

report

Validation of the 2016 Actuarial Valuation for the Australian Priority Investment Approach to Welfare

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THE UNIVERSITY
OF QUEENSLAND
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ISSR

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LIST OF ABBREVIATIONS

ABS	Australian Bureau of Statistics
AGA	Australian Government Actuary
ATO	Australian Tax Office
CPI	Consumer Price Inflation
CURF	Confidentialised Unit Record File
DAA	Data Analysis Australia
DSP	Disability Support Pension
DSS	Department of Social Services
ERP	Estimated Resident Population
GLM	Generalised linear model
HILDA	Household, Income and Labour Dynamics in Australia
ISSR	Institute for Social Science Research
MTAWE	Male Total Annual Weekly Earnings
PBLCI	Pensioner and Beneficiary Living Cost Index
PIA	Priority Investment Approach
PwC	PricewaterhouseCoopers
SA1	ABS Statistical Area level 1
SA2	ABS Statistical Area level 2
SA3	ABS Statistical Area level 3
SA4	ABS Statistical Area level 4
UQ	The University of Queensland

EXECUTIVE SUMMARY

Introduction

Consistent with the recommendations of the McClure Review of Australia's welfare system, the Australian Government Department of Social Services (the Department) is implementing the Australian Priority Investment Approach to Welfare which aims to reduce welfare dependency and to improve the lifetime wellbeing of people and families in Australia. This approach uses actuarial analysis to estimate the future lifetime cost (the actuarial valuation) of Australia's social security system. The results of the analysis will inform development of policy interventions for cohorts at risk of long-term welfare dependency to improve lifetime wellbeing.

The first actuarial valuation was undertaken by PricewaterhouseCoopers (PwC) in conjunction with Data Analysis Australia (DAA). This baseline valuation estimated the total lifetime costs for the Australian population as at 30 June 2015 and was documented in the report, *Valuation Report 30 June 2015 Baseline Valuation*, which was publically released by the Minister for Social Services on 20 September 2016.

The Department engaged the University of Queensland's (UQ) Institute for Social Science Research (ISSR), in conjunction with Deloitte Actuaries and Consulting Limited to validate the baseline valuation which was documented in the report, *Validation of the Actuarial Valuation for the Australian Priority Investment Approach to Welfare*, prepared for the Department on 3 November 2016.

This initial validation of the baseline valuation was undertaken with reference to the scope of the valuation for the Provider and focused on the specific processes and methodologies that were used to produce the baseline valuation. This included the simulation of the baseline model population, the projection of the welfare utilisation of the population into the future and the actuarial payment and indexation assumptions applied to the model.

The current report provides a validation of the refinements and changes made to the approach and methodology used for the second actuarial valuation which is an updated estimate of the total lifetime costs based on information as at 30 June 2016 (the 2016 valuation). These validation findings are to be read in conjunction with the baseline validation report.

Summary of findings

This review has concluded that considerable improvements have been made to the valuation methodology with the implementation of the following recommendations from the validation of the Baseline Valuation report:

- PwC and the Department have established a governance arrangement that includes project oversight by the Department's Investment Approach Taskforce and the Investment Approach Inter-Departmental Committee (IDC). This includes guidance on the economic assumptions that were confirmed following consultation with the IDC.
- The imputation process for missing data was improved through updating the algorithm for projecting the population from the census date to 2016.
- Statistical process uncertainty in the simulated lifetime costs for the overall model population was estimated using ten simulation runs over the lifetime for each person in the model population.
- New class characteristic risk variables have been included in the dynamic simulation model to improve predictions. The class variable values were predicted following simulation of the welfare class but before utilisation of payment types and amounts.
- An economic module has been included in the 2016 valuation. This module has been designed to aid understanding of the extent to which the macro-economic environment influences welfare utilisation and the number and mix of current welfare recipients has been influenced by the economy. The development of this module has assisted PwC in modelling explicit scenarios for the future macro-economic environment in place of the implicit scenario(s) embedded within the baseline valuation. It will also allow PwC to explore the potential impact of different scenarios of future economic conditions in future valuations, thereby increasing the adaptability of the overall approach.

Recommendations

Additional recommendations have emerged for consideration in future evaluations:

In order of priority it is recommended that:

1. A written document be produced outlining the development plan detailing planned improvements and refinements of the valuation model which is then approved and overseen by the governance body. This would include clarification of the suggestions and recommendations that can be pursued and achieved in the approach to the subsequent valuation, given available time and resources, and any that will be carried forward to future valuations.
2. The processes relating to the analysis of change are agreed and documented and allocation of movements in the valuation to changes in experience or assumptions are reviewed by the Department.
3. Where there are multiple changes in the valuation due to multiple changes in policy, the analysis of change should separate out the change due to each policy in isolation, in order to assess the impact of each policy initiative separately. The analysis of policy changes should be improved by including additional details such

as impacts for specific cohort, impacts on expenditure by different payment types and likely periods of impact in the future.

4. The analysis of change figure should be adjusted to improve interpretability by the non-actuarial reader, as described in Section 6.
5. A detailed knowledge transfer strategy is developed, agreed to by both the Department and the Provider, and implemented for future valuations. This strategy should combine a program of activities as outlined in Section 7.2, and include delivery of the complete set of working files in addition to the delivery of sufficient technical documentation and presentation material for training to ensure the on-going ability of the Department to implement the valuation model independently.
6. That the process of deriving flow assumptions for non-welfare recipients to the welfare classes, based on calibration of the models applied to the administrative data, be more clearly explained and documented.
7. A more detailed description and explanation of the form and structure of the dynamic statistical models fitted to the available data for deriving flow assumptions, is documented with future valuations. To support improvements to the modelling and assumption setting process, this should include a summary of the analyses and results demonstrating improvements in the accuracy of predictions as relevant additional variables and interactions are added to the model.
8. A review of demographic models, existing or in development within the Australian Government, is undertaken to inform the inclusion of available variables in the demographic models for the flow assumptions.
9. Improvements are made to the development of the projection assumptions through a refinement of the dynamic generalised linear transition models, based on the findings from the review.

1 INTRODUCTION

The Department of Social Services (the Department) is implementing an investment approach to welfare. The primary aim of the Australian Priority Investment Approach to Welfare is to reduce welfare dependency and to improve the lifetime wellbeing of people and families in Australia. This approach uses actuarial analysis to estimate the future lifetime cost of Australia's social security system and the results of the analysis will be used to develop policy interventions for cohorts at risk of long-term welfare dependency and, in turn, improve lifetime wellbeing and reduce the Commonwealth's future costs. The use of actuarial valuations is consistent with the recommendations of the McClure Review of Australia's welfare system and is a Ministerial priority.

The first actuarial valuation was undertaken by PricewaterhouseCoopers (PwC) in conjunction with Data Analysis Australia (DAA) (the Provider). The baseline valuation estimated the total lifetime costs for the Australian population as at 30 June 2015 and was documented in the report, *Valuation Report 30 June 2015 Baseline Valuation*, which was publically released by the Minister for Social Services on 20 September 2016.

The University of Queensland's (UQ) Institute for Social Science Research (ISSR), in partnership with Deloitte, was engaged to validate the first two actuarial valuations of the Commonwealth's social security and income support system using the Australian Priority Investment Approach to Welfare. The initial baseline valuation was documented in the report, *Validation of the Actuarial Valuation for the Australian Priority Investment Approach to Welfare* (the baseline validation report) prepared for the Department on 3 November 2016.

This current report provides a validation of the refinements and changes made to the second actuarial valuation which is an updated estimate of the total lifetime costs based on information as at 30 June 2016 (the 2016 valuation). These validation findings should be read in conjunction with the baseline validation report. The initial validation of the baseline valuation was undertaken with reference to the scope of the valuation for the Provider and focused on the specific processes and methodologies that were used to produce the baseline valuation. This included the simulation of the baseline model population, the projection of the welfare utilisation of the population into the future and the actuarial payment and indexation assumptions applied to the model.

The current validation of the 2016 valuation has focussed on refinements and changes to the approach and methodology used for the 2016 valuation.

2 CLARIFICATION OF SCOPE

The validation of the 2016 valuation has been undertaken with a focus on amendments to the baseline valuation methodology with the aim of improving the accuracy and robustness of the 2016 and subsequent valuations.

The objectives of this second validation of the 2016 valuation were to:

- a) validate the changes and refinements to the valuation methodology;
- b) assess the method of summarising and visualising the overall change in lifetime cost from the baseline valuation to the 2016 valuation (assessing the change);
- c) assess application of the suggestions and recommendations outlined in the pre-existing validation of the baseline valuation report.

The validation process did not include reviewing the underlying dataset extracted from the Department of Human Services Enterprise Data Warehouse, reconstructing the analyses already undertaken as part of the actuarial valuation, testing of alternative statistical or actuarial models to improve the valuation, or conducting a validation on processes and methods unchanged from the baseline validation. Rather, this report has been designed to build upon the previous report of the baseline validation which includes detailed information on the approach and methodology for validation as well as the subsequent suggestions and recommendations for future valuations.

3 APPROACH TO THE VALIDATION OF THE 2016 ACTUARIAL VALUATION

The approach to the actuarial valuation uses statistical methods and dynamic micro-simulation models to create the model population and to project the lifetime welfare pathways of all individuals in the population. Financial projections are then made to estimate the future lifetime cost of Australia's social security system for the model population.

The validation process for the 2016 valuation was facilitated by an initial teleconference with the Department, PwC and the ISSR-Deloitte team on 12 April 2017, followed by a face-to-face meeting on 15 May 2017 to discuss and clarify outstanding queries. Throughout the duration of the validation process regular correspondence between the Department, ISSR and Deloitte took place via weekly or fortnightly teleconferences. To assist with the validation process, PwC provided the ISSR and Deloitte team with a set of working papers and exhibits that have been used to share information about the model development between the Provider and Department. It was agreed with the Department that validation of the SAS software code used to implement the model for the actuarial valuation was not required.

ISSR reviewed Steps 1 to 5 of the valuation process including the creation of the model population and the dynamic micro-simulation model. Deloitte actuaries reviewed the actuarial assumptions related to the simulation of annual payments, payment indexation and adjustments in Steps 6 to 8 and Step 10. The ISSR-Deloitte team together provided the validation findings arising from these reviews.

The models developed and applied in the valuation process included hundreds of individual assumptions and therefore it was not possible to review or validate each and every one. However, the relevant sets of assumptions were reviewed and a broad philosophy was taken to their validation, including consideration of the appropriateness of the data used and model specification.

The Validation of the 2016 actuarial valuation focused on refinement and amendment of the valuation methodology undertaken to improve the accuracy and robustness of the 2016 and subsequent valuations. Clarification of the data, methodology and assumptions adopted in the original valuation was sought through consultation with PwC in an effective and cooperative manner.

The application of the validation criteria focused on the assessment of changes and refinements to three primary components outlined below:

- a) the reasonableness of the assumptions and parameters used throughout the model ;
- b) how well the actuarial analysis is able to predict lifetime costs;
- c) technical accuracy of technical documentation; and
- d) the adequacy of the process used for transfer of knowledge to the Department.

Consideration was given to:

- the process for creating individual records representing the entire Australian population as at 30 June 2016;
- the use of existing evidence about the social, demographic and economic trends of individuals (e.g. demographic trends in population growth and historical trends in welfare dependency);
- specifications of statistical models used to estimate the transition probabilities for dynamic characteristics associated with welfare utilisation;
- the formulation of the dynamic micro-simulation model used to project the future circumstances and characteristics of the closed Australian population; and
- the assumptions related to future annual payments and indexation.

This included an assessment of the formulation of the final statistical models used and the inclusion of relevant predictor variables reflecting individual, demographic and family characteristics as well as justification for the exclusion of missing predictor variables. Consideration was also given to eligibility for payment types under different circumstances.

4 PROJECT GOVERNANCE

The validation report for the baseline valuation recommended that the economic assumption setting process for the valuation be formalised and clarified in a model governance framework. Given the high sensitivity of the lifetime costs to changes in assumptions it was recommended that assumptions are set on a long-term basis, and the roles of the IDC and actuarial consultant should be clearly defined. The process for changes in assumptions should be clarified and any such changes should be clearly documented and approved by the governance body.

Prior to the baseline actuarial valuation a governance arrangement was established that includes project oversight by the Department's Investment Approach Taskforce and the Investment Approach Inter-Departmental Committee (IDC). The Department also established an Internal Reference Group to provide additional guidance.

These oversight bodies direct the scope of the work, direct the development priorities for the model and provide guidance in relation to the basis used to establish model assumptions. This includes guidance on the economic assumptions that were confirmed following consultation with the IDC.

The advice provided by PwC in the 30 June 2016 Valuation Report is considered to be Prescribed Actuarial Advice as defined in the Code of Professional Conduct issued by the Actuaries Institute. Our review has concluded that the advice provided satisfies the Code.

5 VALIDATION OF REFINEMENTS AND CHANGES TO METHODOLOGY

Priorities for model improvement were identified by the Provider and a development plan for the 2016 valuation was agreed in conjunction with the Department and IDC. This resulted in a number of significant changes to the valuation model. An overview of model developments for the 2016 valuation are summarised in Table 8 (page 33) of the 2016 Valuation Report.

The development plan was not recorded in a single document but encompasses agreements made in general conversation and email communication. For future valuations it is recommended that a written document be produced outlining the development plan which is then approved and overseen by the governance body. This would include clarification of the suggestions and recommendations that can be pursued and achieved in the approach to the subsequent valuation, and any that will be carried forward to future valuations.

The 2016 actuarial valuation commenced prior to July 2016, and the Provider did not receive the final report on the validation of the 2016 valuation until October 2016. Therefore, not all suggestions and recommendations listed in the validation report could be implemented in the 2016 valuation, but will be carried forward, where applicable, to the 2017 actuarial valuation.

The validation findings for the changes and refinements to the approach and methodology for the 2016 valuation are described in Sections 5.1-5.10 below.

5.1 DEVELOPMENT OF A DATA SET WHICH REPRESENTS THE 2016 AUSTRALIAN POPULATION

- a) Synthetic population creation; b) Model population:

5.1.1 Suggestions and recommendations from the baseline validation

- It was suggested that collaboration with ABS be further sought by the Department to explore the possibility of using the 5% sample census CURF to simulate the synthetic population. This would enable more accurate simulation of population data and improve representation of small population sub-groups, for example, people who identify as Indigenous Australians.
- More detail could be provided about the imputation procedure for simulating the level of detail required to create the model population. The imputation process and algorithm used for this was complex and involved some ad hoc decisions. Providing more

systematic information about how missing data is dealt with and how replacement data is imputed, including selection of similar observations is important for future model maintenance and enhancement.

5.1.2 Response to recommendations from validation of baseline valuation

- The Department met with ABS in regards to accessing the 5% sample as recommended in the previous validation and discussions to access the 5% sample for future valuations are continuing.
- The imputation process for missing data was improved through updating the algorithm for projecting the population from the census date to 2016. This process includes the allocating of people from the 5-year age band in the CURF data, to a single year of age. This imputation procedure was enhanced in 2016 to allow for the contribution of more individual factors including gender, indigenous status, marital status, children, income and education. The updated procedure uses the detailed age distributions from the 2011 Census TableBuilder whilst also maintaining the overall age profile of the 2016 ERP. The process developed to do this is referenced in Section 11.5 of the working notes, and the SAS files are also included as exhibits. This was a refinement of the existing imputation process and assumptions.

5.1.3 Additional changes and refinements

- No further changes and refinements were made to the creation of the synthetic and model populations.

5.1.4 Updated validation criteria for this process

- The transparency criteria has been improved from 'very good' to 'excellent' relative to availability of data and resources.

5.1.5 Refinement of suggestions and recommendations

- The governance body should continue conversations with ABS to explore potential access to a 5% sample of the most recent Census data to improve inclusion of under-represented sub-groups of people in the model population.
- The accuracy of the valuation could be improved by using the most recent Census data to simulate the relevant model population. When the 2016 Census data becomes available, it will be possible to simulate the 2016 model population based on this most recent data, and to use the 2016 Census TableBuilder to update imputation of individual characteristics. This approach will enable an assessment of the deviation in the valuation estimate based on the difference in the 2016 model population derived from the 2011 Census relative to the 2016 model population derived from the more

current 2016 Census. The result will provide information on the size of uncertainty in the valuation due to the lag in Census data.

5.2 SEGMENTATION OF WELFARE RECIPIENTS INTO CLASSES

5.2.1 Suggestions and recommendations from the baseline validation

- It is suggested that more detailed welfare payment information will allow the better categorisation of welfare utilisation. For example, there is currently not enough information to distinguish individuals receiving ABSTUDY payments from those receiving other study related payments.
- The 'rest of Australia' (class 12) comprises over 50% of the population and is categorised by one single class. Despite having the lowest future lifetime costs per person, this class accounts for approximately 40% of the total lifetime costs for the full population. Over half of the model population is not in receipt of welfare payments at the valuation date. It is possible that sub-groups of this 'rest of Australia' class move into and out of other welfare classes at different rates and therefore further partitioning of this portion of the population may improve the accuracy of the class movement assumptions. For example, spatial regions and co-located industry sectors are associated with the types and availability of employment to individuals residing in the region, and also with access to higher education. Vulnerability of regions to sectors of the economy, such as the agricultural and mining sectors, will influence employment opportunities and the duration of unemployment. Different locations of residence may therefore impact on the rates of movements in and out of other welfare classes for individuals with similar risk factors. Stratifying the 'rest of the population' class by geographical location, and investigating rates of class movement for each stratum, for example by broad labour market regions, may lead to a more refined partitioning of the 'rest of Australia' for the purposes of valuation and targeting of interventions.

5.2.2 Response to recommendations from validation of baseline valuation

- The first suggestion listed in 5.2.1 above has been addressed (see 2016 Valuation Report Chapters 8.1-8.3). Payment type has been considered in modelling welfare utilisation and class movement for classes 1-3.
- The second suggestion has been referred to by the provider in the second last paragraph on page 18 of the 2016 valuation report, acknowledging that geographical information could have some impact.

5.2.3 Additional changes and refinements

- Further work has been undertaken to redefine the payment category definitions and mappings for supplements and allowances. This has led to some changes to the ten non-income support payment categories (see Table 6, page 28 of the 2016 Valuation report). The seven income support payment categories have not been altered for the 2016 valuation.
- A more detailed analysis of data maturity issues that was made possible by the availability of delayed payment records beyond the baseline valuation date, has resulted in improvements in data maturity adjustments and hence the overall modelling process. Data adjustments were made to allow for:
 - additional utilisation of non-income support payment categories H (FTB), I (family) and J (new parent);
 - the undercount of children;
 - the movement of entrants and re-entrants from the non-active into the active welfare classes.

5.2.4 Updated validation criteria for this process

- The validation criteria had received the maximum rating for the baseline valuation and has not been updated for this section.

5.2.5 Refinement of suggestions and recommendations

- It is suggested that an appropriate definition of geographical location, perhaps aligned to labour market region, be explored for its association with welfare class and the transition from the 'rest of Australia class' to other active welfare classes. Preliminary investigation and descriptive analysis of individuals who enter or re-enter the active welfare classes, by location, controlling for demographic characteristics and welfare history will reveal whether geographical location has a significant impact on welfare class movement. This information, obtained from current welfare utilisation data, could be useful in determining whether individuals are more likely to enter the welfare system or move classes due to reduced access to employment opportunity in their residential location. However, because the magnitude of the impact of geographical location in addition to the impact of individual demographic characteristics on the transition to welfare utilisation may be small relative to effort in updating the model for the overall valuation, this activity could be considered as low priority in the current framework.

5.3 SIMULATION OF FUTURE LIFETIME PATHWAYS

5.3.1 Suggestions and recommendations from the baseline validation

- Preparation of a paper on the results from performing multiple simulations (at least ten) to quantify uncertainty in prediction of transition probabilities from one year to the next, and over a whole lifetime for the entire model population.
- It is suggested that transition models be considered for additional risk characteristics, for example, labour force participation. However, these decisions need to be balanced against data quality, data availability and model complexity.
- While we have observed a rigorous approach applied to the assumption setting process we recommend that future valuations include a clear separation of any movement in the overall valuation between the following elements:
 - Changes in modelling methodology
 - Changes in modelling assumptions
 - Changes due to emerging experience.

5.3.2 Response to recommendations from validation of baseline valuation

- To address the suggestions relating to statistical process uncertainty in the simulated lifetime costs for the overall model population, ten simulation runs over the lifetime for each person in the model population were implemented to compute a measure of uncertainty for the valuation. The total change in lifetime cost due to process uncertainty was estimated to be \$2billion and this is reported in the last row of Table 25 in the 2016 Valuation Report.
- New class characteristic risk variables have been included in the dynamic simulation model. The individual class variable values are predicted following simulation of the welfare class but before utilisation of payment types and amounts. The eight new variables are:
 - Primary care recipient age (class 4)
 - Primary care recipient relationship (class 4)
 - Primary care recipient medical condition (class 4)
 - Number of adult care recipients (class 8)
 - Number of child care recipients (class 8)
 - DSP primary medical condition (class 5)
 - Employment earnings indicator (classes 1, 2, 3, 4 and 5)
 - Most recent income support payment type (classes 1, 2 and 3).

The employment earnings indicator provides a reasonable measure for labour force participation which will be an important predictor of payment category utilisation.

- The discussion of overall results in Chapter 7 of the 2016 Valuation Report describes the changes in the valuation related to model refinements, updated assumptions and policy changes.

5.3.3 Additional changes and refinements

- No further changes and refinements were identified for the overall simulation of future lifetime pathways, however, changes and refinements were made to the processes encompassed within the model sequence. These refinements are described below in Sections 5.4-5.10 below.

5.3.4 Updated validation criteria for this process

- The technical accuracy criteria has been improved from 'very good' to 'excellent' due to inclusion of the estimate of statistical process uncertainty in the sensitivity analysis.

5.3.5 Refinement of suggestions and recommendations

- It is suggested that a technical paper be prepared for future valuations, with a justification and more detail on the method used for assessing process uncertainty and the implications for estimated lifetime costs at the cohort level.
- It is suggested that additional class characteristic risk variables, that have been shown to improve transition predictions, are considered and included in the simulation model sequence as more data becomes available with each valuation date.
- The modelling process is currently rather labour intensive. Because of this, it is not practical to run multiple simulations based on various underlying datasets that reflect different policy scenarios. It is suggested that efforts are made to automate aspects of the modelling process, where it is appropriate, and to explore options for improving efficiencies across the modelling processes.
- Flexibility in the model related to the specification of the time period for projection is limited and could be improved by considering shorter periods (half-yearly, quarterly) in future model enhancements. It is suggested that an investigation of improvements to model predictions facilitated by adjusting the projection period be documented for future reference.

5.4 ASSUMPTIONS TO PROJECT FUTURE CIRCUMSTANCES AND CHARACTERISTICS OF EACH PERSON

5.4.1 Suggestions and recommendations from the baseline validation

- It is recommended that improvements be made to the development of the projection assumptions through a refinement of the dynamic generalised linear models. This should include adding variables that are known to be of importance in predicting

transitions in partnership status, birth of a child and educational attainment, such as earnings and ethnicity. The effects of interactions among the variables included in the models should be further investigated as this may improve the accuracy of the projections.

- It is recommended that a more detailed explanation of the modelling is incorporated into subsequent reviews and that additional analysis is undertaken to support the assumption that statistical process error is minimal.

5.4.2 Response to recommendations from validation of baseline valuation

- The HILDA data was used to develop the demographic flow assumptions for individuals in the non-welfare recipient classes for the baseline valuation in 2015. The recommendation for improving the models to derive the flow assumptions for the non-welfare recipient classes was issued after the projection modelling for the 2016 valuation was well in advance. For the current valuation, the demographic flow assumptions for partnership status, number and age of children in care and educational attainment in the non-welfare recipient classes were derived from the Department's updated administrative data across all active classes, and these assumptions were then adjusted to align with the model outputs from the HILDA data used in the 2015 valuation.
- The Department's administrative data were used to develop the demographic flow assumptions for individuals in the welfare recipient classes. The overall structure of these models is unchanged but the data was updated to include an additional year of data for the 2016 valuation and additional calibration adjustments were made to align simulated demographic characteristics of individuals by class age and gender distribution with similar forecast population distributions.
- Change in partnership status was modelled separately for each welfare class. This is essentially acknowledging an interaction between partnered or not and welfare class.
- The working notes describing the technical approach and statistical specification of these dynamic generalised linear models have not been updated.

5.4.3 Additional changes and refinements

- Mortality assumptions have been refined to reflect DSP medical condition information. Mortality assumptions have also been reduced for the rest of the population to offset the loadings applied to indigenous people and DSP recipients, so that the overall mortality rate across the population is broadly in line with the AGA Life Tables. The reductions have been applied to classes 6 to 12, noting that higher socio-economic classes of people generally have lower mortality rates.

5.4.4 Updated validation criteria for this process

- No changes have been made to the validation criteria for this process as the models based on HILDA data have not been further investigated or updated. It is acknowledged that refining these models were of low priority for the 2016 valuation given time constraints and that the recommendations are considerations for future valuations.

5.4.5 Refinement of suggestions and recommendations

- It is recommended that improvements are made to the development of the projection assumptions through a refinement of the dynamic generalised linear transition models that includes interaction terms. The report acknowledges that "...partner status, child information and highest level of education appear predictive of entry probabilities and so these were included as factors in all the entry rate assumptions" (first sentence, page 49, 2016 valuation report). The effects of interactions among the variables included in the models should be further investigated as additional interaction terms may improve the accuracy of the projections. In particular, the impact of factors such as ethnicity, education and earnings on transitions in partnership status and children in care, and in turn welfare class, will be very different for men and women. Therefore, all variables should be interacted with sex in these models.
- It is recommended that a more detailed description and explanation of the form and structure of the dynamic statistical models fitted to the available data for deriving flow assumptions, is documented with future valuations. To support improvements to the modelling and assumption setting process, this should include a summary of the analyses and results demonstrating improvements in the accuracy of predictions as relevant additional variables and interactions are added to the model. A report on this analysis will help the Department understand how individual models are performing, which may need adjustment and which should be prioritised for refinement.
- It is recommended that the process of deriving flow assumptions for non-welfare recipients to the welfare classes, based on calibration of the models applied to the administrative data, be more clearly explained and documented.
- It is suggested that geographical location, at least to separate major city, region and rural areas, and transitions of residential movement among these location types, should be considered in the models applied to HILDA data. It seems reasonable that demographic flow assumptions for non-welfare recipients, and their movement into welfare classes will differ among these broadly defined locations with different labour market opportunities. Estimates of the likelihood of future residential mobility among these locations and the association with other demographic transitions will be obtainable from HILDA data.

- It is suggested that a review of demographic models, existing or in development within the Australian Government, is undertaken to inform the inclusion of available variables in the demographic models for the flow assumptions.

5.5 ASSUMPTIONS FOR WELFARE CLASS MOVEMENTS

5.5.1 Suggestions and recommendations from the baseline validation

- The first recommendation from 5.4.1 is also relevant for predicting welfare class movement for individuals. It is recommended that improvements are made to the development of the welfare class projection assumptions through a refinement of the dynamic generalised linear models. This should include adding variables that are known to be of importance in predicting transitions in welfare class. The effects of interactions among the variables included in the models should be further investigated as this may improve the accuracy of the projections.
- It is recommended that improved step-by-step technical detail be provided to the Department to facilitate future modelling of an individual's movement in payment utilisation and welfare class and calibrating the predicted transitions to the foundation assumptions.

5.5.2 Response to recommendations from validation of baseline valuation

- Eight additional variables have been included in the dynamic generalised linear models to generate the risk based assumptions for the different welfare classes. These eight variables are:
 - Primary care recipient age (class 4)
 - Primary care recipient relationship (class 4)
 - Primary care recipient medical condition (class 4)
 - Number of adult care recipients (class 8)
 - Number of child care recipients (class 8)
 - DSP primary medical condition (class 5)
 - Employment earnings indicator (classes 1, 2, 3, 4, 5)
 - Most recent income support payment type (classes 1, 2, and 3).
- Developing the risk based assumptions separately for each welfare class is equivalent to including interactions of all variables with welfare class in the model for class movement.
- The assumptions have been updated to reflect the recent experience since the baseline valuation and to consider the influence of previous and new class-relevant variables included in the models.
- A new risk model has been introduced for class '7 Non IS Family' to improve class movement predictions.

5.5.3 Additional changes and refinements

- The age-range represented in the experience of each class has been reviewed and updated where relevant.
- Additional calibration adjustments have been made to ensure that class movement assumptions align with forecasts of the population by age, gender, welfare class and other predictive factors. The Census data was used to check the reasonableness of the adjustments.
- Changes in class movement assumptions following changes to the dynamic models have been described in Chapter 5 of the 2016 valuation report.

5.5.4 Updated validation criteria for this process

- The technical accuracy criteria has been improved from 'very good' to 'excellent' relative to availability of data and resources, as the models for welfare class movement have been considerably refined and updated for most of the welfare classes.
- The transparency criteria has not been updated from 'very good' as additional documentation is required describing details for models and calibration adjustments for all welfare classes.

5.5.5 Refinement of suggestions and recommendations

- An employment earnings measure was not included in the models for transition of a re-entrant from class 10 or new-entrant from class 12 to the welfare recipient classes. While it is acknowledged that an indicator of no employment earnings would be highly correlated with movement onto a welfare recipient class, it is also likely that individuals with lower earnings would be associated with a higher probability of entering one of these classes. Therefore it is recommended that a variable measuring the size of employment earnings, obtained from the HILDA data, be included in the dynamic models predicting transition of an entrant to a welfare recipient class. Similarly to the first recommendation in 5.4.5, it is further recommended that other predictive variables available in the HILDA data, including ethnicity, are included in the model for entry to the welfare recipient classes, and all variables are interacted with sex to capture the different pathways of women and men.
- As for the baseline valuation, it is recommended that improved step-by-step technical detail be provided to the Department to facilitate future modelling of an individual's movement in payment utilisation and welfare class and calibrating the predicted transitions to the foundation assumptions.

5.6 FUTURE ANNUAL PAYMENTS FOR EACH WELFARE RECIPIENT

5.6.1 Suggestions and recommendations from the baseline validation

Our baseline review did not highlight any recommendations or suggestions.

5.6.2 Response to recommendations from validation of baseline valuation

No response was required as our baseline review did not include any recommendations or suggestions.

5.6.3 Additional changes and refinements

There have been no material changes to the methodology applied by PwC and the approach remains reasonable based on the available data and time frames.

5.6.4 Updated validation criteria for this process

The rating for all the valuation criteria remain unchanged from 'excellent' as outlined in our baseline review.

5.6.5 Refinement of suggestions and recommendations

Our current review has not highlighted any new recommendations or suggestions.

5.7 DEVELOPMENT AND APPLICATION OF ADJUSTMENTS TO THE ASSUMPTIONS

5.7.1 Suggestions and recommendations from the baseline validation

Our baseline review did not highlight any specific recommendations or suggestions.

However, while we did not identify any significant areas for enhancement we did note that the validation of eligibility for the Aged Pension is an important part of assessing the overall costs split between Aged Pension and other costs.

5.7.2 Response to recommendations from validation of baseline valuation

No specific response was required as our baseline review did not include any recommendations or suggestions.

In our comments regarding the assessment of overall costs split between aged pension and other costs we noted that including assumptions regarding the status and duration of individual's Australian residency may make this process more robust and that further investigation could be undertaken to assess the merits of adding this assumption. While

we still believe this investigation would be worth consideration it is not essential to the valuation process

5.7.3 Additional changes and refinements

There have been no material changes to the methodology applied by PwC and the approach adopted remains reasonable.

As discussed in our previous report we have considered the approach taken by PwC to economic adjustments, through the addition of an economic module which was not developed as part of the baseline valuation.

This module has been designed to aid understanding of the extent to which:

- The macro-economic environment influences welfare utilisation;
- The number and mix of current welfare recipients has been influenced by the economy.

The development of this module has assisted PwC in modelling explicit scenarios for the future macro-economic environment in place of the implicit scenario(s) embedded within the baseline valuation. It will also allow PwC to explore the potential impact of different scenarios of future economic conditions in future valuations, thereby increasing the adaptability of the overall approach. For the 2016 valuation the economic module focussed on the strongest relationships identified, in particular those relating to utilisation of working age payments. PwC have noted that further development of the module may be considered in future, as additional reference data becomes available for analysis.

5.7.4 Updated validation criteria for this process

The rating for all the valuation criteria remain unchanged from 'excellent' as outlined in our baseline review.

5.7.5 Refinement of suggestions and recommendations

We have not identified any significant areas for enhancement with the approach at this time. However, we reiterate our comments from the baseline valuation the validation of eligibility for the Aged Pension is an important part of assessing the overall costs split between Aged Pension and other costs. Including assumptions regarding the status and duration of individual's Australian residency may make this process more robust and further investigation could be undertaken to assess the merits of adding this assumption.

5.8 DEVELOPMENT OF INDEXATION ASSUMPTIONS TO INDEX THE PAYMENTS MADE IN FUTURE YEARS

5.8.1 Suggestions and recommendations from the baseline validation

- We recommend that the assumption setting process be formalised and clarified in a model governance framework. In particular, the roles of the IDC members and the actuarial consultant should be clearly set out and the process for changes in assumptions be clarified, and any such changes be clearly documented and signed off. This is particularly important given the high sensitivity of the lifetime costs to these assumptions.
- Secondly, we recommend that the MTAW assumption (and any other indexation assumptions considered in future, such as national minimum wage), be set on a constant long-term basis in order to be internally consistent with the discount rate assumption.

5.8.2 Response to recommendations from validation of baseline valuation

In our review and discussions with PwC we have seen evidence that the governance framework relating to the assumption setting process has been improved and additional narrative relating to the process adopted for setting assumptions is more clearly articulated in the valuation report.

Our second recommendation has not been adopted for the 2016 valuation.

5.8.3 Additional changes and refinements

Lifetime costs are estimated as the net present value of projected payments. Payments are expected to increase in each future year and the indexed payments will then need to be discounted or deflated to allow for the time value of money.

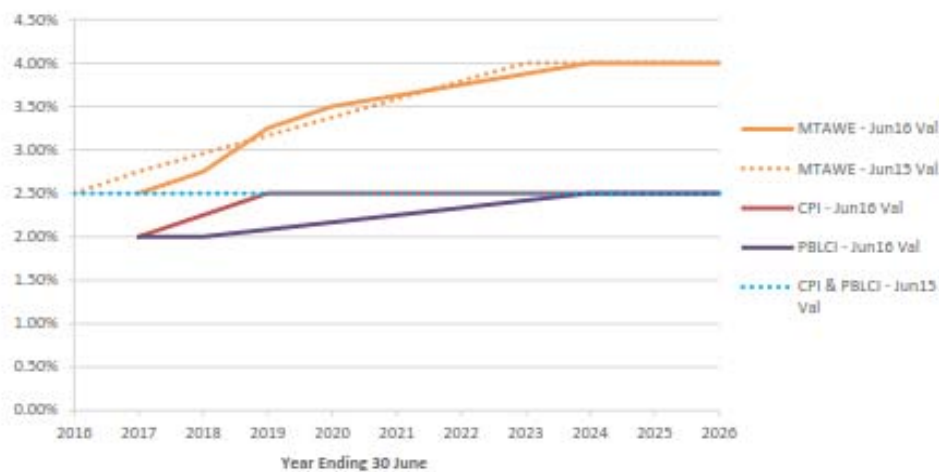
PwC approach

Indexation assumptions are based on the relevant inflation index together with information on any planned changes to the payment structure or criteria and vary payment category. The relevant rate of inflation applied to the index is a function of the macroeconomic outlook.

Assumptions are aligned with Treasury's forecasts and medium- to long-term approach for projecting price indices, as outlined in the 2016-17 Budget and 2015 Intergenerational report. Under this framework, the indexation rates are largely determined by the economic cycle over the short to medium term, but are fixed over the long term in line with economic fundamentals. The valuation assumes:

- Short-term growth (up to 2017-18) consistent with 2016-17 Budget forecasts.
- Medium-term growth (from 2017-18 to 2022-23) consistent with published 2016-17 Budget projections to 2019-20 and interpolated for years between 2020-21 and 2022-23.
- Long-term growth in the Consumer Price Index (CPI) and the Pensioner and Beneficiary Living Cost Index (PBLCI) of 2.5 per cent per annum and Male Total Average Weekly Earnings (MTAWE) of 4.0 per cent per annum.
- Rates of increase in minimum wage are in line with past experience.

The chart below illustrates the change in indexation assumption between the baseline and the 30 June 2016 valuations.



The methodology used by PwC to determine the discount rates to be applied is consistent with many other long-duration actuarial valuations and ensure a long term stable gap between discount rates and inflation rates.

PwC’s approach and in particular the use of a constant long term discount rate has been discussed and agreed with the Australian Government Actuary.

The valuation assumes a nominal discount rate of 6 per cent per annum over the entire projection period. This rate is consistent with the rate used in valuing the Commonwealth’s defined benefit superannuation liabilities, and representing a longer term average of the 10 year government bond yield. This is the same rate as adopted in the baseline valuation.

The gap between the indexation and discount assumptions reduces in the short to medium term, but is constant in the longer term beyond 2024.

Review and comments

As outlined in our previous report our professional opinion is that consistency in assumption setting is of fundamental importance and that all assumptions should be set as either a long term constant rate or should vary by term. Therefore if term dependent inflation rates are adopted then we would strongly recommend that term dependent discount rates are also applied. Alternatively, if a constant, non-term dependant discount rate is used then we would recommend that constant non-term dependent inflation rates are also applied.

Consistency between the indexation and discount rate assumptions is important as it gives a realistic real discount rate (i.e. the gap between the discount rate and the indexation assumptions). The current method and assumptions used by PwC result in a higher real discount rate in the short term than in the medium to long term, as shown in the table below:

Indexation regime	Assumption	Discount assumption	Real discount rate
CPI	2.0% to 2.5%	6%	4.0% reducing to 3.5%
PBLCI	2.0% to 2.5%	6%	4.0% reducing to 3.5%
MTWA	2.5% to 4.0%	6%	3.5% reducing to 2.0%

This is not consistent with current economic conditions. Further, in our view the complexity of introducing a term dependent discount rate consistent with indexation rates should be minimal.

5.8.4 Updated validation criteria for this process

The rating for all the 'Coherence' valuation criterion remains unchanged from the "good" rating included in our previous report, as our concerns regarding the consistency of the inflating and discounting assumptions have not been addressed.

5.8.5 Refinement of suggestions and recommendations

Our recommendation that indexation and discounting assumptions are set on a consistent basis remains unchanged from our previous report.

5.9 SUMMARISE VALUATION RESULTS FROM THE PROJECTION MODULE FIT FOR PURPOSE

5.9.1 Suggestions and recommendations from the baseline validation

Our baseline review did not highlighted any recommendations or suggestions.

However, while we did not identify any significant areas for enhancement with the approach we did note that by definition the baseline valuation did not include a comparison to prior valuations and that a key area for consideration in the second valuation would be the development of an analysis of change framework.

5.9.2 Response to recommendations from validation of baseline valuation

No specific response was required as our baseline review did not include any recommendations or suggestions.

A detailed analysis of change has been included in the 2016 valuation. Further commentary on this is included in Section 6 of this report.

5.9.3 Additional changes and refinements

Detailed commentary on the changes made to the methodology and assumptions applied in the various components of the modelling approach is provided in sections 5.1 to 5.8.

5.9.4 Updated validation criteria for this process

The rating for all the valuation criteria remain unchanged from 'excellent' as outlined in our baseline review.

5.9.5 Refinement of suggestions and recommendations

Our current review has not highlighted any specific new recommendations or suggestions.

5.10 UNCERTAINTY AND SENSITIVITY OF VALUATION

5.10.1 Suggestions and recommendations from the baseline validation

Our baseline review did not highlight any recommendations or suggestions.

5.10.2 Response to recommendations from validation of baseline valuation

No response was required as our baseline review did not include any recommendations or suggestions.

5.10.3 Additional changes and refinements

There have been no material changes to the methodology applied by PwC and the approach remain reasonable based on the available data and time frames.

5.10.4 Updated validation criteria for this process

The rating for all the valuation criteria remain unchanged from 'excellent' as outlined in our baseline review.

5.10.5 Refinement of suggestions and recommendations

Our current review has not highlighted any new recommendations or suggestions.

6 COMPARING VALUATIONS

The main purpose of the analysis of change undertaken by PwC is to gain an understanding of which assumptions have changed and the impact of those changes on the valuation, that is, the estimated lifetime cost of welfare. In particular, it is important to be able to understand changes in the valuation as a result of experience versus changes due to updated assumptions. Due to the nature of the calculations within the valuation the attribution of the change in value necessarily involves a significant amount of judgement.

While we have not reviewed the allocation methodology applied in the analysis of change in detail, we understand from discussions with PwC that any gradual trends in the experience underpinning the assumptions are experience related and any step changes in the experience are considered to be most likely to be related to policy changes. The approach for the attribution of the change in value reflects this, together with specific analysis of the policy change impacts and impact of updating each of the valuation model inputs.

The analysis of change undertaken by PwC is in line with our expectations for an actuarial valuation of this type. However, we believe that the process would benefit from further development of the governance framework to encompass the analysis of change, and particularly with regards to the judgemental aspects of the process. We recommend that the processes relating to the analysis of change are agreed and documented and the allocation of movements in the valuation to changes in experience or assumptions are reviewed by the Department.

The analysis of change is a critical part of the valuation because it will be used to assess the success or otherwise of policy initiatives in the future, which is essentially the purpose of undertaking the valuation of lifetime costs.

Where there are multiple changes in the valuation due to multiple changes in policy, the analysis of change should separate out the change due to each policy in isolation, in order to assess the impact of each policy initiative separately. The analysis of policy changes should be improved by including additional details such as impacts for specific cohort, impacts on expenditure by different payment types and likely periods of impact in the future.

It is important that the implementation of adjustments and chosen methodology for assessing change is suitable and provides capability of policy impacts to be evaluated independently of one another.

Average lifetime cost

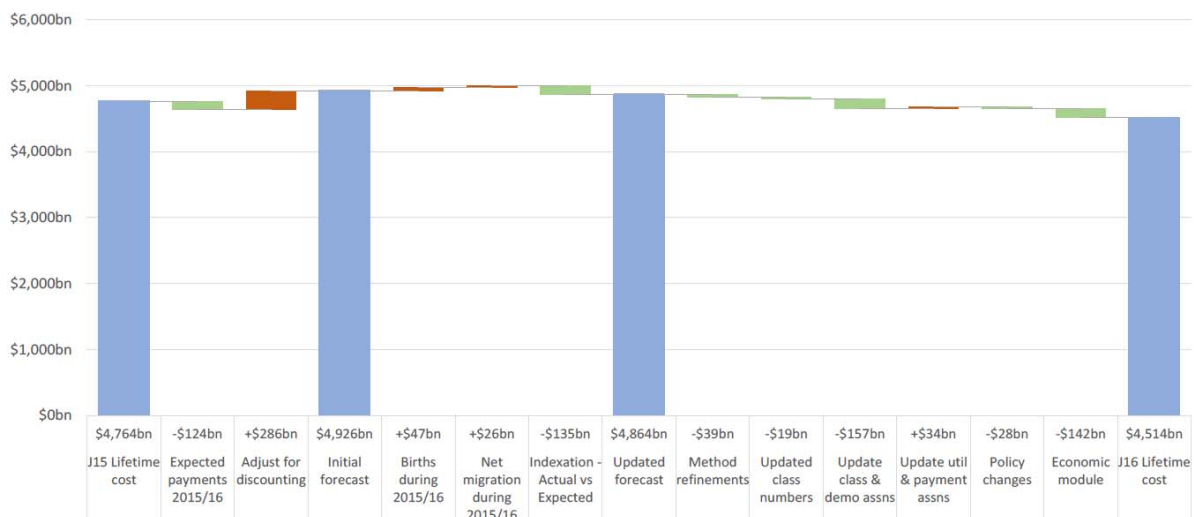
The total lifetime cost for the model population is estimated to be \$4,514 billion as the 30 June 2016, in respect of the 24.2 people included in the model population.

The assessment of total lifetime cost has reduced from \$4,764 billion at 30 June 2015 to \$4,514 billion at 30 June 2016. This is a reduction of \$250 billion reflecting that the changes arising in the updated assessment have more than offset the effects of the increase in the population and inflation.

To understand the change in estimated lifetime cost the initial forecast has been updated to take into account information on births during the 2015-16 year, the changes in population at other ages based on the net migration and the effect of indexation of payments being lower than expected over the year and a downwards revision of future indexation.

The impact of births and net migration are to increase the lifetime cost by \$47billion and \$26 billion respectively. The actual indexation over the year has been lower than expected and so allowance for this has acted to reduce the lifetime cost by around \$135 billion. This results in an updated forecast of \$4,864 billion which provides a benchmark to which the 2016 valuation result can be compared. The 2016 lifetime cost of \$4,514 billion is a reduction of \$350 billion from the updated forecast.

The figure below which demonstrates the change in lifetime cost from the baseline valuation to the 2016 valuation has been reproduced from the 2016 valuation report (Figure 3, page 73).



The interpretability of this figure to non-actuarial readers would be improved by altering the presentation of the graph so that:

1. The vertical axis of the graph displays a lower limit of \$4,000bn and an upper limit of \$6,000bn.
2. The second and third columns be reversed so that “Adjust for discounting” appears before “Expected payments 2015/16”. It would be more interpretable for a non-actuarial reader to first adjust the 2015 lifetime cost up so that it is reported in terms of the higher real cost for 2016.
3. The next column represents “Removal of expected payments in the 2015/16 year” at a cost of -\$124bn, to commence the accumulation of lifetime cost from 30 June 2016.
4. The column label of “initial forecast” be changed to “2016 initial forecast”.

6.1 ASSESSMENT OF VALIDATION CRITERIA

6.1.1 Reasonableness

The approach taken is reasonable and based on the available data and timeframes.

6.1.2 Technical Accuracy

We have not performed a full technical review of the analysis of change models developed by PwC. However, our review of the materials provided by PwC suggest that the modelling undertaken is technically sound and that appropriate processes have been undertaken and internal technical and peer review processes have been completed.

6.1.3 Transparency

To fully understand the impact of policy changes the analysis of change needs to separate the overall impact into individual components.

6.1.4 Coherence

The methodology and analysis of change results documented in the Valuation Report are consistent with standard actuarial methodology.

6.1.5 Future Adaptability & flexibility

The allocation of the overall change in valuation to different policy change elements is to an extent a manual/subjective process and therefore it could be difficult to achieve consistency from year to year and constricts the adaptability of the model.

Recommendations

- The processes relating to the analysis of change are agreed and documented and the allocation of movements in the valuation to changes in experience or assumptions are reviewed by the Department.
- It is recommended that the analysis of change figure be adjusted to improve interpretability by the non-actuarial reader.
- Where there are multiple changes in the valuation due to multiple changes in policy, we recommend that the analysis of change should also separate out the change due to each policy in isolation, in order to assess the impact of each policy initiative separately. The analysis of each change should be improved to include additional detail on the expected impacts.

7 KNOWLEDGE TRANSFER

7.1 BACKGROUND

Knowledge transfer, as defined by the University of Cambridge, “encompasses a broad range of activities to support mutually beneficial collaborations between universities, businesses and the public sector”. It includes the transfer of tangible and intellectual property, expertise, learning and skills between individuals or organisations.

Research reported in the literature suggests that effective collaborations can take a variety of forms, including both formal and informal networks, and a variety of different kinds of interactions, with some studies indicating that interpersonal, face-to-face interactions are more likely to encourage effective use of research (Court & Young, 2003; Nutley, Walter, & Davies, 2007; Weiss, 1999). Early and continuous involvement of “end users” in the development of new technologies is important to ensure that their concerns are adequately addressed leading to higher rates of success in industry adoption and worker utilisation (Johnson, Gatz, & Hicks, 1997).

An important goal of the scope for the Provider of the actuarial valuation for the Australian priority approach to welfare is to transfer knowledge, models and support materials to the Department to enable future valuations of the Commonwealth’s current and future liabilities under the Australian social security system.

For this goal to be achieved, a vast amount of knowledge needs to be transferred from the Provider to the Department, encompassing complex data management, simulation and analytical processes as well as actuarial assumption setting and related judgements. This will require an extensive take-up of new understanding and skills by the Department and a strategy needs to be developed with a sufficient lead time to ensure that the appropriate number of personnel and expertise is in place to independently produce future valuations beyond 2018.

7.2 STRATEGY

The overarching aim of the knowledge transfer strategy will be to handover the responsibility for undertaking future valuations from PwC to the Department. Documentation alone will not achieve this and so it is important that a phased approach is taken to transferring ownership of the valuation processes and activities over the next two years.

The key stages embedded within the strategy should include:

- Development of an operating model for how the valuations will be undertaken within the Department, including consideration of:
 - Structure of the Department valuation team;
 - Required capabilities;
 - Assessment of current capabilities;
 - Capability gap analysis;
 - Development of a strategy to address gap (e.g. training, secondments, reverse secondments, recruitment);
 - Plan for up-skilling new personnel with staff turnover.
- Development of a plan to support regular interaction between the Department and the PwC during engagement including the following activities:
 - Face-to-face interactions and hands-on coaching;
 - Co-location of PwC and DSS project teams;
 - Group meetings and discussions;
 - Workshops with presentations on implementation methods;
 - Production and testing of user manuals for data preparation and model implementation;
 - Demonstrations of implementation methods.
- Detailed training documentation for implementation and reference beyond the engagement period.
- Agreed plan and timeline for action of knowledge transfer activities.

Successful knowledge transfer requires the development of a robust knowledge transfer plan. This plan needs to be agreed to by both the Department and PwC and requires continuing commitment. The plan should include suggestions on how to include staff from the Department throughout the development of the validation process, for example through arranged secondments. A clear outline of roles and responsibilities will guarantee the completion of tasks in line with milestones required to be met through the life of the validation project. This is crucial in ensuring that the decisions, assumptions and processes involved are well understood by the Department. Supporting material and thorough and detailed documentation will ensure the on-going ability of the Department to implement the model internally.

At the time of preparation of this 2016 validation report, PwC and the Department are in the process of developing a plan to achieve the overall objective of the knowledge transfer strategy. This plan still requires significant development and should contain sufficient detail to facilitate timely activities and document preparation that will ensure a successful phased handover of the responsibility to undertake future valuations to the Department beyond 2018. In developing the knowledge transfer plan the Department may find it helpful to refer

to the Actuaries Institutes “Actuarial Capabilities Framework” (Actuaries Institute, accessed 30 June 2017).

7.3 ASSESSMENT OF VALIDATION CRITERIA

7.3.1 Reasonableness

The documentation made available for review, including the Valuation and Methods report and shared working papers provide a good overview and some detail on the steps taken to create the model population and to project the lifetime pathways of all individuals in the population. Other activities have been undertaken to facilitate knowledge transfer including regular meetings, shared work spaces, sharing of computer code, development of training material and delivery of training sessions. However, our view is that the level of detail and guidance provided in the documents is too limited for the transfer of responsibilities. The knowledge transfer process requires improvement through the co-development of an agreed strategy as described in 7.2 in addition to the provision of more detailed prescriptive documentation.

7.3.2 Technical Accuracy

The review of materials provided suggests that the information reported in the knowledge transfer process is technically accurate, however, more detailed explanations and instructions should be documented and exchanged to ensure the accurate transfer and use of this information.

7.3.3 Transparency

Development of the knowledge transfer process is required to ensure that all necessary steps undertaken to update the valuations are transparent to enable replication of the modelling and assumption-setting procedures.

7.3.4 Coherence

The review of materials provided and discussions with PwC suggest that activities undertaken for knowledge transfer are basically coherent with current literature, however, the process of exchange of knowledge through these existing and additional activities should be improved in agreement with the Department.

7.3.5 Future Adaptability & flexibility

In our view the current knowledge transfer process does not ensure complete transfer of responsibilities to the Department for producing valuations independently. However, our

understanding is that PwC and the Department are in the process of developing a plan to achieve the overall objective of the knowledge transfer strategy.

Recommendations

- It is recommended that a detailed knowledge transfer strategy is developed, agreed to by both the Department and the PwC, and implemented for the 2017 valuation. This strategy will combine a program of activities as outlined in Section 7.2, with the drafting and delivery of technical documentation and appropriate presentation material for training to ensure the on-going ability of the Department to implement the valuation model independently.

8 VALIDATION FINDINGS

Table 7.1: Rating of each validation criteria applied to each of the methodology steps undertaken by PwC in the actuarial valuation of the Australian Priority Investment Approach to Welfare; 2016 Validation; impact of changes and refinements on validation criteria for each step.

Steps in Valuation Model by Validation Criteria	Reasonable-ness	Technical Accuracy	Transparency	Coherence	Future adaptability
Step 1: Creation of model population at 30 June 2015	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Step 2: Segmentation of welfare recipients into classes	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Step 3: Specification of dynamic micro-simulation model	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓
Step 4: Assumptions to project individual circumstances	✓✓✓	✓✓	✓✓✓	✓✓	✓✓✓
Step 5: Assumptions for welfare class transitions	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓

Steps in Valuation Model by Validation Criteria	Reasonable-ness	Technical Accuracy	Transparency	Coherence	Future adaptability
Step 6: Assumptions for future annual payments	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Step 7: Adjustments to assumptions	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Step 8: Payment indexation assumptions	✓✓✓	✓✓✓	✓✓✓	✓	✓✓✓
Step 9: Summarising valuation results fit for purpose	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Step 10: Uncertainty and sensitivity of valuation	✓✓	✓✓✓	✓✓✓	✓✓	✓✓✓
Step 11: Analysis of change	✓✓✓	✓✓	✓✓	✓✓✓	✓
Knowledge transfer	✓	✓✓	✓	✓	✓

Table Legend:

- | | |
|----------------------|---|
| ✓✓✓ Excellent | The approach undertaken was thorough given availability of resources. |
| ✓✓ Very good | The approach taken was sound but could be improved with further investigation. |
| ✓ Good | The approach undertaken could be improved in several ways or requires more consideration and explanation. |

X Development Required

9 REFERENCES

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APPENDIX I: VALIDATION FINDINGS OF BASELINE (2015) VALUATION

Table 7.1: Rating of each validation criteria applied to each of the methodology steps undertaken by PwC in the actuarial valuation of the Australian Priority Investment Approach to Welfare; baseline (2015) valuation.

Steps in Valuation Model by Validation Criteria	Reasonable-ness	Technical Accuracy	Transparency	Coherence	Future adaptability
Step 1: Creation of model population at 30 June 2015	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓
Step 2: Segmentation of welfare recipients into classes	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Step 3: Specification of dynamic micro-simulation model	✓✓✓	✓✓	✓✓✓	✓✓✓	✓✓
Step 4: Assumptions to project individual circumstances	✓✓✓	✓✓	✓✓✓	✓✓	✓✓✓
Step 5: Assumptions for welfare class transitions	✓✓✓	✓✓	✓✓	✓✓✓	✓✓✓

Steps in Valuation Model by Validation Criteria	Reasonable-ness	Technical Accuracy	Transparency	Coherence	Future adaptability
Step 6: Assumptions for future annual payments	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Step 7: Adjustments to assumptions	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Step 8: Payment indexation assumptions	✓✓✓	✓✓✓	✓✓✓	✓	✓✓✓
Step 9: Summarising valuation results fit for purpose	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Step 10: Uncertainty and sensitivity of valuation	✓✓	✓✓✓	✓✓✓	✓✓	✓✓✓

Table Legend:

✓✓✓ **Excellent**

The approach undertaken was thorough given availability of resources.

✓✓ **Very good**

The approach taken was sound but could be improved with further investigation.

✓ **Good**

The approach undertaken could be improved in several ways or requires more consideration and explanation.

X Development Required