Connecting Australia:

The impact of the nbn on Australian lives and the economy

Summary of methodology

2018

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Overview and motivation of this study

The purpose of the study is to understand how the nbn has performed in achieving its original policy intention to improve the lives of Australians, reduce the digital divide, and drive economic benefits.

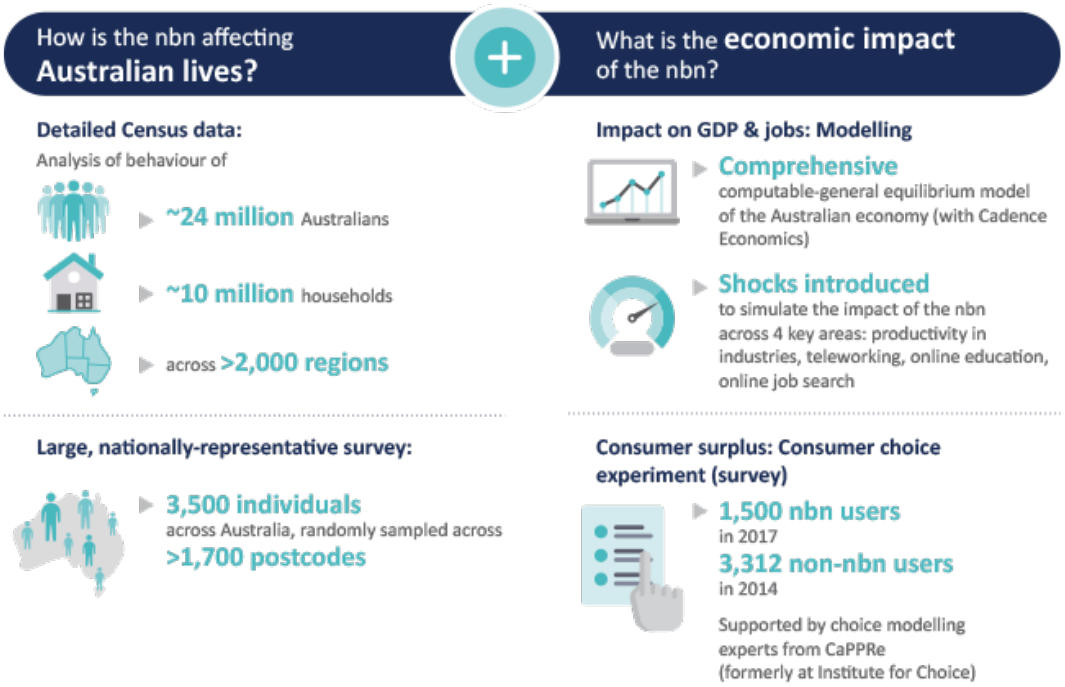
nbnco's 2016 Corporate Plan states that *"the primary role of nbn is to enable Australia's greater participation in the digital economy and help bridge the digital divide – between young and old, city and country, and Australia and the rest of the world. … [The] nbn is delivering vital infrastructure investment and promises to further transform the way business operates and the way we live our lives".*[1] This was also reinforced by Prime Minister Turnbull in the Statement of Expectations 2016, highlighting that the purpose of the nbn is to *"foster productivity" and "drive economic and social benefits for Australians".*[2]

This study uses the opportunity of the partial rollout to measure the broader social and economic impact of the nbn, compared with areas that do not have nbn. The data and results from this work also establishes a baseline from which to measure change in behaviour over time.

Analytical models used in this study

The analysis used four econometric models, as well as a number primary and secondary data sources, to measure the impact of nbn on the lives of Australians and on the economy, as shown in Exhibit 1. The following sections will explain the methodology of each model.

Exhibit 1. Data sources and econometric models



[1] nbnco Corporate Plan 2016

[2] Statement of Expectations from the Hon Malcolm Turnbull to nbnco, 24h August 2016

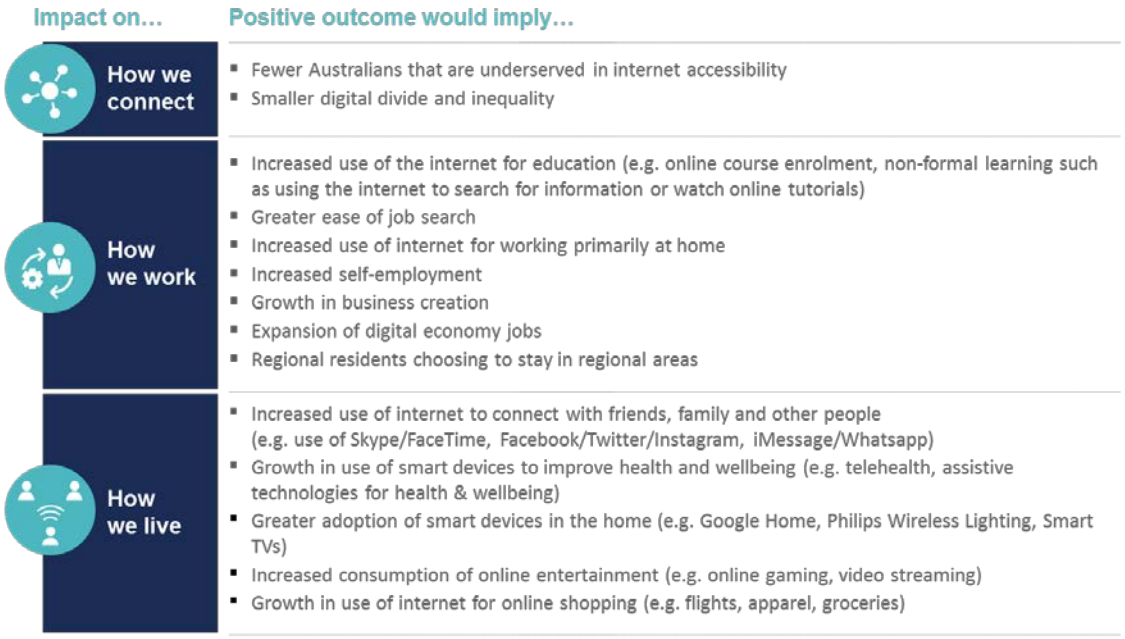
i) Identifying the important impacts to measure

The first step to understanding the impact of the nbn on the lives of Australians was to identify the areas of a person's life that would be affected by faster broadband. To do this, AlphaBeta and nbnco jointly constructed an 'impact framework' to capture meaningful impacts on end users (Exhibit 2).

A valuable impact framework needs to have the following features:

- **Relevant** to nbnco's objectives outlined in the Corporate Plan
- **Measurable** through publicly available data or an end-user survey
- **Insightful** about the nbn's current impact on the lives of Australians or useful as a baseline for measuring future impact

Exhibit 2. Impact framework



SOURCE: Workshop and interviews with nbnco, AlphaBeta analysis

ii) Collecting data on the metrics in the impact framework

After identifying the impact areas for this study, the next step was to acquire data on each metric:

- **How we connect** – internet speed and access data for Australia and other OECD countries
  - Data was sourced from the ABS and OECD on internet access, including the distribution of users across internet speed tiers in Australia and other OECD countries.
  - Data was collected on the share of people without internet access from the International Telecommunications Union.

- ABS and OECD speed tiers were aligned.
- We estimated the share of people that will be without internet access in Australia in 2021, based on the historical trend for 2012-2016 as reflected in the ITU data.
- We calculated a Gini coefficient – a statistical index used to measure inequality – for the distribution of fast internet access in OECD countries. The Gini coefficient was based on the share of people in OECD countries per fixed broadband speed tiers and the mean speed within each speed tier. The population shares served as weights for each speed tier to estimate the Gini coefficient of the underlying speed distribution.

- **Geographic rollout information** – ascertain degree of rollout across different regions to identify regions with high and low presence of the nbn
  - We analysed geospatial data on the nbn rollout as of November 2017 at the so-called 'Mesh Block' level, the smallest geographical area defined by the Australian Bureau of Statistics (ABS)
  - We estimated the degree of rollout (in %) using various geographical boundaries such as suburbs and postcodes to identify regions with high and low presence of the nbn based on the degree and duration of the rollout.
- **How we work** – six metrics from the impact framework using Census data from 2006, 2011, and 2016
  - We analysed unbiased and independent Census data at the very granular level of Statistical Areas Level 2 (SA2)
  - We split the SA2s into two groups for comparison: regions with nbn (high presence of the nbn) and regions without nbn (low presence of the nbn)
- **How we work and live** – remaining metrics from the impact framework using a large, national phone survey
  - In collaboration with Ipsos, we conducted a nationally representative 12-minute survey comprising 3,500 individuals in Australia between Nov and Dec 2017 with quotas on age, gender, and geography
  - Residents from 1,757 postcodes were randomly sampled, targeting areas with high or low nbn rollout to ensure a mix of nbn users (51% of sample) and non-nbn users (49% of sample)

iii) Analysis of Census data

The ABS and the Census provided rich data sources for examining the impact of the nbn on outcome variables for 'how Australians work' (Exhibit 3). The following outcome variables were measured:

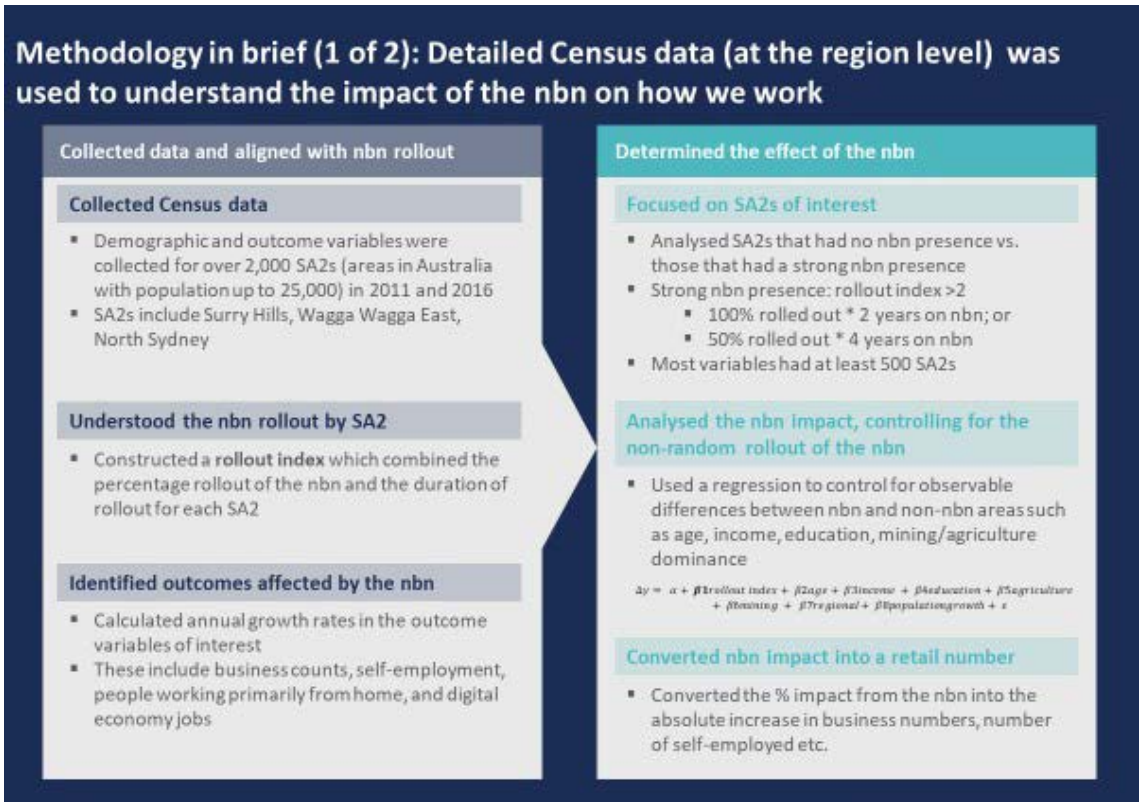
- Annual growth rate in business (ABS Business Counts)
- Annual growth rate in people that are self-employed (ABS – Census)
- Annual growth rate in people working from home (ABS – Census)
- Annual growth rate in digital economy jobs (ABS – Census)

A linear regression was used to analyse the Census data. This regression included a number of variables to control for the non-randomness of the nbn rollout (including age, income, education, industry, metro/regional). The regression was run on a subset of the census data. Specifically, this dataset only included SA2s deemed to have met a certain threshold of rollout, as well as SA2s where the nbn had not yet been rolled out. Each observation (SA2) in the regression was weighted according to the 2016 population to ensure the regression was robust to outliers.

The results were assessed for significance at the $p<0.05$ level, however most metrics that yielded significant results had $p<0.01$.

The national effects (coefficients) on each outcome variable were then converted into an absolute number, for example, the number of businesses whose formation was likely driven by the nbn. To measure the national effect of the nbn, we compared two scenarios: one with nbn access and one without. The difference between these two scenarios was defined as "nbn effect".

Exhibit 3. Analysis of detailed Census data



iv) Analysis of survey data

Metrics: Given the limited number of metrics available in public data to measure the impact of the nbn, we used a bespoke national survey to collect data on metrics that measure how the nbn has impacted the way Australians work and live (Exhibit 4). Examples of these metrics include:

- How Australians learn and work: enrolment in online courses, time spent using the internet for non-formal learning, and internet use for job search
- How Australians live: time spent using the internet for socialising, use of smart devices to improve health and wellbeing, and time spent using the internet for entertainment

Controls: The rollout of the nbn was conducted in a non-random fashion, prioritising poorly served areas in the first stages of the rollout. To reflect the non-randomness of the rollout and ensure our

survey results are robust, we needed to create certain controls to account for the different types of people living in areas with and without nbn access. Examples of controls include: age, income, gender, metro/regional, and education levels. Binomial and ordinal logistical regression models were used to establish these controls.

Measuring the nbn impact: The regression models aimed to:

- Compare behavioural differences between nbn and non-nbn users
- Control for observable differences in characteristics of the individual that would change his or her propensity to behave in a particular way (e.g. younger people are more likely to enrol in online courses)

The results were assessed for significance at the $p<0.05$ level, however most metrics that yielded significant results had $p<0.01$.

Estimating the impact of the nbn in Australia was calculated for each metric by:

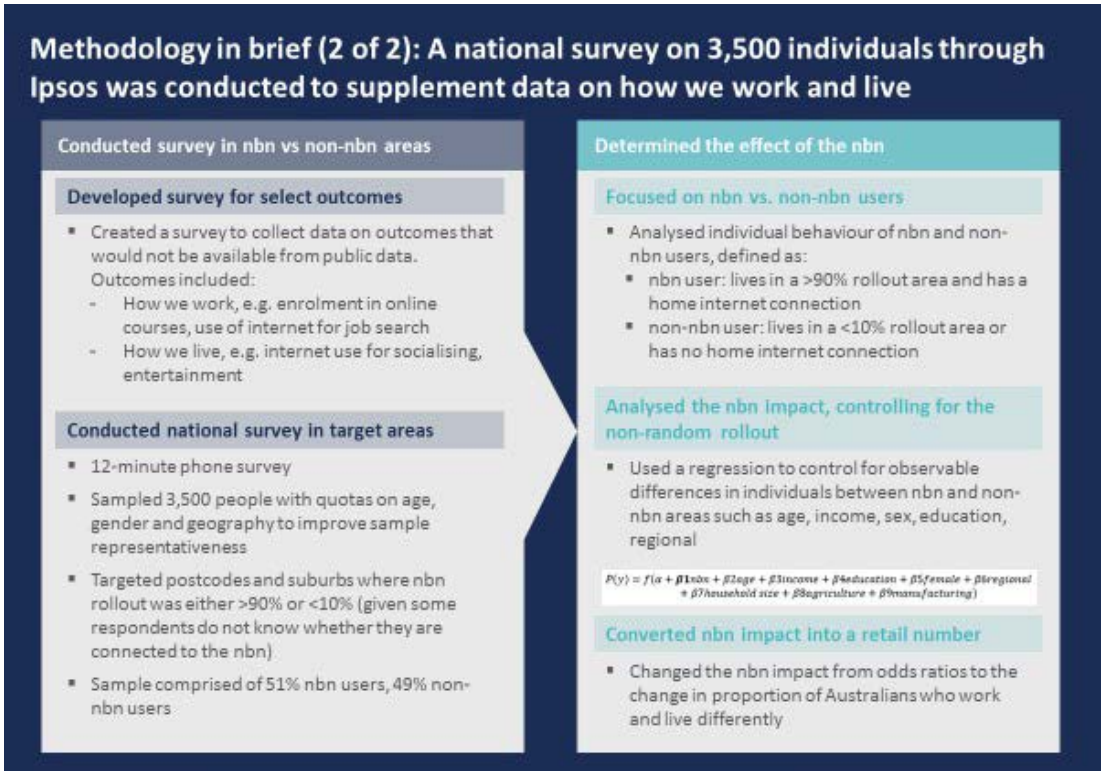
1. Running the logistical regression model on the survey data, weighted by population age brackets
2. Calculating the controls for the average Australian (e.g. average age, average level of education)
3. Analysing the marginal effects of the nbn on average Australians; results reflect how likely an average Australian would participate in an activity, such as enrolling in an online course
4. Comparing the likelihood of average Australian nbn users and non-nbn users to engage in a certain activity to observe the effect of the nbn

Variations: Alternative model specifications were used to further validate results. Because the nbn dummy variable (an individual is either nbn user or not) was the primary variable of interest in this analysis, AlphaBeta assessed and compared the results using two different definitions of nbn connectivity:

- Self-reported nbn connection (based on the individual reporting their home internet connection as the nbn or not)
- Inferred nbn connection (based on the percentage rollout of the individual's residential area, where people in areas with >90% rollout were assumed to be nbn users, while those in areas with <10% rollout were regarded non-nbn users)

Results from both definitions of nbn and non-nbn users generated similar findings. However, results from the inferred nbn connection are likely to be more robust, as past surveys indicate that approx. 20-30% of respondents misreport their nbn status. In this survey, over 8% of respondents did not know their type of home internet connection.

Exhibit 4. Large, nationally-representative survey



v) Measuring the impact of the nbn on regions in Australia

To understand the impact of the nbn at a more local level, this study estimated the impact of the nbn on behaviour change within 88 regions at the Statistical Areas Level 4 (SA4s), as defined by the ABS. In metropolitan areas, SA4s are areas with 300,000 – 500,000 people; in regional areas, SA4s are areas with 100,000 – 300,000 people.

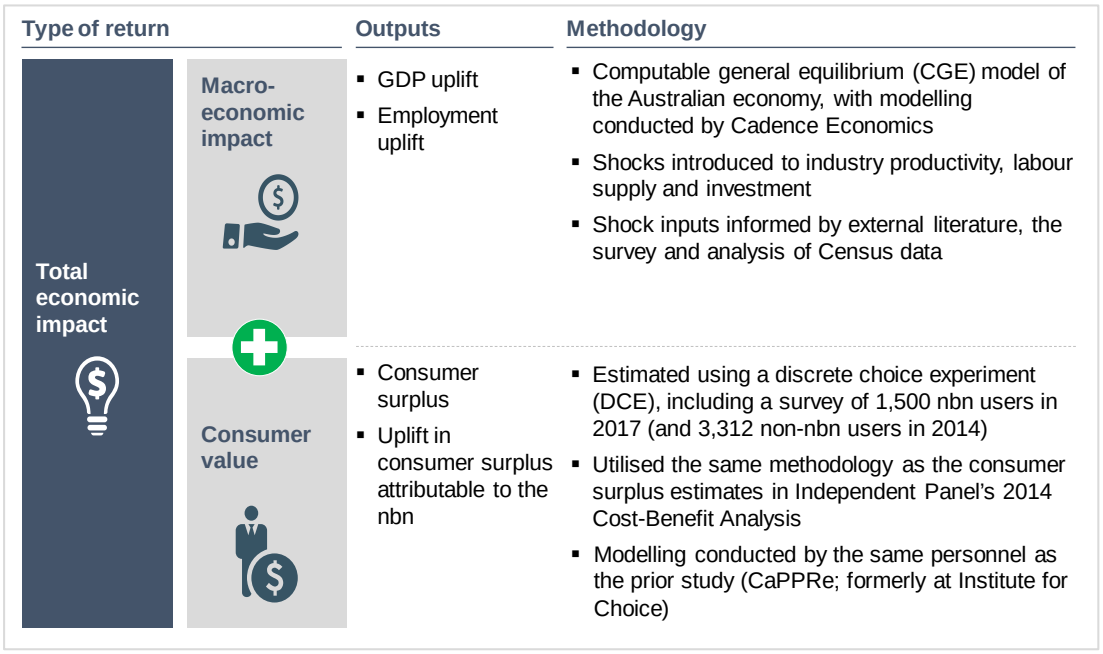
Like the national analysis, the method used to analyse Census and survey data were different. At a high level, both methods involved using national results and applying the nbn effect at the local level through variations in population size, percentage rollout, and other demographic factors.

Variation in the estimated regional impact of the nbn is fundamentally driven by the degree of rollout in a region and by demographic differences between regions

Measuring the impact of the nbn on the Australian economy

To model the overall economic impact of the nbn, we assessed its impact on key macroeconomic variables (including GDP and employment), and its benefit for individual consumers. Different methods were employed for each, and these are described below (Exhibit 5).

Exhibit 5. Methodology for economic modelling



vi) Macroeconomic impact

The impact of the nbn on macroeconomic outcomes was estimated using a Computable General Equilibrium (CGE) model, which is a full simulation of the Australian economy. CGE modelling is widely used to assess the impact of large projects, as it captures the complex interactions between different macroeconomic variables (including GDP and total employment). For this part of the analysis, AlphaBeta worked with Cadence Economics (formerly the CGE modelling team of Access Economics, which conducted similar valuations of the nbn in 2010).[3]

To estimate the macroeconomic impact of the nbn we introduced a series of "shocks" to the CGE model and measured the change in GDP and employment over time relative to a scenario without the nbn. These shocks included:

- **Improvements in business productivity due to higher broadband speeds and greater access to broadband.** These were modelled based on the expected increase in internet speeds attributable to the nbn, combined with results from international literature that estimate the economic implications of increased internet speed.[4]
- **Improved labour market outcomes due to online education.** This shock was modelled based on survey data on the additional share of people studying for courses as a result of the nbn, and ABS data on the employment and earnings of people with qualifications (versus without).
- **Increases in hours worked due to nbn-enabled teleworking.** This shock was modelled based on a result from Census data on the increase in people working from home due to the nbn.

[3] See Access Economics (2010) "Economic Impact of the National Broadband Network in Queensland" and Access Economics (2009) "Impacts of a national high-speed broadband network"

[4] An additional shock was introduced to the healthcare industry to reflect increased adoption of telehealth. This shock was based on data from the survey, combined with international literature on the potential cost savings from telehealth.

- **Additional hours worked due to the use of online job search (leading to less time between jobs).** This shock was calculated using survey data on the additional share of people using online job search as a result of the nbn, combined with external literature on the ability for online job search to reduce time between jobs (and therefore boost hours worked in the economy).

The CGE model was run for the following three scenarios, in which the shocks described above increased proportionally with the implied uplift in broadband speed (Exhibit 6).

Exhibit 6. Alternative speed uptake scenarios

The economic impact of the nbn could be increased if Australia further harnessed the potential of the nbn. A number of different scenarios for take-up in 2021 have been modelled:

1	2	3
Scenario: Corporate Plan target	**Scenario: Focus on 50**	**Scenario: Top-end users**
The economic impact in 2021 of Australia moving to:	The economic impact in 2021 of Australia moving to:	The economic impact in 2021 of Australia moving to:
▪ The speed tier mix in 2021 as identified in the 2018-2021 Corporate Plan ▪ Engaging in behaviours and business activity that capitalise on the benefits of these speeds	▪ A 'focus on 50' scenario, with all households on lower speed tiers moving at least up to 50mbps plans ▪ Engaging in behaviours and business activity that capitalise on the benefits of these speeds	▪ The speed tier mix of the current top 20% of users ▪ Engaging in behaviours and business activity that capitalise on the benefits of these speeds

vii) Consumer surplus

In the context of broadband, consumer surplus is the additional value consumers attach to their home broadband connection, measured as the difference in what they are willing to pay and what they are actually paying. For example, if a consumer is willing to pay $154 per month for a home broadband connection but actually only pays $70 per month, he or she derives a consumer surplus of $84 per month. The *increase* in consumer surplus (before versus after the introduction of the nbn) is one way to measure the extent to which the nbn has made consumers better off.

An online survey comprising a discrete choice experiment was used to estimate the consumer surplus. The experiment was conducted by the same personnel and involved a similar method as the 2014 Independent Cost-Benefit Analysis (CBA). As part of the experiment, 1,500 nbn users were surveyed in 2017 (and 3,312 non-nbn users in 2014) and asked to choose between different internet plans at different price points. The sensitivity of consumers to different attributes (e.g. price, speed, data & brand) was then modelled using a latent class model.[5] Estimates of consumer surplus were derived by combining the model parameters with information on the plans available pre- and post-nbn. The previous work conducted as part of the 2014 CBA provided a valuable "pre-nbn" baseline model of consumer surplus. The uplift in consumer surplus attributable to the nbn was derived from the difference between the 2017 estimate and the equivalent estimate from the 2014 model.[6]

[5] Consumer surplus was derived using methods consistent with those employed in the 2014 Cost-Benefit Analysis. These methods (including the latent class model) are detailed in Train (2009) "Discrete choice methods with simulation", Cambridge University Press.

[6] The 2014 estimates were adjusted for inflation (figures are expressed in 2017 currency) and for the availability of cable broadband for a subset of users pre-nbn (2014 consumer surplus was adjusted up slightly to account for the higher consumer surplus experienced by the 8% of households that were subscribed to cable broadband).