Broadband Dynamic Value Assessment
Understanding Possible Macroeconomic Benefits of Broadband in Developing Countries

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Introduction

In an era of severely constrained financial resources, public policymakers in middle-income[1] and developing countries face many choices about the best infrastructure projects in which to invest, knowing that only a limited number of initiatives can be funded. In general, the benefits of improved broadband penetration are easy to identify. They include enablement of Internet-based tools and databases, quicker information exchange, and improved productivity. Quantifying the financial benefits, however, is difficult because of their diffuse nature. A decision by public policy officials to undertake the often difficult changes required merely to implement "more broadband" requires additional supporting analyses about which benefits are most significant.

To maximize the value of broadband investments, the Cisco® Internet Business Solutions Group (IBSG) recommends a strategy for prioritizing which geographic and sectoral areas and applications of broadband will yield the greatest economic return. To this aim, Cisco IBSG developed the Broadband Dynamic Value Assessment (BDVA) model to help policymakers choose among several types of prioritization alternatives.

BDVA refers to both an engagement process and a set of tools, including the BDVA simulation framework. The model is ideal for helping decision makers and stakeholders collaborate on a shared vision of how broadband and broadband services can contribute to a country's socioeconomic development.

Although there are challenges in estimating the benefits of improved broadband penetration with 100 percent accuracy, BDVA is designed to help decision makers and stakeholders collaborate on a shared vision of how broadband and broadband services can contribute to a country's socioeconomic development. BDVA enables client teams and Cisco to understand the research and underpinning assumptions required to estimate the magnitude of a country's economic gains from pervasive adoption of broadband technologies within related socioeconomic reform programs. Moreover, a public policy prioritization scheme can be developed by evaluating the relative benefits of potential strategies. The BDVA model also helps countries understand service provider economics related to the construction of new broadband infrastructure, and how the adoption of various operating models, incentive programs, or regulatory/legislative changes can improve a country's economic outlook.

This paper provides an overview of BDVA within Cisco IBSG's Country Transformation framework for emerging markets. Cisco IBSG will issue additional papers regarding BDVA in the coming months.

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1. The World Bank classifies all low- and middle-income countries as "developing." Middle-income countries are those with per-capita incomes between US$400 and $4,000 annually.
http://www.britannica.com/EBchecked/topic/381337/middle-income-developing-country

Challenges

In trying to quantify the benefits of broadband for any developed or developing country, there is a shortage of practical data that measures the benefits of improved broadband penetration—particularly for developing countries and long-term time frames. One reason for this is the relative newness of broadband usage. Also, the types of broadband-based initiatives that can have a profound impact on a country's development rely on new technologies and processes that leapfrog the status quo in terms of sophistication and capabilities. While productivity improvements are difficult to measure, estimating gains from large changes in an economy or in a company's business model is even more challenging.

Among the few studies that do exist, it's rare to find data that quantifies exactly how investments in broadband improve gross domestic product (GDP) or productivity. That is, many macroeconomic studies show a correlation between greater broadband use and economic growth, but issues of causality are described only with anecdotes or examples. Most studies measure just the size of the overall benefit rather than the power of the economic improvement mechanism.

Other narrowly focused microeconomic studies evaluate the benefits of broadband in a specific private-sector or government setting. Measurements are based on the value of the applications they enable. For example, spending money to improve broadband usage in schools can reduce textbook costs and teacher-training expenses, thereby raising test scores and salaries.

There are two problems, however, with these types of microeconomic studies. First, it is difficult to list all possible applications of broadband for which benefits can be calculated, particularly on a discrete basis. Second, this approach does not account for any network effects; for any single broadband-enabled application, the benefits may increase as broadband applications are added in other sectors. For example, accurate tabulation of the benefits from increased broadband usage in schools also requires consideration of the possibility that companies will deepen their academic and corporate ties via broadband-based collaboration tools.

Empirically, a middle ground between these two approaches is required.

The BDVA Proposition

The BDVA process fills a void between these macro- and microeconomic models. It enables broadband stakeholders or decision makers to build dynamic scenarios of possible broadband benefits by sector or usage type. BDVA focuses on public policy broadband implementation objectives, taking a middle road that links broadband penetration rates to "pillars," which, in turn, drive GDP growth. These pillars essentially are proxies for public policy broadband implementation objectives. In this manner, the user can simulate which of these pillars might have the greatest impact on GDP growth, and use this information to refine a national strategy for achieving the greatest benefits from wider broadband usage. Figure 1 shows the three stages of the BDVA economic model.

Figure 1. Flow of the BDVA Model

Source: Cisco IBSG Economics & Research Practice, 2009

The BDVA pillars are a set of quantitative and qualitative metrics chosen with four properties in mind:

1. The pillars must be influenced by an improved presence of broadband

2. The pillars must impact GDP in a meaningful way

3. Data must be widely available for many developing countries

4. Broadband benefit measurements driven by each pillar must be as discrete as possible among all pillars

The pillars are drawn from one of three sources: "2008–2009 World Economic Forum Global Competitive Report,"[2] the World Bank's World Development Indicators database,[3] or the World Health Organization (WHO).[4] Pillars can be defined by survey data, actual economic measurements, or constructed variables. The broadband pillars are described based on business size, industry sectors, and general business environment:

Small and Medium-Sized Business (SMB)

Pillar 1: The amount of time it takes to start a business (in days)

Pillar 2: SMB business environment (calculated index)

Pillar 3: Clustering of linked local businesses (survey results)

Government

Pillar 4: Government prioritization of information and communications technology (ICT) (survey results)

Pillar 5: Presence of ICT in government offices (survey results)

Pillar 6: Laws relating to ICT (survey results)

Education

Pillar 7: Internet access in schools (survey results)

Pillar 8: Quality of math and science (survey results)

Pillar 9: University/industry collaboration (survey results)

2. http://www.weforum.org/en/initiatives/gcp/Global%20Competitiveness%20Report/index.htm

3. http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/0,,menuPK:476823~pagePK:64165236~piPK:64165141~theSitePK:469372,00.html

4. http://www.who.int/whr/2006/annex/06_annex1_en.pdf

General Business Environment

Pillar 10: Production-process sophistication (survey results)

Pillar 11: Buyer sophistication (survey results)

Pillar 12: Ease of access to loans (survey result)

Pillar 13: Venture capital availability (survey result)

Healthcare

Pillar 14: Improvements in survival rate among the labor force (reductions in death rates of those 15–60 years old by gender)

Based on Figure 1, the BDVA user first proposes public policy changes that will impact broadband penetration rates among households. While the BDVA model will suggest a possible value for the point of broadband saturation in the long term, the onus is on the user ultimately to decide what this saturation rate might be. The model will then suggest a path based on a country's historical penetration rates, changes in price, income distribution, and other broadband distribution restrictions. Similarly, the user must also gauge—or at least validate—the model's assessment of the impact these policy changes have on the pillars' value.

By 2029, the model assumes that these developing-country pillars will improve to achieve a developed-country norm in a linear manner, although the BDVA user can modify this assumption. BDVA users can make comparisons with this developed-country norm and with other BDVA countries' pillar values to estimate improvements over time.

Lastly, improvements to the pillars statistically drive GDP growth through regression analysis results.[5] The BDVA simulation framework does not provide purely empirical results because users essentially define improvement measurements based on external analyses of the hypothesized benefits of a program in, perhaps, comparison with other countries' experiences. Regression results do, however, help the user understand a relative order of magnitude of the benefits available vis-à-vis improvements made to the pillars.

It is important to restate that these pillars consider only the value of public sector-based broadband initiatives; they do not account for all economic benefits societywide. Cisco IBSG estimates that these pillars account for roughly 30 percent of total benefits. (This percentage will vary widely by country, depending mostly on the proportion of a country's public sector relative to the total economy.) Most of the remaining broadband benefits will come from the private sector in the form of vertical industry investments needed to acquire and use broadband and associated network technologies.

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5. In statistics, regression analysis refers to techniques for modeling and analyzing several variables, when the focus is on the relationship between a dependent variable and one or more independent variables.

As an example of how this might work from a simulation framework perspective, we can examine the first pillar: the time it takes to start a business. There are two ways in which this pillar can influence GDP via broadband-induced improvements. First, broadband can be used by federal or local governments to streamline public-private business infrastructure, making government and public access to records, licenses, and deals simple, fast, inexpensive, and accurate. The second method involves broadband use by the start-up itself, once the infrastructure is in place to support faster start-up times.

In a CNN.com article, "Where Best to Base Your Business," Slovakia and Colombia were cited as good places to start a business because of their ability to streamline several processes, such as creating electronic one-stop shops for businesses, shrinking regulatory delays, improving credit registries, and introducing more flexible labor laws.[6] Other start-up procedures that could be improved include registering transfers of property, constructing and closing business deals, or applying for and obtaining bank credit.

In a 2008 study of the best countries for small businesses, published on CNNMoney.com, Azerbaijan was credited for "heading this year's list of most active reformers" as a result of slashing its business start-up times from 122 days to 16 days in one year.[7] One of Azerbaijan's key ICT-led reforms includes a public registry of information on all loans reported by the financial system, more than doubling coverage of borrowers with a credit history.[8]

Increased broadband use can also play a long-term role in a start-up's business plans. From an economic standpoint, faster start-up times can help shift the industry mix of start-ups from producers of goods (such as manufacturing, construction, or agriculture) to producers of services (such as business, household, and retail). Pervasive use of broadband can foster the development of companies in these areas because far fewer assets are required by services firms to begin a business. Moreover, a larger services sector could acquire more international customers. Indeed, offshore development of business services is a common element of a macroeconomic growth plan.

BDVA users will have to identify specific programs their country will use to improve Pillar 1, and estimate the impact that these programs will have on reducing the time it takes to start a business. The BDVA model will then map this improvement to GDP growth.

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6. http://edition.cnn.com/2004/BUSINESS/09/08/go.world.bank.report

7. http://money.cnn.com/2008/09/10/smallbusiness/best_countries_for_small_biz.smb/index.htm

8. http://www.doingbusiness.org/Reformers/ECA2008.aspx (World Bank)

Generating Broadband Scenarios: How the BDVA Process Works
Setting Broadband Penetration Rates for 2009–2012

The first step in using the BDVA simulation framework involves choosing the country involved. The model will then present a time series of suggested broadband penetration rates for 2009 through 2012, and for 2029, based on historical data collected by the International Telecommunication Union.[9] Figure 2 shows how to set broadband penetration rates.

Figure 2. Setting Broadband Penetration Rates via the BDVA Simulation Framework
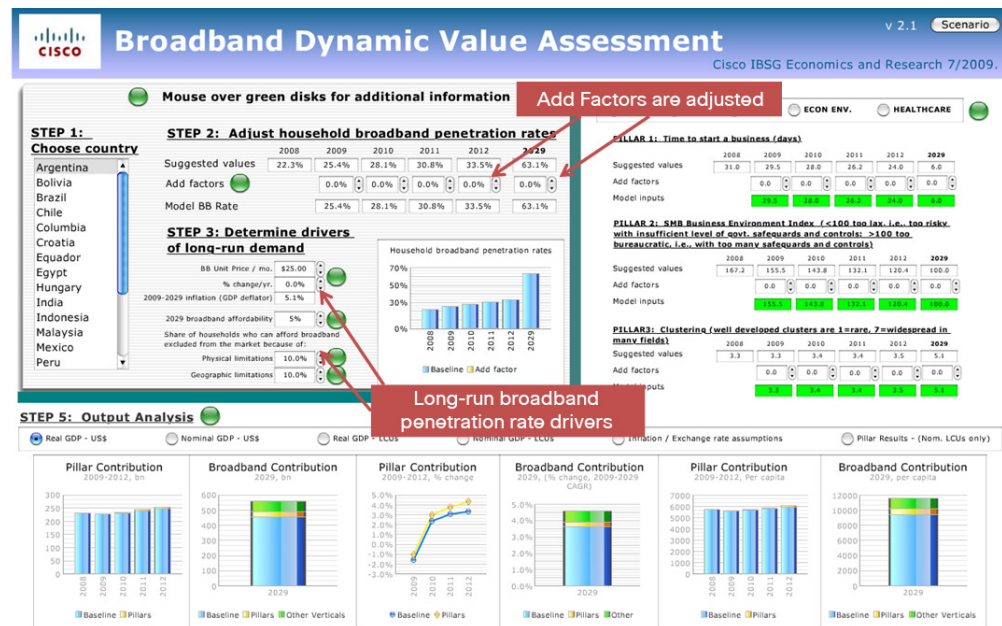
Source: Cisco IBSG Economics & Research Practice, 2009

Once rates are suggested via the model, the user can accept the suggested forecasts or make changes via the "Add Factor" toggles (as indicated by the red arrows in the top portion of Figure 2). Such changes should be made carefully and only as a result of country-specific analysis done within the context of a BDVA engagement. Additionally, after making an Add Factor adjustment in a particular year, the user must carefully adjust all Add Factors in later years to assure consistency of the assumptions. Adjusting an Add Factor will directly change the broadband penetration rate used in subsequent steps of the model. Several factors enter into this determination:

- Extent of private sector investment, particularly in telecommunications service providers

- Mix of broadband channel alternatives (such as cable, DSL, and wireless) and geographic coverage

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9. "Yearbook of Statistics: Telecommunication Services (Chronological Time Series 1997–2006)," 34th Edition, International Telecommunication Union (ITU), July 2008. ITU penetration rates contain actual data through 2006; data beyond 2007 are estimates or forecasts. Forecasts are based on "S-curve" projections of the ITU data.

- Degree of competitiveness among broadband service providers (quality and price of service)

- Ability of the population to acquire and use IT equipment required for access, including 3G-equipped cell phones

- Experience of countries with comparable size, per-capita incomes, and competitiveness of telecommunications markets

Setting the 2029 Broadband Penetration Rate

While the 2009–2012 penetration rates are based on short-term economic and government policy considerations, the BDVA simulation framework assumes that the 2029 broadband penetration rate will reflect a maximum rate determined by the share of households able to afford and purchase broadband. That is, every household that has the income and capability to purchase broadband will do so by 2029, other than those described in the fourth bullet point below. Affordability is determined by:

- **Price of broadband.** The model default value is US$25 per month, based on a rough assessment of the Organisation for Economic Co-operation and Development (OECD) average monthly subscription prices for low-speed broadband connections.[10]

- **Price growth rate.** The default price is then used as a starting point and is forecast through 2029. Comparisons against a country's overall inflation rate come into play. For example, if a country is expecting 4 percent inflation, on average, over the next 20 years, a 2 percent increase in the price of broadband will result in a decrease in the relative price of broadband for that period. Additionally, product quality is one variable left to interpretation by the user of the model. It is safe to assume that the type of broadband service available in 2029 will be very different from today's service.

- **Household demand for broadband as a share of income.** This variable determines the maximum share of annual income a household is willing to spend on broadband services. The threshold can be set between 2 percent and 5 percent of household income. As broadband importance, quality, and applications increase, the threshold is expected to rise.

- **Share of the population that will not purchase broadband.** This variable considers households that will never purchase broadband at any price, and includes people who are infirm, imprisoned, or technology-averse.

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10. *OECD Communications Outlook 2009*, ISBN 9789264059832, Table 7.16, August 2009.

Changing the Pillars and Estimating Their Impacts

Once a country has been selected from the left-hand portion of the BDVA simulation framework in Figure 2, the pillar data for that country will appear. Analogous to broadband penetration rates, the model will calculate suggested forecasts, allowing them to be changed using Add Factors (see Figure 3).

Figure 3. Changing the Pillar and GDP Views
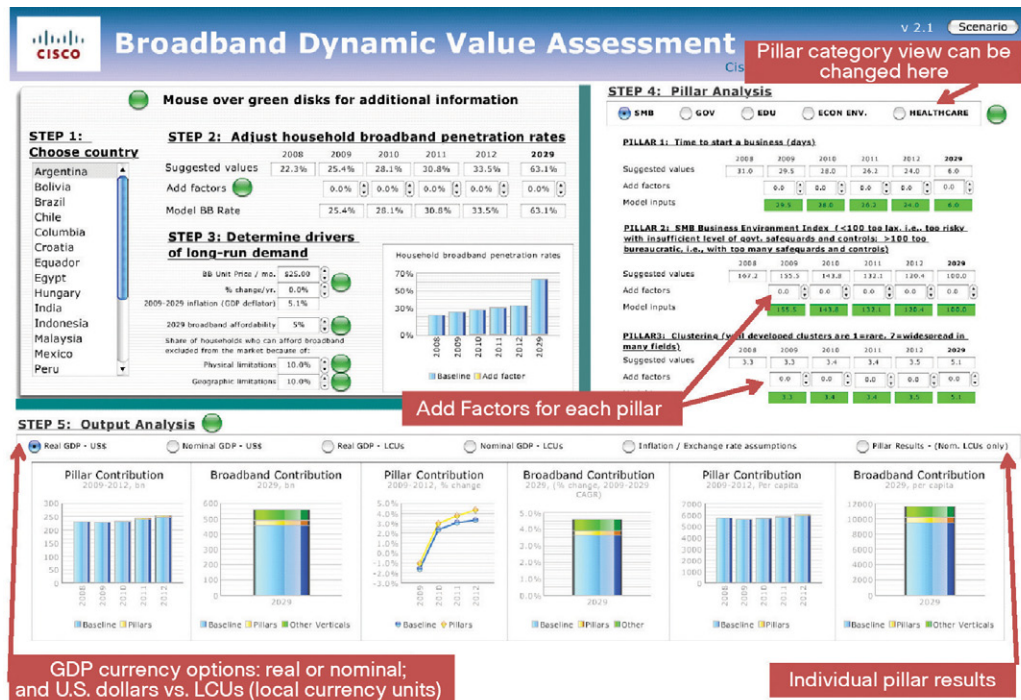
Source: Cisco IBSG Economics & Research Practice, 2009

Figure 3 shows the various pillars based on selections from Step 4's Pillar Analysis bar in the upper-right-hand corner of the model. Relative GDP contributions from each of the pillars can be obtained by clicking the Pillar Results button in the right-hand corner of Step 5, at the bottom of the Figure.

In Step 5, from the pillar sections on the radial bar, users can select the appropriate units for GDP as either real or nominal, and in both U.S. dollars and local currency units. From the same bar, the simulated inflation and exchange rate assumptions can also be displayed.

Dips in 2009 GDP reflect current global economic weakness. For 2029, the user must consider that increases in broadband penetration will level off as the maximum penetration rate is neared, reducing incremental GDP growth attributable to broadband in the long term.

A Hypothetical Example

This section identifies the types of questions and issues a BDVA user may encounter.[11] To illustrate, we use Chile as an example.

After selecting Chile from the country list in Figure 3, the BDVA simulation suggests a forecasted household broadband penetration rate increase—from 28 percent in 2008 to 39.2 percent in 2012. In examining comparable forecasts for Argentina, Bolivia, and Brazil—knowing that a major proposal is being considered that will improve competition among broadband service providers—our hypothetical user concludes that a 50 percent broadband penetration rate is achievable by 2012, rather than the forecasted 39.2 percent. The user then enters 10.8 percent as the Add Factor for 2012 (the difference between 50 percent and 39.2 percent). Because these proposed aspects of the program will be phased-in between 2009 and 2010, the user also enters 2.5 percent, 5 percent, and 7.5 percent as Add Factors for 2009, 2010, and 2011, respectively. Doing so results in a smoother path to achieving the 50 percent goal in 2012.

The user also believes that the 2019 penetration rate estimate of 67.6 percent is too low, given that a rate of 50 percent will be obtained in 2012. One way to increase this rate is to reduce the change in broadband price growth from 0 percent to -2 percent, reflecting a likely outcome of increased competition. This raises the 2019 penetration rate to 69.2 percent.

The next step involves assessing the pillars in relation to the proposed public policy prescriptions. Similar to the broadband penetration rate, the BDVA simulation provides suggested forecasts for each pillar, gradually edging each pillar's values toward developed-country norms. Clicking on the Pillar Results option, to the far right of the Output Analysis bar (Figure 3, Step 5), shows that most of the economic gains are found in Pillar 1, reducing the amount of time it takes to start a business from 27 days to six days.

Pillar 10 is the second-most-valuable pillar: production-process sophistication (achieving a better survey-based score by using more capital-intensive production processes). Thus, of the 14 Pillars, 1 and 10 will provide the greatest benefit from improved broadband penetration.

The user believes that the time it takes to start a business, however, will not change to this extent as a result of the broadband programs under consideration. The user will then enter Add Factors to keep the number of days constant at 27.

The user also has determined that a key aspect of the broadband programs to be implemented includes a $50 million initiative to improve primary and secondary math and science education (Pillar 8). Based on comparisons with other developing countries, the user determines that this program will raise the 2012 pillar value from 3.6 to 4.0. The user should change the Add Factors preceding this 2012 change so that the progression to 4.0 is smooth from year to year. Looking at the GDP output in

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11. Questions, responses, and conclusions in this example are purely illustrative and hypothetical.

nominal U.S. dollars, the overall pillar contribution is increased from $6.24 billion to $6.75 billion. Thus, this program yields a cost benefit ratio of 10:1 GDP. If the margin tax rate on this incremental income is higher than 10 percent, such a broadband program will yield net revenue gains to the Chilean government.

Conclusion

For successful broadband implementation, Cisco IBSG recommends using the BDVA simulation framework as a tool to align stakeholders and decision makers around a common, strategic vision. Comparisons of BDVA results with other forecasts can be made only if underlying assumptions of other forecasts are available, including an assessment of the ICT sector that pertains to the broadband penetration forecast.

As with any long-term economic model, the process of creating assumptions that drive the model is more important than results. Specific public sector broadband initiatives should be translated into changes in the pillars to realize GDP benefits. By ranking the pillars' contributions, governments can assess which initiatives are most valuable. In this manner, strategy can be fine-tuned, initiatives can be prioritized, and a diverse group of stakeholders can come together on a vision of the future.

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More Information

The Cisco Internet Business Solutions Group (IBSG), the global strategic consulting arm of Cisco, helps CXOs and public sector leaders transform their organizations—first by designing innovative business processes, and then by integrating advanced technologies into visionary roadmaps that address key CXO concerns.

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