonetheless, LEF adds a complementary new tool to cross-national price comparisons.

An Application to Mobile Voice Services

The potential uses of LEF and its robustness were tested in a pilot study. A convenience sample of service providers and countries was selected for which the required raw data could be collected easily. For the United States, the four major national mobile service providers (AT&T, Sprint Nextel, T-Mobile, and Verizon) were studied. For Belgium, France, Greece, Ireland, Japan, the Netherlands, and the United Kingdom pricing of the largest service provider was examined. Internet homepages of each service provider were used as the primary sources of pricing information. For purposes of the pilot, the analysis was confined to postpaid individual mobile calling plans although the method also works with prepaid service. In principle, the LEF method can be applied to any type of advanced communication service with a heterogeneous pricing structure, including mobile data, mobile broadband, fixed broadband access, and bundles.[11]

In order to construct LEF, it is necessary to find the lowest costs by comparing calling plans for a range of usage levels, which was set between zero and two thousand minutes of use per month. As each carrier offers various plans, in a first step the hypothetical cost for each usage level is calculated for each plan. The lowest expenditure frontier for one service provider is then determined according to equation (1), that is, for each usage level, the lowest cost option is identified. The method needs to be adjusted to allow the comparison of plans of different service providers and plans in different countries, but the basic design principle remains

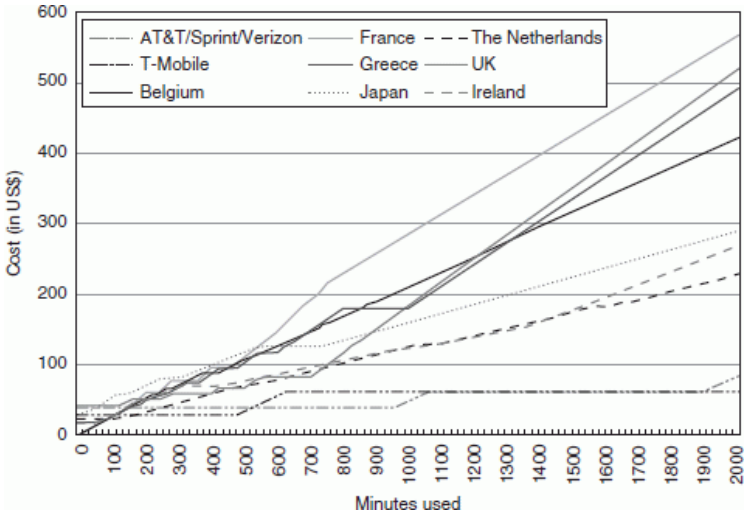
valid. Important forms of differentiation are captured by the LEF method directly, as it analyzes the price performance across an entire range of uses. Other forms of differentiation, such as different conventions regarding on-net and off-net calling or the differentiation in peak and off-peak periods can be standardized to assure comparability.

p. 96 In a similar vein, differences resulting from plan types (e.g., calling party pays, receiving party pays) can be taken into account. The LEF method offers much more flexibility than the OECD basket method to select quality features when calculating the minimal expenditures faced by subscribers. For the analysis presented in the following paragraphs, the call distribution used by the OECD method was utilized. Variations in bundling options can also be neutralized by defining a standardized bundle of services. In principle, LEF offers the flexibility to take quality of service parameters into account. This way, hedonic adjustments to prices could be made.[12] Such adjustments are important in longitudinal analyses if quality of service increases over time.[13] They are also relevant in cross-sectional analyses if quality varies noticeably among service providers (e.g., coverage or signal strength).

All the calculations reported in this chapter calculate the LEF as expressed in equation (1). Monthly expenditure was determined at twenty-minute intervals from zero to two thousand minutes. The price includes value added tax (VAT, similar to sales tax in the United States) where appropriate. To account for the difference between calling-party-pays and mobile-party-pays approaches, expenditures for U.S. subscribers were determined at double the usage levels of users in other countries.[14] Where adjustments for on-net and off-net calling patterns were necessary, the calculations relied on OECD conventions. National currencies were converted to US dollars using purchasing power parities (PPP).[15] The focus was on regular service prices, ignoring temporary promotional offers. A first set of data was collected in 2007 and all information was updated in August 2008. PPP information was obtained from the World Development Indicator database of the World Bank.[16]

Use of the LEF framework is illustrated in Figure 5-1, which maps the lowest cost plans for the four major U.S. providers as well as the plans of the largest service providers for the other countries (as priced in August 2008). The figure shows major differences in the pricing of mobile voice services across nations. In some countries users with high calling volumes faced fairly high costs as pricing plans did not accommodate such uses. On the other hand, U.S. service providers offer plans that are very favorable to high-volume users but leave low-volume users relatively worse off than their counterparts in other countries. This is in part the outcome of the basic US pricing model and in part the outcome of business strategies aimed at enhancing network effects (e.g., by granting free on-net calls). The LEF framework reveals why the OECD mobile price comparisons, which regularly rank the United States as a high-price country,[17] are at least partially misleading: the OECD user profile is based on relatively low usage when considering the US market. In August 2008, the OECD high usage basket contained about 250 minutes of calls per month. At that time,
p. 97 average US use was more than 800 minutes ↳ per month.[18] At this high usage level, the LEF framework shows that US plans are less expensive than comparable plans in other countries. However, American prices imply comparably high expenditures at the lower usage levels that are typical for other countries. Thus, the LEF framework can help overcome locking-in artificial usage levels and hence reveal more about the price performance of individual carriers and countries.

Figure 5-1.



LEF comparison (prices as of August 2008).

Making Sense of International Comparisons

Even if meaningful indicators can be designed, data and observations need a narrative to explain the causes of the differences and similarities revealed in international comparisons. Moreover, from the observation that another country boasts better performance in one or more dimensions it does not follow that the same outcome can be replicated in another country. Institutional and other constraints often prevent imitation and often even emulation.[19] Explanations for performance differences are constructed in many ways but five explanations are particularly important in cross-national policy comparisons: (1) analogies and metaphors; (2) case studies; (3) nonparametric statistical analysis; (4) parametric statistical analysis; and (5) the emerging approach of qualitative comparative analysis. Each of these methods has advantages and disadvantages but as long as they are kept in mind, utilizing alternative methods can offer complementary outlooks on a given set of empirical observations.

Analogies and metaphors are important ways of learning and can stimulate political will to work toward
p. 98 certain goals.[20] By juxtaposing observations ↳ in two or more countries, they may shed light on a factor that has contributed to the superior performance of one or the inferior performance of another. For example, the "information superhighway" metaphor has inspired US and foreign policy makers. Whereas analogies and metaphors work indirectly, case studies offer a widely used way to understand and reconstruct complex issues more specifically. Case studies allow an in-depth understanding of a phenomenon based on documentary research, interviews, participant observation, or a combination thereof. Because of their flexibility they are well-suited for unraveling complicated multifaceted processes. For this reason, they are widely used in information and communication policy studies.

For example, the contributions in Fransman examine the experience with broadband in several countries.[21] By comparing the national experiences within a unified framework of national innovation systems, reasons that explain different trajectories and performance can be developed. Nonetheless, caution is in order. To utilize insights from case studies to inform policy in other places and at other times, conditions for transferability must be met. Situations in countries that are compared need to have certain structural similarities (e.g., economic, technological, and institutional conditions); policy makers need to have similar feasible instruments at their disposal; and there needs to be a reasonable expectation that the system will respond in like ways to changes in policy.

Examples abound where lessons were drawn from information and communication policy in other places and at other times. Unfortunately, rather than examining the conditions under which lessons can be drawn, a tacit assumption is often made that lessons can be extracted in a straightforward way. Many such lessons have been proposed in papers analyzing, among others, ownership structure, the design of regulatory institutions, and many specific regulatory instruments, but these conditions are less often specified. Thus, examples of failures to learn from each other coexist with successes. For example, 3G spectrum auctions in several European countries—inspired by US forays into auctions—were poorly designed, eventually,

causing delays to the introduction of 3G services. On the other hand, many countries succeeded in establishing independent regulatory agencies, a model that originated in the United States and Canada.

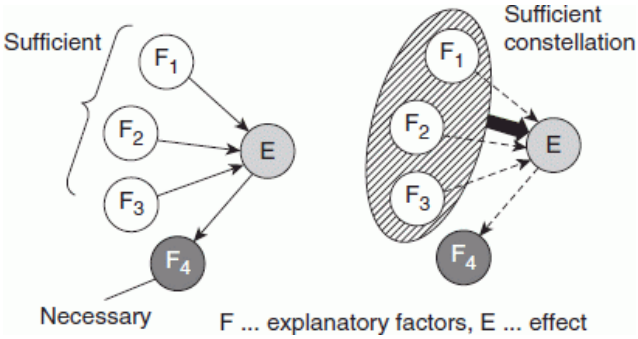
International and comparative research has a long tradition in media and communication research. Much of this work is qualitative but there is an increasing quantitative research tradition. Statistical methods force the analyst to think in different ways about the contingencies of policies. Nonparametric statistical analyses, such as data envelope analysis (DEA), compare many units of analysis and derive a "best practice"
p. 99 frontier reflecting the best achievement of units. For example, the diffusion of broadband in ↳ rural communities might be examined to determine the characteristics of communities that have achieved higher adoption rates. DEA allows calculating how far any particular unit of analysis falls short of the best-practice frontier and possibly also provides hints as to which factors act as constraints. Although this is rarely stated explicitly, DEA rests on the assumption that the same causal process is at work across all units of analysis, which may or may not be justified, particularly if data from different national contexts are utilized. If it is, DEA provides a useful tool to analyze and possibly alleviate performance constraints. As the method does not provide a specific numerical estimate of the effects of a policy instrument on the dependent variable, DEA may need to be supplemented with parametric approaches.

Of the various parametric statistical approaches, this paper will only address econometric methods. Econometric methods allow estimation of numerical parameters that express the partial effects of independent variables on the dependent variable. From these parameters, elasticities can be determined that provide an appreciation of the effects of changes in the independent variables on the dependent variable. If some of the independent variables can be modified by policy, these models allow the calibration of policy instruments, which is not possible with nonparametric approaches. Econometric models are best suited for analyses of large data sets of one hundred or more cases. Investigations can examine cross-sections of observations in one or more countries, longitudinal data drawn from one and the same unit over time, or combine the two in panel data analyses. Due to the availability of more observations from a growing number of countries and the release of increasingly powerful statistical analysis packages, econometric analyses have mushroomed during the past decade. However, the available data is sometimes of dubious reliability and information on policy variables is often incomplete and partial. This may create a mismatch between theoretical models of the influence of institutional arrangements and governance mechanisms on performance and the more rudimentary empirical implementations and tests of the theories.

Whereas this is common in empirical research, there are other aspects of econometric analysis that will have to be kept in mind. Ragin pointed out that econometric methods assume that a variable is a sufficient condition for an outcome.[22] For the sake of convenience many studies specify empirical models in which each independent variable influences the outcome in an additive fashion. Whereas this is not inevitable, it is widespread among empirical researchers and has two shortcomings. First, institutional arrangements and policies may be necessary but not sufficient conditions for an outcome, which is difficult to detect using traditional econometric methods. Second, institutional arrangements may affect outcomes in constellations in which one or more factors together are necessary or sufficient for an outcome.

p. 100 This is illustrated in the right half of Figure 5-2, where factors F1–F3 jointly constitute a sufficient condition for an outcome, for example, high broadband adoption. In such a situation, the presence of only one or two of these factors and hence policies that rely on one or two of these factors would not yield the desired outcome. Although this could be modeled in principle using interaction terms, it may be cumbersome given the complexity of institutional arrangements.

Figure 5-2.



Complex patterns of causation.

Models using observations from multiple countries and time periods have to make certain assumptions about the nature of the underlying causal processes. If there are reasons to believe that the same process is at work independently of space and time, observations might simply be *pooled*. In this case, one set of parameters is estimated from which information on the effectiveness of policy instruments can be derived. Whether such constant coefficient models truly reflect a phenomenon needs to be determined on conceptual rather than statistical grounds. If there is reason to believe that in a cross-national panel data set country-specific variables are at work, as seems plausible, given that the national context will typically matter, the so-called *fixed effect* models may be used. Here the assumption is that unit-specific influences (e.g., country-specific influences) exist, which are estimated without further differentiation. For the remaining variables the strong working assumption applies to be that they affect all units equally across time and space. Its validity will manifest itself in the quality of fit of the empirical model, such as the statistical significance of each parameter estimate, the statistical significance of the entire equation, and the share of the variance of the dependent variable that is explained by the independent variables. In the alternative random effects model, no such unit-specific effects are hypothesized, implying that a generic process is at work that affects all units in the same way.

The complex interaction among institutional arrangements, some of which are policy variables, can also be modeled with a relatively new class

p. 101 of models based on set theory.[23] Qualitative comparative analysis (QCA) allows better differentiation of sufficient and necessary factors shaping a dependent variable. It also allows the examination of groups of factors for joint sufficiency or necessity. This is done using set-theoretic relations between variables and conventional probability tests for sufficiency and necessity. A factor is sufficient, if its presence always (or with a certain probability) goes hand in hand with the dependent variable; it is necessary if the factor is present (or present with a certain probability), whenever the dependent variable is observed. Joint necessity and joint sufficiency for groups of factors is similarly defined. The versatility of QCA comes at a cost, though, in that no quantitative parameter estimates can be derived. Thus, an important piece of information that could inform policy makers—the strength of the response of the system to varying an instrument—is missing. Nonetheless, QCA is in many ways more compatible with the ways institutional arrangements interact with outcomes because it allows modeling constellations. It has the additional advantage that it can be used if the number of observations is below that required to conduct reliable parametric analyses and is therefore also known as a "small sample technique." QCA is widely used in political science and sociology but is rarely applied to information and communication industries. Econometric and other methods sometimes yield similar, sometimes complementary, and sometimes contradictory conclusions. For example, multivariate regression analysis may detect a positive influence on unbundling but QCA may show that it is neither a necessary nor a sufficient condition.[24] Such discrepancies point to the need of further research.

None of the methods mentioned so far is particularly strong in modeling dynamic interaction processes with many feedbacks, as is characteristic for information and communication industries. Essentially, a process that is stable in time is tacitly assumed in the modeling efforts. It is possible to include time lags into models to capture intertemporal links. However, parametric models and QCA have limits in accommodating dynamic feedbacks. One possible approach, if sufficiently long time series are available, is time series analysis. Univariate time series analysis explains a dependent variable from its own past whereas multivariate time series analysis also uses other explanatory variables. Like QCA, time series analysis is rarely utilized in information and communication policy research. Dynamic problems could be addressed using simulation models. Such models are slowly introduced and come in several variants. Second-generation simulation models use higher-level aggregates, often at the sectoral level, to examine dynamic relations among relevant factors, some of which may be policy instruments.[25] The latest generation of models uses agent-based and genetic programming approaches to examine data.[26] These

p. 102 approaches are particularly suited to ↳ study dynamic interactions that cannot be captured easily using game theoretic models because solutions are difficult to find using analytic methods.

Overall, the approaches reviewed here provide powerful tools to researchers. However, to draw valid lessons the limitations, explicit and tacit assumptions have to be considered to avoid rash conclusions. Methodological pluralism may help overcome some of the constraints of each particular method: findings that can be replicated using multiple approaches can be seen as more robust than findings that are only detectable with one method.

Conclusion

International comparisons are increasingly used to assess and inform communications policy. The proliferation of data and software to analyze data by and large has been a great benefit and allowed new insights. National policy makers have been able to learn from each other more systematically. At the same time, meaningful benchmarking and learning need to overcome considerable pitfalls and apply great care that is often lost in the current debates. Consequently, international comparisons are often used to support stakeholders' preconceived notions rather than to inform the policy debate. To serve the latter goal, meaningful metrics need to be designed and greater awareness of the power and limitations of empirical tools would be helpful. The chapter suggests one new method, the lowest expenditure frontier, to address some of the challenges of designing good metrics. LEF, with its roots in statistical techniques and welfare theory, is best seen as a complement to existing metrics. Indicators, by themselves, do not provide explanations. Better theories and empirical methods that help derive useful insights from an increasingly overwhelming flood of empirical data are particularly scarce and in need of improvement. Fortunately, an array of approaches is available and as long as researchers are aware of their respective advantages and weaknesses, there is hope that international benchmarking will indeed facilitate policy learning and contribute to better policies. Methodological pluralism is a particularly appealing response to the increasing complexity of communications and its governance.

Notes

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12. J. Triplett, *Handbook on Hedonic Indexes and Quality Adjustments in Price Indexes: Special Application to Information Technology Products* (Paris: OECD, 2006).
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14. One simple way is to assume that outgoing and incoming calls are equally distributed. In a calling-party-pays (CPP) environment, one hundred minutes of outgoing and one hundred minutes of incoming calls cost a user the equivalent of the one hundred outgoing calls. In a mobile-party-pays (MPP) environment, the subscriber has to pay for two hundred minutes as both outgoing and incoming calls are counted. To correct for this difference, one hundred CPP minutes must be equated to two hundred MPP minutes in determining LEF.
15. Purchasing power parity is an economic technique employed in order to determine the relative values of two or more number of currencies. It is necessary because the amount of goods that a currency can purchase differs substantially depending on various factors including availability of goods, demand for the goods, and inflation.
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