Document of the Inter-American Development Bank

**nicaragua**

**Broadband Program**

**(NI-L1090)**

**Economic Analysis**

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**content**

I. Introduction 1

II. Methodology and Assumptions 1

A. Methodology 1

B. Assumptions 3

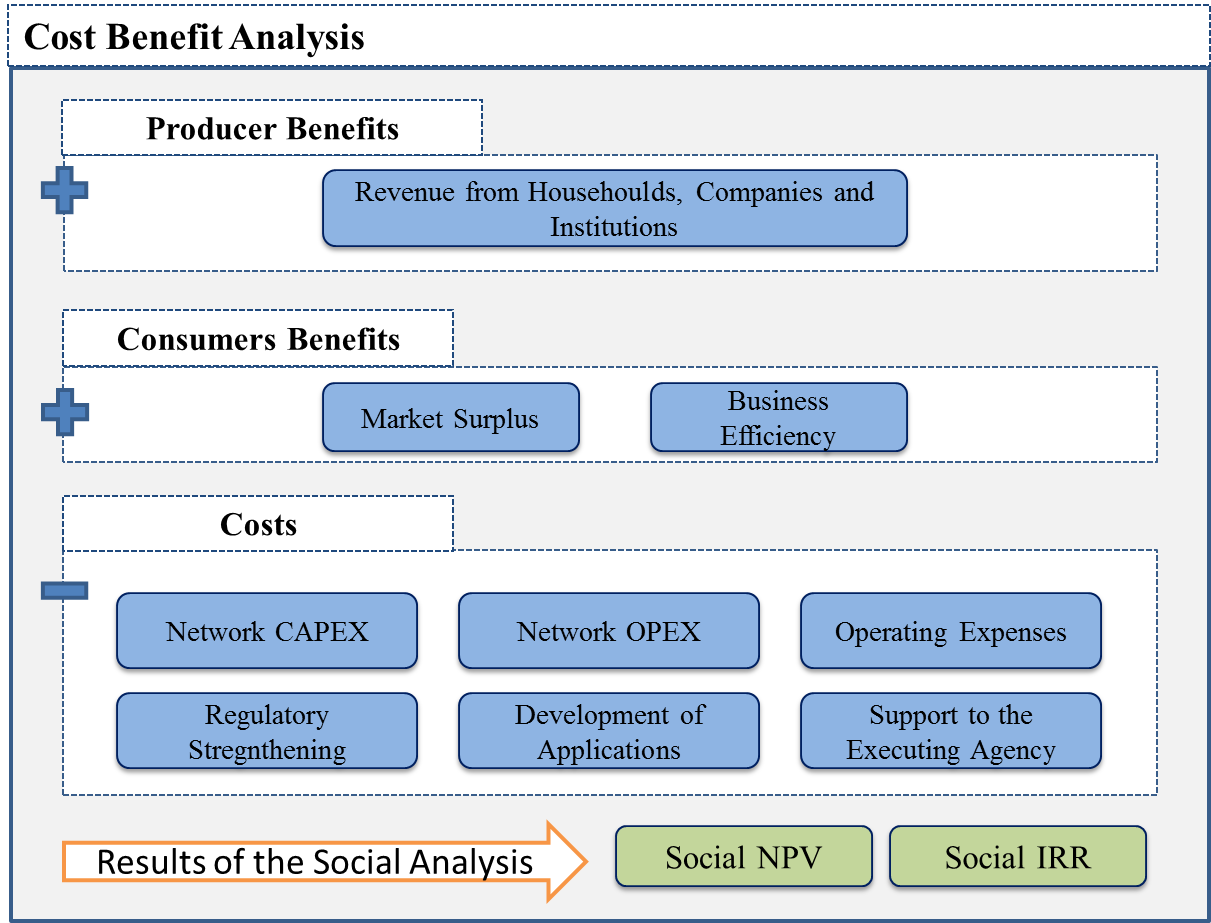
III. Valuation of the Economic Benefit 8

IV. Sensitivity Analysis 9

V. Summary 11

1. Introduction
   1. Broadband is a lever for socio-economic growth. According to a study published by the Bank, it has been observed a 3.19% increase in the GDP and a 2.61% increase in productivity where broadband penetration has increased 10% in the Latin American and Caribbean (LAC) Region. Besides this impact, broadband offers opportunities to increase life standards. For example: (i) broadband fosters the development of innovative education and health models and brings public administration closer to the citizen; and (ii) it has an important impact on the productive sector.
   2. Consequently, the Government of Nicaragua (the government) has identified broadband as a key element to foster socio-economic development. The government has recently developed a draft of their National Broadband Plan (NBP) around three main areas: (i) deployment of infrastructure; (ii) fostering of Information and Communication Technologies (ICT) services use; and (iii) strengthening of the regulatory framework. The government has begun implementing the NBP with an aggressive strategy to bridge the digital divide. The government is planning to expand the existing network of the national electric company, *Empresa Nacional de Transmisión Eléctrica* (ENATREL), to provide nationwide wholesale backbone services under the principle of open and equal access and also to expand last mile coverage connecting public facilities and installing access nodes so that other Internet Service Providers (ISP) can also provide Broadband Services (BBS).
   3. The government has requested the support of the Bank for its experience and value-added contribution in dealing with the complexity of specific geographical areas covered under this program (for example, low financial profitability, technical difficulties).
   4. **Proposed Intervention.** The Bank will support the government in the execution of its National Broadband Plan. To ensure a comprehensive program that impacts the whole ecosystem the proposed intervention will have three pillars: (i) infrastructure to reach unconnected and underdeveloped regions (backbone and last mile networks); (ii) regulation, key to ensure efficient use of the infrastructure; and; (iii) capacity development, especially important to foster the use of broadband.
2. Methodology and Assumptions
3. A. Methodology  
   1. The program will provide resources for up to US$50 million: US$40.5 million to finance infrastructure, US$2.5 million for regulatory strengthening, US$5 million to develop applications and US$2 million to support the executing agency.
   2. The methodology applied is based in the Discounted Cash Flow (DCF) analysis, which is widely used in the telecom industry to assess investment opportunities.
   3. Firstly, the producer benefits are estimated. This concept considers the revenue that the operator that will provide the broadband access through the deployed infrastructure would obtain from the connected households, companies and institutions.
   4. Subsequently, the consumer benefits are estimated. There have been considered two different types of consumer benefits: (i) the market surplus, which is the benefit that consumers, companies and institutions would obtain thanks to being able to access to broadband services at lower prices; and (ii) the business efficiency, which measures the increased productivity of companies adopting broadband thanks to this project. The latter is considered inside the consumer benefits because these companies are consumers in the broadband market and will improve their sales thanks to broadband. The two benefits are independent because the first has to do with the price to access broadband services while the other is related with the increased sales of companies. In other words, households and institutions will only “enjoy” the first benefit while companies will “enjoy” both of them.
   5. Finally, all the costs associated to the project are considered and the Social Net Present Value (S-NPV) and Social Internal Rate of Return (S-IRR) are calculated with the resulting cash flow (Producer Benefits + Consumer Benefits – Costs)

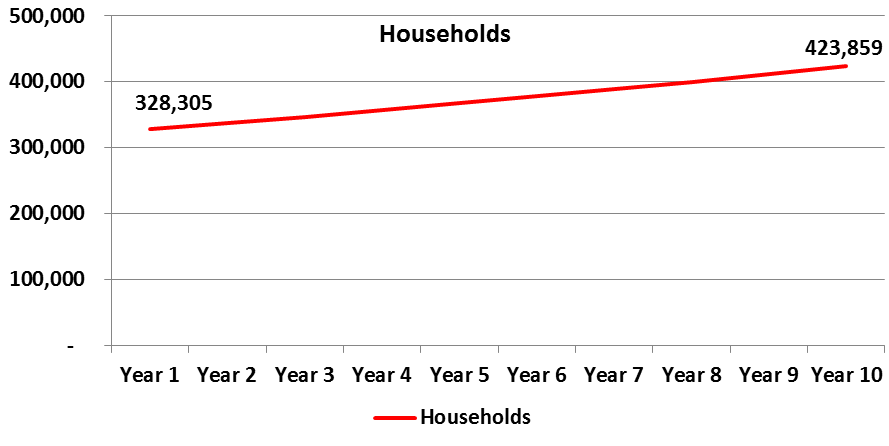
Chart 1 Summary of the implemented methodology



* 1. Despite the fact that several studies suggest that broadband benefits impact on multiple aspects of society, this analysis follows the principle of prudence and only takes into account a selection of clearly quantifiable benefits with a clear impact on the benefited regions.
  2. The present analysis allows, taking into account multiple inputs, forecast the cash and social flows as explained before. These flows have been valued for a 10 years period, with a discount rate of 12%.
  3. Additionally, a sensitivity analysis has been performed in order to assess the robustness of the results (see Section IV. Sensitivity Analysis).

1. B. Assumptions
   1. This Cost Benefit Analysis (CBA) is based on the following data and assumptions:
      1. According with the proposed deployment plan, the number of households benefited by this project is 328,305. It is important to note that these households will be covered (and not necessarily connected), The number of connected households depends on the market dynamics (price, market potential, etc.) and a detailed explanation on how it has been calculated can be found in 2.8.i.
      2. Based on historical data, the expected growth in the number of households for the upcoming years has been forecasted:

Chart 2: Projected number of households in the benefited area



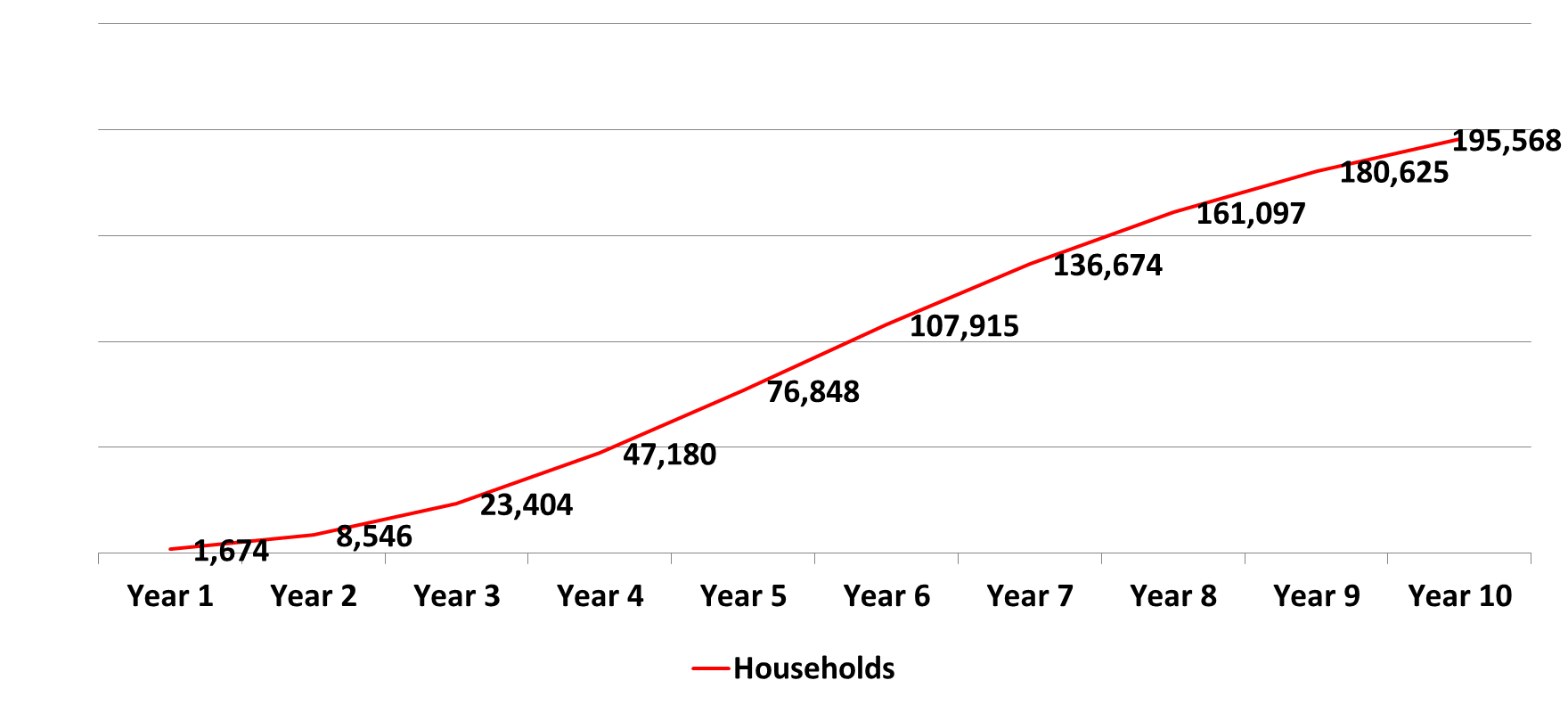
* + 1. According with the proposed deployment plan, the number of companies benefited by this project is 38,866. To estimate this number, the total number of companies in Nicaragua is considered (121,919[[1]](#footnote-1)). Then, to estimate the number of companies in the area of project intervention we have calculated the Gross Product per municipality and distributed the companies (following the approximation that municipalities with a higher product will have a higher number of companies). The list with the estimated number of companies per municipality can be found in Annex I of the present document.
    2. Based on historical data, the expected growth in the number of companies for the upcoming years has been forecasted. Specifically, we have considered the lowest growth in Nicaragua between the years 2011 and 2014, using data from INSS (*Instituto Nicaragüense de Seguridad Social*):

Chart 3: Projected number of companies in the benefited area



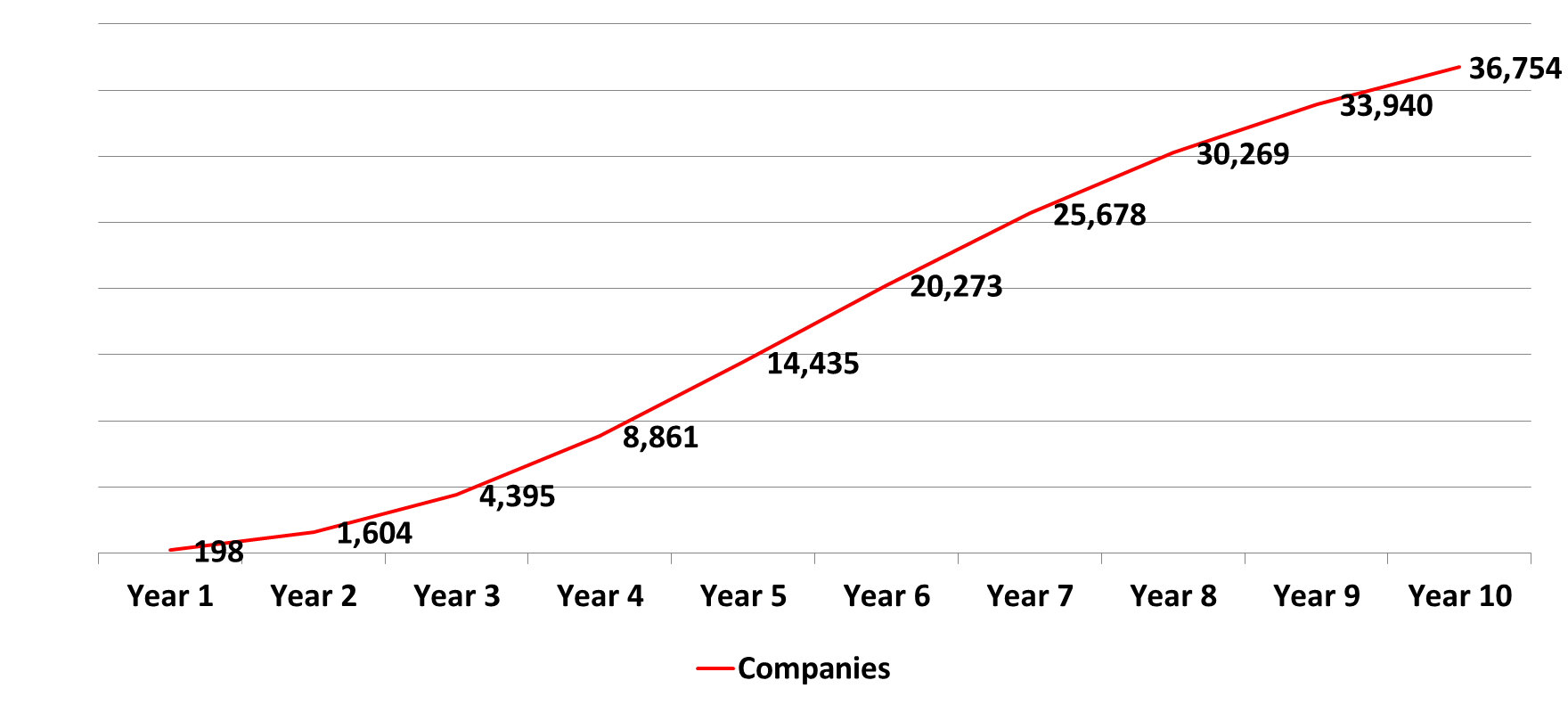
* + 1. The broadband potential market has been estimated from the results of the survey undertaken for the National Broadband Plan. Taking into account the results of this survey and the price of the broadband service (200 cordobas), the potential market has been estimated to be 46.14% of the households in the covered area.
    2. The exchange rate considered in the analysis is 27.22 Cordobas for each US$ (as found in Bloomberg in June 2015).
    3. Operation and Maintenance (O&M) costs have been set as a 10% of the total investment, taking into account international references[[2]](#footnote-2).
    4. The operating expenses have been estimated in US$11.89 million to serve the whole potential market, based on the following concepts:
       1. Fixed lines, mobile lines, internet, water, electricity, cleaning services, office supplies, marketing campaign (estimated as 5% of the sales), transport, fuel and oil, distribution and warehouse, rentals and other expenses.
       2. Staff costs, including general manager, secretary, marketing manager, sales personnel, engineers, regional technical support, network vice manager and rest of staff.
       3. Energy expenses
       4. Taxes and fees
       5. Billing systems and software
       6. Insurances, irrecoverable debts and contingencies
    5. In order to estimate the demand from households, institutions and companies, the Gompertz Curve (commonly used in the sector, for examply by the US telecommunications regulatory agency FCC[[3]](#footnote-3)) has been used. The formula of this curve has the following structure:
       1. Below is the description of the parameters included in the formula:
* y: The expected adoption at a given time
* b: the slope of the Gompertz curve. Measures the abruptness of the adoption
* a: the turning point. Measures the year in which switches from linear to exponential.
* m: the asymptote. Measures the expected adoption level once the market is fully developed. In the context of this project, m is the potential market.
* t: time.
  + - 1. To estimate the demand from households, a growing sigmoid-shaped curve has been projected taking into account the projection of households in the benefited area ( and the potential market (46.14%). The chart below shows the resulting adoption curve:

Chart 4 Households adoption Gompertz curve



* + - 1. Note that the numbers of connected households in Years 2 and 5 (8,546 and 76,848) are the same present in the results matrix as intermediate and goal values.
      2. To estimate the demand from companies a similar process has been followed, obtaining the following adoption curve:

Chart 5 Companies adoption Gompertz curve



* + - 1. Again, note that the numbers of connected companies in Years 2 and 5 (1,803 and 16,225) are the same present in the results matrix as intermediate and goal values.
      2. To estimate the demand from institutions (health), all the institutions that will be connected in this project have been considered. This number is keep fixed for the whole period because while there will be additional connections, these will not be attributable to the project. The number of connected institutions is 276 health centers.
    1. The price that has been considered in the project is 200 córdobas (US$ 7.34) for a 1Mbps connection, as estimated in the Nicaraguan National Broadband Plan.
    2. To estimate the market surplus, the following has been considered:
       1. Since the project is expected to bring more competition and improved infrastructure, one of its main effects will be reducing the price in the area of project intervention. This will have an effect on broadband demand which will raise providing further price reductions due to economies of scale. All this effects are considered in the market surplus..
       2. It has been performed an estimation of the value of the Market Surplus taking into account data from studies on the impact of broadband in the economy, developed between 2009 and 2012 by Shane Greenstein (Northwestern University) and Ryan McDevitt (University of Rochester).
       3. These studies use the generated market surplus in the US to estimate the consumer surplus in other countries, considering that the impact of broadband is similar and that the assessed countries are now experiencing the same changes the US followed in that period.
       4. The authors also calculate the percentage of the market surplus that ends up benefiting the users: in the majority of the studied countries consumers are benefited in a percentage around 20%. Specifically for the Latin American countries, in Brazil the percentage in the last year assessed is 21.95% while in Mexico it is barely an 8.12%. The low value in Mexico may be caused by the early stage of development of the broadband ecosystem.
       5. To calculate the market surplus expected in Nicaragua, the per capita values obtained in the study for Mexico has been considered (Brazil has not been considered because the market shows a different level of development):

Table 1 Consumer surplus per capita estimated in Brazil and Mexico

[[4]](#footnote-4)

* + - 1. After, the per capita value for Nicaraguan consumer surplus has been estimated taking into account the relative income per capita (which is important to make the data comparable). The selected proxy is the Mexican proxy (due to the similarity in broadband adoption).

Table 2 Estimated consumer surplus per capita in Nicaragua



* + - 1. Finally the Mexican proxy has been applied along with the population projected in the benefited area in order to estimate the consumer surplus for the first 6 years (the rest of years is maintained fixed because it is considered that the ecosystem is fully developed). The benefited population is calculated taking into account the number of covered (because the original study calculates the value taking into account all the population and not only the connected people) households and the average number of people per household in Nicaragua (5.59).
      2. Since the network is expected to be deployed in 4 years, the Consumer Surplus is only calculated for the percentage of people covered by the networks.

Table 3 Estimated Consumer Surplus in the benefited area



* + 1. To estimate the consumer benefits associated with the increased business efficiency, the following has been considered:
       1. The relationship between broadband penetration and increased business efficiency has been assessed in multiple studies to date[[5]](#footnote-5). The use of broadband by companies provides benefits in productivity, employment, sales and exports among others.
       2. According to the study The Impact of Broadband on Growth and Productivity, developed by the European Comission in 2008, the productivity of companies can improve up to a 5% for manufacturing companies and up to 7.5% for service companies.
       3. Since these estimations are from Europe and therefore not completely applicable, the number used has been adjusted to the Latin American case using the 2.6% explained in paragraph 1.1.
       4. It is important to note that this improvement is not only associated with the use of broadband but rather with the update and remodeling of the associated processes. Thus, the study emphasizes that the benefits expected for manufacturing companies will only take place if the companies invest and remodel their supply chain.
       5. The analysis has taken into account the aggregated product in Nicaragua:

Table 4 GDP values

[[6]](#footnote-6) 

* + - 1. On the other hand, the number of companies that will connect to broadband thanks to this project has been estimated. Since the effect of broadband on businesses efficiency is not immediate, it has been considered that this effect does not start until 3 years after the adoption of broadband by the company.
      2. To estimate the final value of this benefit, it has been calculated an increased product of 2.6% in the companies adopting the broadband service after 3 years.

1. Valuation of the Economic Benefit
   1. This section describes the flows that have been considered.

= Increased Business Efficiency Benefits

* 1. Taking into account these data, the Social Net Present Value (S-NPV) generated by the program is expected to be US$24.34 million, under the explained conditions with a Social Internal Return Rate (S-IRR) of 21%.

1. Sensitivity Analysis
   1. A sensitivity analysis has been performed over the described scenario, varying multiple inputs of the cost benefit analysis. The results measured in the analysis are the S-NPV and the S-IRR. Below there is a table with the results of the sensitivity analysis performed:

Table 5. S-NPV sensitivity analysis

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Considered Value** | **NPV low** | **NPV high** |
| Potential Market | 46.14% | $1.15 | $52.16 |
| Business Efficiency | Annually Calculated | $7.39 | $41.30 |
| Discount Rate | 12% | $41.87 | $12.00 |
| Exchange Rate | 27.22 | $40.01 | $15.90 |
| Price | 200 córdobas | $13.38 | $35.31 |
| Operating Expenses | 11.89 million | $31.79 | $16.89 |
| Operating and Maintenance Costs | 10% | $28.37 | $20.31 |
| Market Surplus | Annually Calculated | $22.21 | $26.48 |

* 1. The values in the column “S-NPV low 30%” show the resulting S-NPV making each variable a 30% lower than the considered value. The values in the column “S-NPV high 30%” show the resulting S-NPV making each variable a 30% higher than the considered value. Below there is a chart showing the same information graphically:

Chart 6: Sensitivity Analysis: Net Present Value

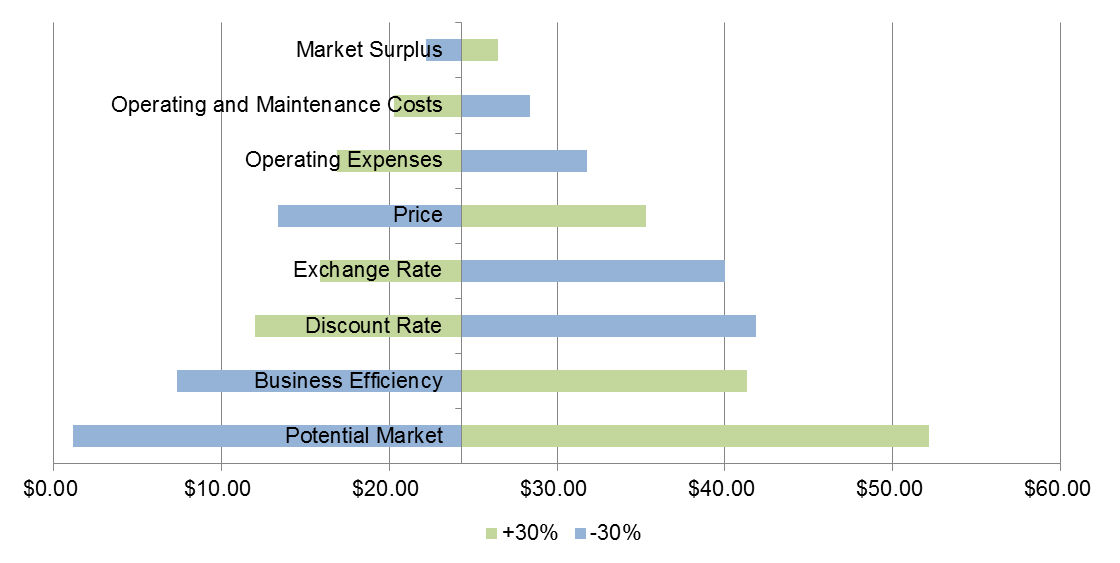
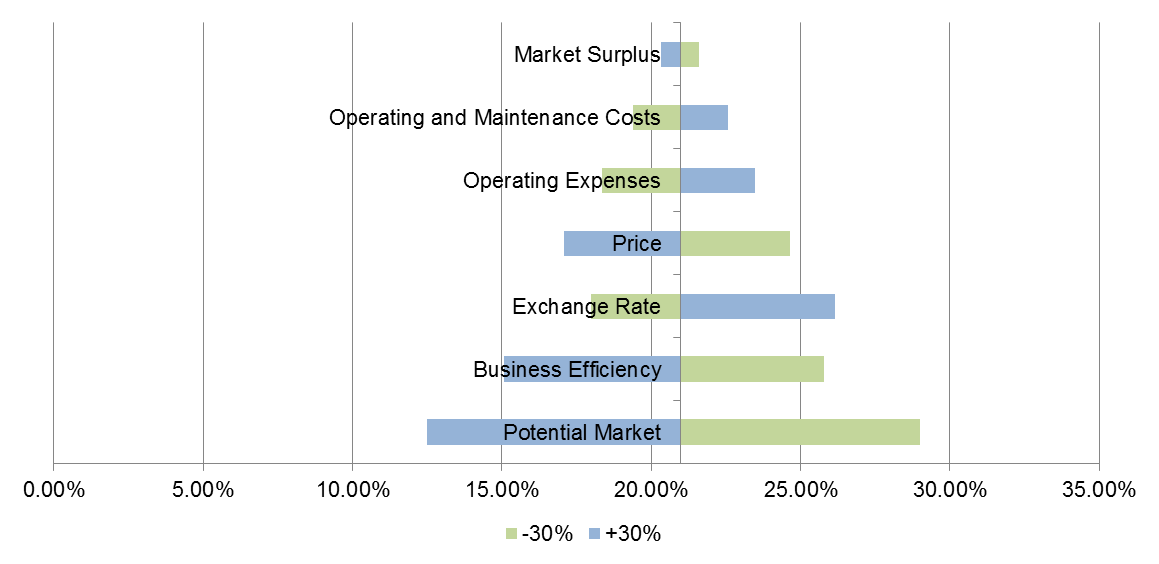


Table 6. IRR sensitivity analysis

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Considered Value** | **S-IRR low** | **S-IRR high** |
| Potential Market | 46.14% | 12.48% | 29.00% |
| Business Efficiency | Annually Calculated | 15.08% | 25.78% |
| Exchange Rate | 27.22 | 26.16% | 18.00% |
| Price | 200 córdobas | 17.09% | 24.64% |
| Operating Expenses | 11.89 million | 23.48% | 18.36% |
| Operating and Maintenance Costs | 10% | 22.57% | 19.40% |
| Market Surplus | Annually Calculated | 20.32% | 21.59% |

* 1. The values in the column “S-IRR low 30%” show the resulting S-IRR making each variable a 30% lower than the considered value. The values in the column “S-IRR high 30%” show the resulting S-IRR making each variable a 30% higher than the considered value. Below there is a chart showing the same information graphically:

Chart 7: Sensitivity Analysis: Internal Rate of Return



* 1. The variables that have the highest impact on the S-NPV are the Potential Market, the benefits from the increased Business Efficiency and the Discount Rate. As for the S-IRR, the variables with the greatest impact are the Potential Market, the benefits from the increased Business Efficiency and the Exchange Rate.
  2. It is important to note that the potential market is the most important variable for both the S-NPV and the S-IRR. It is very unlikely that the potential market drops as much as 30%. As part of its National Broadband Plan, the Government of Nicaragua is developing a nationwide demand stimulation plan which will further increase the potential market.
  3. In any case, the S-NPV and the S-IRR remain positive for all the considered scenarios, above US$1.15 million and 12.48% respectively, which emphasizes the robustness of the results.

1. Summary
   1. From the present analysis, it is expected that the program generates an aggregated net benefit of US$24.34 million. The S-NPV remains positive for multiple variations on the inputs as detailed in section IV. Therefore, the execution of this program is recommended.

Annex I: Resultados del Análisis de Flujos de Caja Descontados



1. Ver: [Banco de Nicaragua](http://www.bcn.gob.ni/publicaciones/periodicidad/anual/nicaragua_cifras/nicaragua_cifras.pdf). [↑](#footnote-ref-1)
2. Cost Models of different International Operators (National Regulatory Agencies). [↑](#footnote-ref-2)
3. http://download.broadband.gov/plan/fcc-omnibus-broadband-initiative-(obi)-working-reports-series-technical-paper-bam-attachment-9-gompertz-penetration-rate-documentation.pdf. [↑](#footnote-ref-3)
4. As a reference, in 2004 broadband penetration was 1.72% in Brazil and 0.97% in Mexico. These numbers are comparable with the current 2.17% in Nicaragua and the 0.51% in the area of project intervention (source: ITU <https://www.itu.int/en/ITU-D/Statistics>) [↑](#footnote-ref-4)
5. For example “The impact of broadband in growth and productivity – MICUS – 2008” and “Impact of Broadband on the Economy – TIU -2012” [↑](#footnote-ref-5)
6. Source: World Bank [↑](#footnote-ref-6)