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**Working Paper**

## An Analysis of Benefit Flows in New Zealand Using a Social Accounting Framework

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# An Analysis of Benefit Flows in New Zealand Using a Social Accounting Framework

Omar Aziz, Nick Carroll  
and John Creedy

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New Zealand Government

**NZ TREASURY  
WORKING PAPER  
13/01**

An Analysis of Benefit Flows in New Zealand Using a Social Accounting Framework

**MONTH/YEAR**

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## Abstract

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This paper presents a social accounting model to examine the entrants, exits and transitions of individuals among a wide range of benefit categories in New Zealand. Transition rates and flows are estimated separately for periods before the global financial crisis (GFC) and periods following the crisis. The data were obtained from the Benefit Dynamics Dataset maintained by the Ministry of Social Development. The model is used to examine, using simulations, the implications for the time profile of changes in the stock of benefit recipients under a range of counterfactual situations. It is suggested that the model can provide a useful tool for policy analysis.

### **JEL CLASSIFICATION**

I38 Health, Education, and Welfare - Welfare and Poverty - Government Policy; Provision and Effects of Welfare Programs  
J11 Labour and Demographic Economics - Demographic Economics - Demographic Trends and Forecasts

### **KEYWORDS**

Social Accounting; Benefit Flows; Simulation

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# An Analysis of Benefit Flows in New Zealand using a Social Accounting Framework

## 1 Introduction

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The aim of this paper is to present and explore the use of a model designed to examine the entrants, exits and transitions of individuals among a wide range of benefit categories in New Zealand. It is suggested that an understanding of the factors affecting the number of individuals in receipt of various benefits requires information about movement from one benefit category to another, in addition to flows on and off the benefit system as a whole. The demographic accounting approach seems to be particularly well suited for modelling benefit flows.<sup>1</sup> The transition rates and flows, measured over discrete periods of three months, are estimated separately for a number of periods before the global financial crisis (GFC), which reflect relatively stable patterns of entry and movement, and periods following the crisis, which saw substantial changes, particularly in a number of inflow rates. The data were obtained from the Benefit Dynamics Dataset (BDD) maintained by the Ministry of Social Development (MSD).

The model can be used to make simulations of the number of individuals in the various benefit categories, using assumptions about the variation over time in the inflows to the benefit system and transition rates between benefits. Simulations are reported for several assumptions about economic conditions over the period February 2011 to November 2016.<sup>2</sup> The model is used to examine the implications for the stock of benefit recipients of several counterfactual scenarios which change the inflows and outflows from benefits.

The approach can thus be used to examine the following types of question. How important are the changes in stocks which result from an underlying set of inflow, transition and exit rates, in comparison with those affecting a particular benefit type and resulting from a policy change? How important are flows among benefit categories in understanding the potential effects of a policy reform that concentrates on a single category? How quickly might a change in the inflows to, or exit rates from, a particular benefit category or

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1 For an extensive discussion of social accounting models, see Stone, J.R.N. (1973) Transition and admission models in social demography. *Social Science Research*, 2, pp. 185-230.

2 Official Treasury and MSD forecasts of the number of benefit recipients are provided in the Budget Economic and Fiscal Update, and are based on estimated relationships between GDP and the number of benefit recipients. The purpose of the simulations presented here is to illustrate the impact of different counter-factual scenarios and illustrate the sensitivity of numbers to the underlying flows.



categories, arising from a policy change, affect the stocks of benefit recipients?<sup>3</sup> The inflows are taken as 'given' here, but of course in using the approach for practical analyses they could be modelled using other methods, including demographic projections.

Section 2 presents the basic framework used. It outlines the relationships between stocks and flows, the calculation of costs and the approach used to consider policy changes. The New Zealand flows data are described in Section 3. This section also defines the benefit categories and the construction of the transition matrices. Summary information regarding inflows and average durations, before and after the global financial crisis, are also briefly discussed. Section 4 reports simulations of benefit numbers up to November 2016 under several assumptions about the economic conditions over the period. Section 5 explores the potential implications of a reduction in inflows to Unemployment Benefits. Conclusions are in Section 6.

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3 One component of welfare reform has been to develop an investment approach, based on an actuarial valuation of the benefit system (<http://www.msd.govt.nz/about-msd-and-our-work/newsroom/media-releases/2012/valuation-report.html>). While the approach outlined in this paper uses a flows approach, rather than an actuarial approach, it can be used to inform actuarial assessments of the impact of welfare reform.

## 2 The Framework of Analysis

This section presents the basic demographic model of benefit flows.<sup>4</sup> The stock-flow relationships are described in subsection 2.1.<sup>5</sup> In subsection 2.2, the use of the model to deal with policy changes is discussed.

### 2.1 Stocks and Flows

The flows of individuals among defined benefit categories or 'states' from one period to the next can be recorded in a demographic or social accounting matrix. Suppose the accounting period is three months, so that information is available about the state occupied by each individual at the beginning of each quarter. There are  $m$  states. Let  $s_{i,j,t}$  (for  $i, j = 1, \dots, m$ ) denote the number of people who move from state  $j$  to state  $i$  from period  $t$  to period  $t+1$  (at the beginning of quarter  $t$  they are in state  $j$  and at the beginning of quarter  $t+1$  they are in state  $i$ ). These flows are placed in a matrix  $S_t = \{s_{i,j,t}\}$ . Let  $b_t = \{b_{i,t}\}$  denote the vector whose  $i$ th element is the number of people who enter state  $i$  from outside the labour market during period  $t$  (for example, those leaving full time education and inward migrants): these are referred to as 'inflows'. Similarly  $d_t = \{d_{j,t}\}$  is the vector of exits from the system at the end of period  $t$  for various reasons, including migration and death: these are referred to collectively as 'outflows'. Finally,  $n_t = \{n_{j,t}\}$  is the vector of stocks of individuals in each state,  $j = 1, \dots, m$ , at the start of period  $t$ .

**Figure 1 – Relationship between Stocks and Flows**

	State occupied in time period $t$	Inflows	total
state occupied in time period $t+1$	$s$	$b$	$n_{t+1}$
Outflows	$d'$		
total	$n'$		

4 Stone (1973) discussed a number of applications, in particular the movement of individuals through the education system. He also suggested an expansion of the model to allow for 'dependence on the past', but the approach would produce too many 'states' in the present context.

5 An indication of how the model can be used to examine benefit costs is outlined in Appendix F.

The information about stocks and flows are placed in a social accounting table shown in Figure 1 (where for convenience,  $t$  subscripts have been omitted). A prime attached to a variable indicates transposition, so that, for example,  $d_t'$  is the column vector of exits from the system, rewritten as a row vector. In this table, the flows take place from columns to rows. These flows (number of individuals) can be converted into transition rates,  $c_{i,j,t}$ , which denotes the proportion of individuals who started quarter  $t$  in state  $j$  and moved into state  $i$  by the beginning of quarter  $t+1$ . The precise timing of the movement is not recorded in this discrete time framework, so moves are effectively assumed to occur at the end of period  $t$ .<sup>6</sup> The transition proportions are therefore given by

$$c_{i,j,t} = \frac{S_{i,j,t}}{n_{j,t}} \quad (1)$$

In matrix terms, this can be written as  $C_t = S_t \hat{n}_t^{-1}$ , where the 'hat' indicates that the column vector forms the leading diagonal of a square matrix, with zeros in the off-diagonals. Hence  $S_t = C_t \hat{n}_t$ .

Letting  $i$  denote a vector of units, the sum of elements in the  $i$ th row of  $S$  is expressed as  $S_i$ , and noting that  $\hat{n}i = n$ , the 'closing stocks' are related to the 'opening stocks' and the flows according to:

$$n_{t+1} = C_t n_t + b_t \quad (2)$$

Hence moving forward one period:

$$n_{t+2} = C_{t+1} (C_t n_t + b_t) + b_{t+1} \quad (3)$$

And:

$$n_{t+3} = C_{t+2} \{C_{t+1} (C_t n_t + b_t) + b_{t+1}\} + b_{t+2} \quad (4)$$

The time profile of the stocks take a particularly simple form if the transition rates and inflows remain constant over time. Thus, (4) becomes:

$$n_{t+3} = C^3 n_t + (I + C + C^2) b \quad (5)$$

Here  $I$  denotes a unit matrix (a square matrix with a leading diagonal of units, and zeros elsewhere). The column sums of  $C$  are less than one and all the elements are non-negative. Hence, if the process continues long enough,  $\lim_{T \rightarrow \infty} C^T = 0$  and  $I + C + C^2 + \text{etc} = (I - C)^{-1}$ . The vector of equilibrium stocks is therefore:

$$n = (I - C)^{-1} b \quad (6)$$

6 In the discrete time framework, those who enter and leave a benefit category within the period are not recorded. The extent to which individuals may repeatedly enter and leave the benefit system is also not recorded here. It would be possible to redefine states to include some past transitions (allowing for dependence on the past), but this substantially increases the size of the coefficients matrix.

And the time profile of stocks can easily be obtained from repeated use of the modified form of equation (2), whereby:

$$n_{t+1} = Cn_t + b \quad (7)$$

Furthermore, if again the transition rates remain constant, the average time spent in each state (along with its variance) is a simple function of the appropriate diagonal element of the  $C$  matrix. It can be shown that the average time in state  $j$  is  $(1 - c_{j,j})^{-1}$  while the variance of the time in the state is  $c_{j,j} / (1 - c_{j,j})^2$ .

The outflows can be subdivided into a number of categories. For example, some individuals may leave the benefit system by, for example, migrating, dying, or moving into employment with sufficiently large earnings. Hence the (column) vector  $d_t$  can be redefined as a  $K$  by  $m$  matrix where  $d_{k,j,t}$  represents the number of individuals who move out of the benefit system from category  $j$  for reason  $k$ . The corresponding transition proportions are:

$$v_{k,j,t} = \frac{d_{k,j,t}}{n_{j,t}} \quad (8)$$

And if these are, as with the other transition proportions, assumed to remain constant at  $v_{k,j}$ , the numbers in each category in each period are obtained simply from  $d_{k,j,t+1} = n_{j,t+1} v_{k,j}$ .

## 2.2 Examining the Potential Effects of Policy Changes

Policy changes may be designed to affect a wide range of components of the social accounting framework. For example, changes to eligibility conditions for certain types of benefit may affect the number of people moving onto those benefits (both in terms of 'inflows' and transitions from other benefit categories). In addition, changes to the administration of benefits (including, for example, the monitoring of behaviour relating to moral hazard, the provision of information for potential benefit recipients regarding regulations, and so on) can affect flows of individuals in and out of a range of states. In addition, changes to benefit levels and abatement rates, through their effects on individuals' budget constraints and thus financial incentives, can also influence transitions.

It is therefore possible to use the framework presented here to examine the implications for benefit flows of various policy reforms, given *a priori* information about the likely effects on particular elements of the accounting matrix. The effects on future total costs of any particular reform are far from obvious, since they depend on the pattern of movements of individuals through the various states. For example, an initiative designed to increase the flow of individuals off a particular benefit type, and which moves those individuals into other states where they are more likely to move into full time employment and off the benefit system entirely, has different implications from a policy which moves individuals away from what may be an expensive benefit but into other states where they are more likely to remain for longer periods.

Changes in flows, in particular the inflows and outflows, also arise from changes that are independent of the benefit system. Structural or cyclical changes to probabilities of becoming unemployed or gaining employment are likely to have significant impacts on flows and costs. Other exogenous changes include, for example, changes in the age composition of the population and fertility rates.

The effects on equilibrium stocks of individuals in the various benefit categories of changes in the inflow vector are easily obtained from equation (6). Letting  $M = (I - C)^{-1}$  denote the 'matrix multiplier', the changes in the stocks are a multiple of the change in the flows for any category. A change in one of the elements of the inflow vector has effects on many of the stocks, not simply the category whose inflow has changed. Thus, if the  $j$ th element of  $b$  changes, the equilibrium stock changes in all categories,  $i$ , for which the  $i$ th row element,  $m_{ij}$ , from the  $j$ th column of  $M$  is non zero. In equilibrium the outflows from each category must precisely match the inflows, so that an increase in the latter can only be matched by outflows after the stocks have built up sufficiently. The extra inflows in any category also lead to higher movements among benefit categories. In a large system, the consequences can easily be obtained from the matrix multiplier,  $M$ , but of course the elements of  $M$  are not transparent from the flow coefficients, given the matrix inversion involved. The speed of adjustment to the new equilibrium also depends on the speed of convergence of the powers of  $C$  towards zero, as is evident from equation (5). The effects of changes in the elements of  $C$  itself are also discussed in Appendix E.

## 3 New Zealand Flows Data

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This section describes the data used to estimate the flows and transitions among benefit categories, and the construction of the matrices used below. Summary information is also reported on the average durations and entrants.

### 3.1 The Data and Construction of Matrices

The data used here were obtained from the Benefit Dynamics Dataset (BDD) maintained by MSD. The dataset captures the key variables required for the analysis of individual benefit histories. The BDD includes information on all people who received any main working-age social welfare benefit in the period of study, from February 2005 to February 2011. It provides basic information on their demographic characteristics, and traces their changing benefit status and other circumstances from the beginning of the study period (for benefits current at that date) or from the date they are first granted benefit in that period (for new grants). It also traces the benefit histories of partners and dependent children included in benefits.

The first stage involved constructing the relevant flow matrices and vectors for each quarter over the period, resulting in 24 sets of accounts. At this stage, benefit recipients were divided into 63 categories. After examination of these matrices, the number of benefit categories was cut down to 47 separate types, largely by amalgamating different age groups within a category type: some age groups were found to contain very small numbers of individuals.<sup>7</sup> The final set of categories is described in Table 1.

Examination of the many matrices of transitions between quarters showed a relative stability over the pre-global financial crisis (pre-GFC) periods. There are clearly fewer observations for the post-global financial crisis (post-GFC) period, but again the flows showed little change. Hence, a dividing line was drawn between pre-GFC and post-GFC flows. For this reason, the many matrices were reduced to only two sets of flow matrices and vectors, by computing average flows in the two periods. In view of this averaging process, no explicit allowance is made here for seasonality (particularly regarding unemployment benefit inflows). The full details of the two matrices and their flows coefficients are given in Appendix C, where it can be seen that there are substantial 'off diagonal' movements.

However, it is important to recognise that the coefficients are expected to change over time as a result of policy changes, as discussed earlier, as well as extraneous factors. There have in fact been some policy changes over the relevant periods. In considering a practical policy context the nature of the changes over time in particular transitions would be the focal point of analysis. For present purposes the large changes observed for many flows following the GFC provide useful illustrations of the major benefits of the general approach and the potential value of recognising explicitly that changes take place to a system that is not in equilibrium, so that the consequences of any change can be much wider than anticipated.

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<sup>7</sup> Clearly, there remains a small amount of heterogeneity within the groups.

A difficulty arises in dealing with exits from benefits. Instead of having a single vector of 'outflows',  $d$ , many reasons are recorded. In addition, this part of the dataset has a significant number of missing entries. Appendix A describes the method used to divide the exits into just four categories, involving extraneous information from LEED/MSD Feasibility Study<sup>8</sup>. In particular, it is most useful to have information about the flows of individuals off benefits and into employment.

The average number of entrants into each benefit category, before and after the GFC, are reported in Table 3. The largest increases in average entrants are for those with no earnings in all of the basic categories; these are Domestic Purposes Benefit (DPB), Invalid's Benefit (IB), Sickness Benefit (SB) and Unemployment Benefit (UB). Not surprisingly, the largest increases by far are for UBs, particularly in 18\_no and 30\_no categories. However, increases in the corresponding SB categories are also substantial.

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8 <http://m.stats.govt.nz/~media/Statistics/browse-categories/income-work/employment-unemployment/leed/research-reports/leed-msd-feasibility-report-final-2.pdf>

**Table 1 – Benefit Categories**

DPB18_0_e	DPB or WB, aged 18 - <29, youngest child aged 0 - <5, earning \$1 - \$200 pw
DPB18_0_f	DPB or WB, aged 18 - <29, youngest child aged 0 - <5, earning more than \$200 pw
DPB18_0_no	DPB or WB, aged 18 - <29, youngest child aged 0 - <5, earning \$0 pw or missing
DPB18_5+_no	DPB or WB, aged 18 - <29, youngest child aged 5+, earning \$0 pw or missing
DPB18_5+_wrk	DPB or WB, aged 18 - <29, youngest child aged 5+, and earning > \$0 pw
DPB18_nc_no	DPB or WB, aged 18 - <29, no dependent children, earning \$0 or missing
DPB18_nc_wrk	DPB or WB, aged 18 - <29, no dependent children, earning > \$0 pw
DPB30_0_e	DPB or WB, aged 30 - <60, youngest child 0 - <5, earning \$1 - \$200 pw
DPB30_0_f	DPB or WB, aged 30 - <60, youngest child aged 0 - <5, earning more than \$200 pw
DPB30_0_no	DPB or WB, aged 30 - <60, youngest child aged 0 - <5, earning \$0 pw or missing
DPB30_14_e	DPB or WB, aged 30 - <60, youngest child aged 14+, earning \$1 - \$200 pw
DPB30_14_f	DPB or WB, aged 30 - <60, youngest child aged 14+, earning more than \$200 pw
DPB30_14_no	DPB or WB, aged 30 - <60, youngest child aged 14+, earning \$0 pw or missing
DPB30_5_e	DPB or WB, aged 30 - <60, youngest child aged 5 - <14, earning \$1 - \$200 pw
DPB30_5_f	DPB or WB, aged 30 - <60, youngest child aged 5 - <14, earning more than \$200 pw
DPB30_5_no	DPB or WB, aged 30 - <60, youngest child aged 5 - <14, earning \$0 pw or missing
DPB30_nc_e	DPB or WB, aged 30 - <60, no dependent children, earning \$1 - \$200 pw
DPB30_nc_f	DPB or WB, aged 30 - <60, no dependent children, earning more than \$200 pw
DPB30_nc_no	DPB or WB, aged 30 - <60, no dependent children, earning \$0 pw or missing
DPB60_no	DPB or WB, aged 60 - <65, no dependent children, earning \$0 pw or missing
DPB60_wrk	DPB or WB, aged 60 - <65, no dependent children, and earnings > \$0 pw
IB18_e	IB, aged 18 - <30, earning \$1 - \$200 pw
IB18_f	IB, aged 18 - <30, earning more than \$200 pw
IB18_no	IB, aged 18 - <30, earning \$0 pw or missing
IB30_e	IB, aged 30 - <60, earning \$1 - \$200 pw
IB30_f	IB, aged 30 - <60, earning more than \$200 pw
IB30_no	IB, aged 30 - <60, earning \$0 pw or missing
IB60_no	IB, aged 60 - <65, earning \$0 pw or missing
IB60_wrk	IB, aged 60 - <65, earning > \$0 pw
SB18_e	SB, aged 18 - <30, earning \$1 - \$200 pw
SB18_f	SB, aged 18 - <30, earning more than \$200 pw
SB18_no	SB, aged 18 - <30, earning \$0 pw or missing
SB30_e	SB, aged 30 - <60, earning \$1 - \$200 pw
SB30_f	SB, aged 30 - <60, earning more than \$200 pw
SB30_no	SB, aged 30 - <60, earning \$0 pw or missing
SB60_no	SB, aged 60 - <65, earning \$0 pw or missing
SB60_wrk	SB, aged 60 - <65, earning > \$0 pw
u18	a benefit but aged under 18 years
UB18_e	UB, aged 18 - <30, earning \$1 - \$200 pw
UB18_f	UB, aged 18 - <30, earning more than \$200 pw
UB18_no	UB, aged 18 - <30, earning \$0 pw or missing
UB30_e	UB, aged 30 - <60, earning \$1 - \$200 pw
UB30_f	UB, aged 30 - <60, earning more than \$200 pw
UB30_no	UB, aged 30 - <60, earning \$0 pw or missing
UB60_no	UB, aged 60 - <65, earning \$0 pw or missing
UB60_wrk	UB, aged 60 - <65, and earnings > \$0 pw
Misc	other benefits, including CSI and training benefits



**Table 2 – Average Entrants per Quarter**

States	Pre-GFC	Post-GFC
DPB18_0_e	192	122
DPB18_0_f	4	4
DPB18_0_no	1,331	1,024
DPB18_5+_no	209	172
DPB18_5+_wrk	40	26
DPB18_nc_no	363	1,096
DPB18_nc_wrk	37	106
DPB30_0_e	127	83
DPB30_0_f	4	4
DPB30_0_no	789	596
DPB30_14_e	89	99
DPB30_14_f	4	7
DPB30_14_no	404	478
DPB30_5_e	282	189
DPB30_5_f	14	14
DPB30_5_no	1,106	925
DPB30_nc_e	111	246
DPB30_nc_f	5	11
DPB30_nc_no	504	1,393
DPB60_no	161	209
DPB60_wrk	46	52
IB18_e	15	11
IB18_f	1	0
IB18_no	163	162
IB30_e	44	35
IB30_f	2	2
IB30_no	714	755
IB60_no	218	297
IB60_wrk	14	14
SB18_e	107	111
SB18_f	6	8
SB18_no	2,824	3,438
SB30_e	198	189
SB30_f	19	21
SB30_no	3,887	4,608
SB60_no	401	589
SB60_wrk	30	36
u18	1,096	1,077
UB18_e	590	923
UB18_f	47	69
UB18_no	6,255	11,833
UB30_e	399	528
UB30_f	55	92
UB30_no	4,495	7,577
UB60_no	365	529
UB60_wrk	46	53
misc	1,166	1,514

## 3.2 Average Durations

Details of the average number of quarters spent in each benefit category, along with standard deviations, are given in Table 3, using the expressions given in subsection 2.1 above.<sup>9</sup> The largest increases are for: the DPB categories 18\_nc\_no (from 18.98 to 22.15 quarters) and 30\_nc\_no, that is those with no dependent children and no earnings and; IB categories 18\_no and 30\_no, that is, those without earnings. Smaller increases were found for UB recipients in the same age and employment groups, that is categories 18\_no and 30\_no. The average duration for those in UB category 60\_no actually fell from 6.07 to 4.45 quarters after the GFC, reflecting a higher propensity to move into the corresponding SB category. Reductions in average durations therefore do not necessarily mean that individuals are moving off benefits more quickly, since they may simply be moving to other benefit categories. They may also not result in drops in numbers of benefit to the extent that there is an increase in inflows at the same point.

In judging the changes in average durations it should be remembered that the time units are quarters, so that the change from 19 to 22 (for DPB18\_nc\_no actually translates to a change of 36 weeks. Another feature of the durations reported in Table 3 is that the standard deviation for the DPB and IB categories mentioned above, for which the increases in average durations are largest and those average durations are themselves high, are much larger than for other benefit types at over 4 quarters.

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9 It is perhaps worth stressing that the standard deviations relate to the duration distributions; they are not standard errors of the estimated average durations.

**Table 3 – Time Spent in Each Benefit Category: Quarters**

States	Pre-GFC		Post-GFC	
	Average	SD	Average	SD
DPB18_0_e	3.03	1.42	2.61	1.27
DPB18_0_f	1.14	0.38	1.16	0.40
DPB18_0_no	5.67	2.16	4.39	1.84
DPB18_5+_no	4.45	1.86	3.68	1.64
DPB18_5+_wrk	3.19	1.48	2.70	1.30
DPB18_nc_no	18.98	4.24	22.15	4.60
DPB18_nc_wrk	4.90	1.98	4.43	1.85
DPB30_0_e	3.12	1.46	2.67	1.29
DPB30_0_f	1.21	0.46	1.17	0.41
DPB30_0_no	4.80	1.95	3.77	1.66
DPB30_14_e	4.62	1.90	3.63	1.62
DPB30_14_f	1.33	0.57	1.28	0.53
DPB30_14_no	6.39	2.32	4.74	1.93
DPB30_5_e	3.93	1.71	3.15	1.47
DPB30_5_f	1.26	0.51	1.25	0.50
DPB30_5_no	5.07	2.02	3.91	1.71
DPB30_nc_e	6.81	2.41	6.27	2.30
DPB30_nc_f	1.31	0.55	1.43	0.65
DPB30_nc_no	13.42	3.52	21.30	4.51
DPB60_no	8.24	2.69	9.08	2.84
DPB60_wrk	6.54	2.35	6.12	2.26
IB18_e	5.53	2.13	5.22	2.05
IB18_f	1.20	0.45	1.21	0.46
IB18_no	13.85	3.58	17.19	4.02
IB30_e	7.21	2.49	6.48	2.34
IB30_f	1.23	0.48	1.25	0.50
IB30_no	21.60	4.54	24.59	4.86
IB60_no	14.72	3.70	16.26	3.91
IB60_wrk	7.19	2.49	6.27	2.29
SB18_e	2.10	1.05	2.08	1.04
SB18_f	1.14	0.38	1.14	0.38
SB18_no	3.04	1.43	3.47	1.57
SB30_e	3.45	1.57	3.31	1.52
SB30_f	1.25	0.50	1.24	0.49
SB30_no	5.44	2.11	6.24	2.29
SB60_no	5.38	2.09	6.03	2.24
SB60_wrk	4.25	1.80	3.93	1.71
u18	3.28	1.51	3.46	1.57
UB18_e	1.44	0.67	1.59	0.77
UB18_f	1.08	0.28	1.06	0.25
UB18_no	1.87	0.93	2.26	1.12
UB30_e	2.09	1.04	2.29	1.13
UB30_f	1.16	0.40	1.13	0.36
UB30_no	2.70	1.31	3.34	1.53
UB60_no	6.07	2.25	4.45	1.86
UB60_wrk	4.18	1.78	3.14	1.46
Misc	3.92	1.71	4.07	1.75

### 3.3 Decompositions

Having constructed two sets of flows coefficients, relating to pre- and post-GFC periods, along with two vectors of average entrants and numbers on each benefit, this subsection considers what would happen to benefit numbers if transition rates observed during the GFC were to persist until November 2016. Importantly these are ‘what if’ scenarios, rather than forecasts.<sup>10</sup> The purpose of these calculations is to show the impact that underlying transition probabilities can have on the numbers on benefit, rather than to provide an official estimate of the likely numbers on benefit in the future.<sup>11</sup>

Figure 2 shows the effects on the time profile of total number of benefit recipients over the period from February 2011 to November 2016 of starting from average pre-GFC stocks, holding quarterly inflows constant at their average pre-GFC levels, and using the two different sets of forward flow coefficients. Again the hypothetical nature of these illustrative calculations is worth stressing. In a practical reform analysis, the inflows would not be expected to remain constant and a particular time profile for changes in inflows would be modelled. This can easily be accommodated in the present framework. The simulations illustrate the importance of allowing for the inter-benefit flows when changes take place to a system that is out of equilibrium, and disentangling the effects of inflows and transitions.

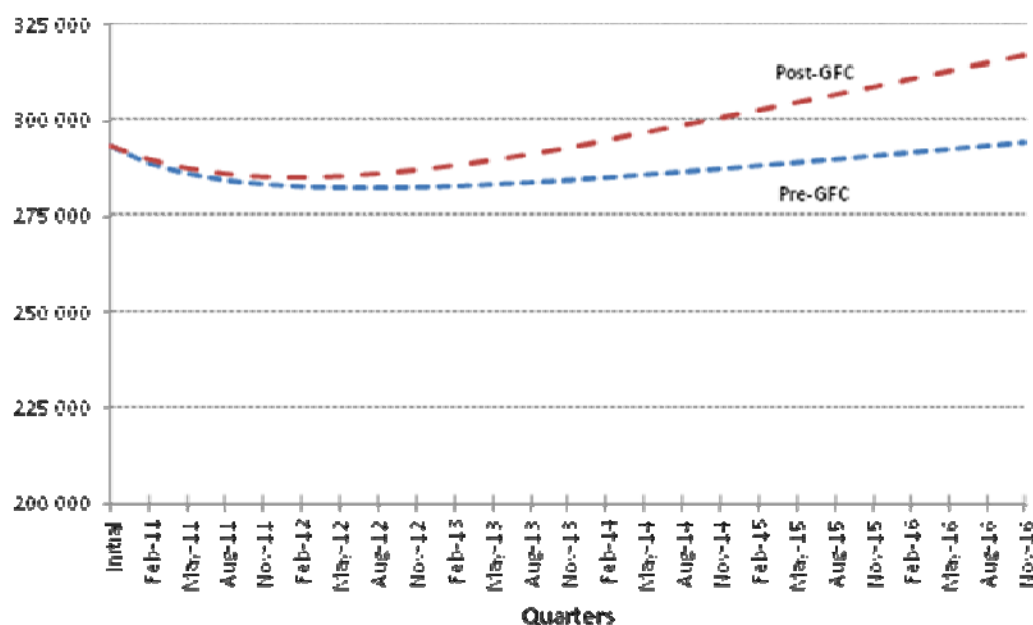
First, in each case the simulated benefit numbers do not follow a simple monotonic adjustment towards a final equilibrium stock. Second, the total number of benefit recipients is consistently higher for the post-GFC transitions, reflecting the longer durations for the majority of benefit types. By 2016 the two simulations differ by about 25,000 individuals. These profiles contrast with those shown in Figure 3, which are constructed using the constant post-GFC average entrants and post-GFC initial stocks. The difference between the two totals by November 2016 is similar to that shown in Figure 2, although the time profiles are quite different. In Figure 3, the two simulations consistently increase over the period. As expected, the total number on the benefit system is much higher when the post-GFC birth vectors (and initial stocks) are used.

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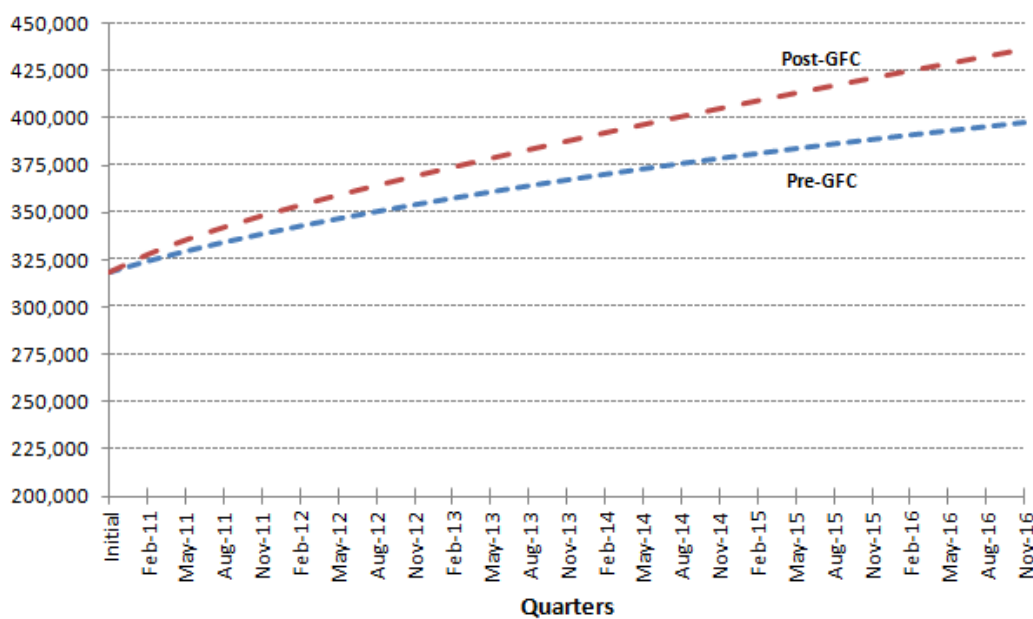
10 Official forecasts of benefit numbers are provided in the Budget Economic and Fiscal Update.

11 The differences between periods are assumed to arise from the GFC, but in some of the non-work focused benefits they may reflect other changes over the period.

**Figure 2 – Effects of Different Transitions with Pre-GFC Stocks and Inflows: All Benefits Combined**



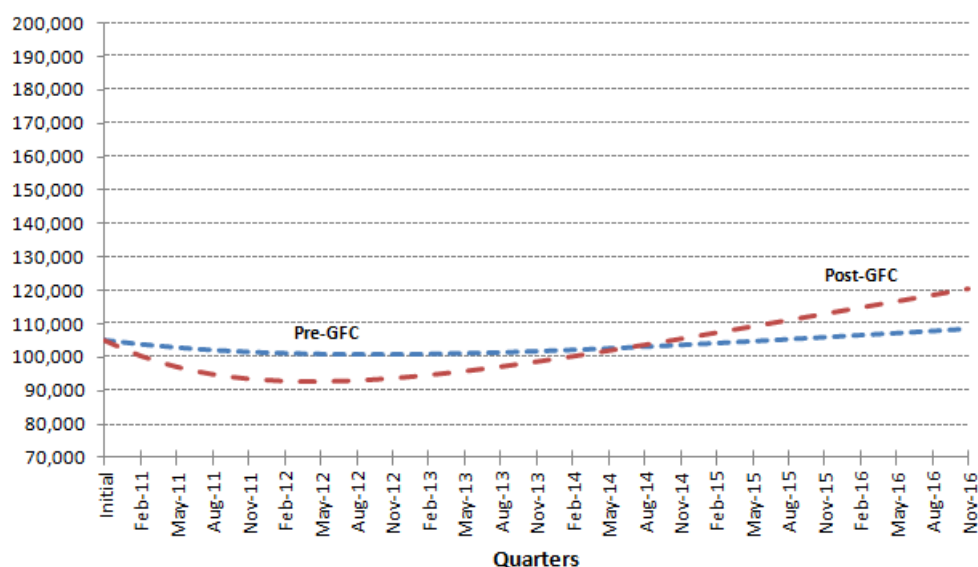
**Figure 3 – Effects of Different Transitions with Post-GFC Stocks and Inflows: All Benefits Combined**



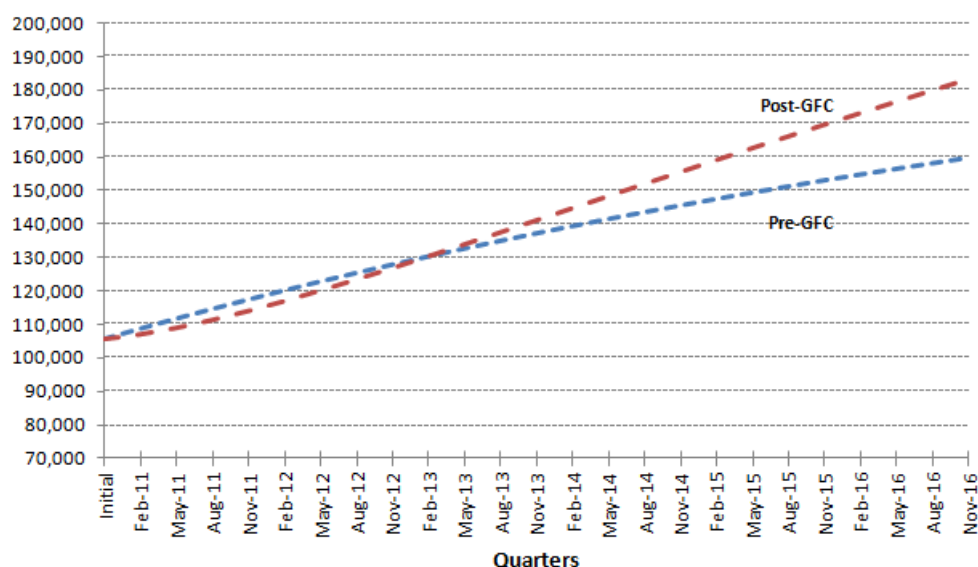
Simulations of DPB recipients over the same period are shown in Figures 4 and 5, using, respectively, the pre-GFC and post-GFC initial stocks and inflows. Here the different profiles display quite different patterns. The difference produced by the two sets of transitions is also much larger when post-GFC birth vectors are used. As with the total beneficiaries, Figure 4 shows that the use of pre-GFC inflows and initial stocks generates non-monotonic profiles of DPB numbers over time. But in this case the post-GFC transition matrix produces lower stocks of DPB beneficiaries than the pre-GFC matrix in the early years of the projection period, only overtaking the pre-GFC transitions in mid-2014. In Figure 5, which uses the post-GFC birth vector each period, the DPB numbers

increase continually over the period for both transition matrices, with the post-GFC transitions overtaking the numbers produced by pre-GFC transitions by early in 2013.

**Figure 4 – Effects of Different Transitions with Pre-GFC Stocks and Inflows: DPB**



**Figure 5 – Effects of Different Transitions with Post-GFC Stocks and Inflows: DPB**

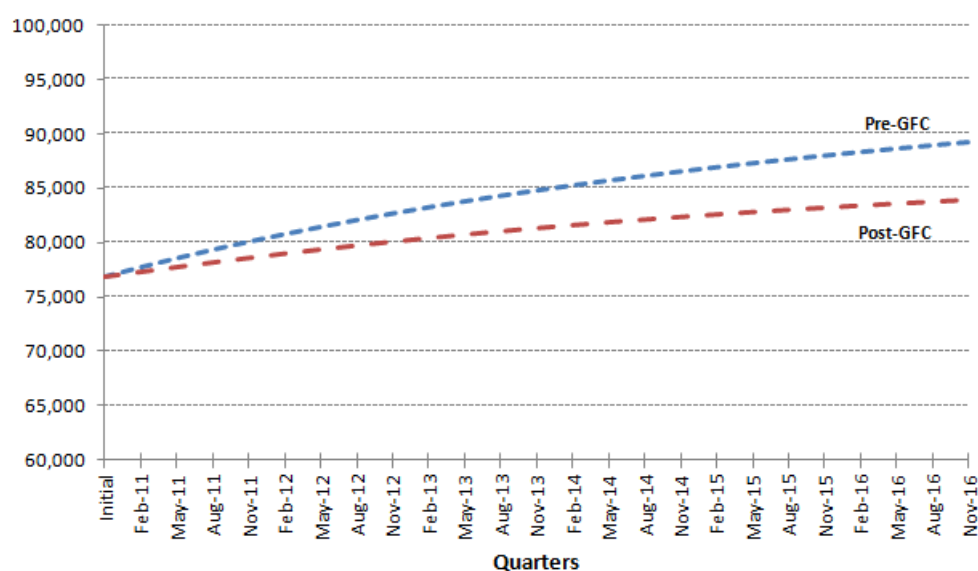


Decompositions using different combination of transition matrices, initial stock and flow vectors, are shown for IB beneficiaries in Figures 6 and 7.<sup>12</sup> In this case the pattern of changes over time and differences between numbers using pre- and post-GFC transitions are similar. The number of IB beneficiaries rises consistently over the projection period. But in this case the stock of IB recipients under pre-GFC transitions is consistently higher than obtained under post-GFC transitions, irrespective of the inflow vector and initial stocks used. This result has interesting implications for the counterfactual cases examined in the following section. It may be expected, in view of the larger inflows to IB

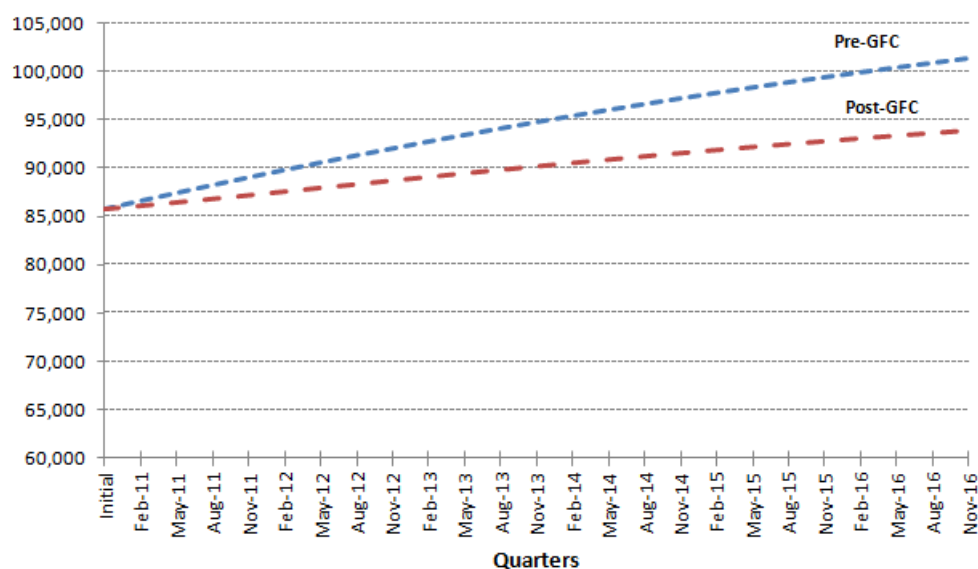
12 There have been policy changes regarding IB beneficiaries over the period though, as explained earlier, the present illustrations ignore such changes.

and the typically longer average durations in the various IB categories post-GFC, that the pre-GFC transitions would produce lower stocks of IB beneficiaries. This is indeed the case in the long-run equilibrium situations: the profiles in Figures 6 and 7 eventually intersect. However, as in all the cases considered in this section, the adjustment to an equilibrium stock can take many years. Inflows to IB from other categories (notably from some SB states) are in fact higher for the pre-GFC period than during the post-GFC years, and this type of inter-benefit transition influences the results in these two decompositions. This characteristic has important implications, as discussed further below, for evaluating both the possible need for policy intervention and the effectiveness of any policy designed to reduce inflows to certain benefits. In the case of unemployment stocks (not shown here) the stocks reach their equilibrium values relatively quickly in each case, mainly because the inflows from outside are large and the durations are relatively shorter than for the other beneficiary types discussed in this subsection. It also highlights the point that numbers of different types of benefit may not all move counter-cyclically.

**Figure 6 – Effects of Different Transitions with Pre-GFC Stocks and Inflows: IB**



**Figure 7 – Effects of Different Transitions with Post-GFC Stocks and Inflows: IB**



## 4 Simulations of Benefit Numbers

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This section reports a range of simulations, up to November 2016, of the numbers of benefit recipients. These simulations effectively provide counterfactuals against which various policy reforms could be examined. The approach involves taking the actual stocks in each benefit category at November 2010, and then making assumptions about the quarterly entries and transitions over the subsequent quarters. These counterfactuals are described in subsection 4.1. Benefit numbers are reported in subsection 4.2. The implications for the number of beneficiaries who are also employed while in receipt of benefits are shown in Appendix D.

### 4.1 The Counterfactual Assumptions

The following graphs show the projected stocks where pre-GFC (2005-08) inflow, outflow and inter-benefit transition rates are applied from February 2011 and continue across the forecast period. This scenario provides benefit recipients under the hypothetical situation whereby there is an immediate return to Pre-GFC transitions on and off the benefit system and between benefit categories. Other profiles incorporate the effect of the GFC (and other structural changes) on benefit numbers, but make assumptions about the timing of the return to pre-GFC transitions. Thus, the profile labelled *Post-GFC+Recovery* assumes that post-GFC transitions prevail until February 2012 after which beneficiary numbers begin a gradual transition back to Pre-GFC levels. However a complete convergence would not occur inside the forecast period.

The profile labelled *Post-GFC->Transition->Pre-GFC* assumes that post-GFC transitions prevail till November 2012 but there is a delay before Pre-GFC transitions apply and lead to relatively reduced stocks of beneficiaries. Finally, the *Post-GFC* profile assumes that post-GFC transitions prevail across the forecast period. As expected, this implies a continued rise in beneficiary numbers across the period. The profile *Post-GFC+Recovery* suggests that a return to pre-GFC rates by February 2012 results in numbers on a benefit falling to around 325,000 within about 12 months. However, a more delayed return to pre-GFC transition rates could result in benefit numbers being 25,000 higher than with an earlier return to pre-GFC rates; see Figure 8. As these simulations are alternative counterfactuals against which policy changes are to be compared, the assumption that the inflows and transitions remain unchanged for a number of quarters at either their pre- or post-GFC values, or at transitional values, reflects an explicit assumption that there are no policy changes over the projection period.

All simulations thus begin, in the initial period, from the same vector of stocks. These clearly do not reflect a long run equilibrium, especially since the actual November 2010 stocks arise from circumstances which have operated for a relatively short time. As explained in Section 2, the application of fixed inflows and transition rates ultimately produces a long run equilibrium in which the total outflows are matched by inflows, and the vector of stocks of individuals in each benefit category remain fixed. Three of the four counterfactuals ultimately move to, and then continue to apply, the pre-GFC inflows and transition rates. Hence it is clear that these cases will ultimately converge on the same vector of the distribution of individuals across benefit types. It can take many periods to approach the long-run equilibrium, although the stocks for some benefit types may converge more quickly than others. The starting points where the pre-GFC inflows and transition rates apply are obviously different. For example, the benefit numbers are much



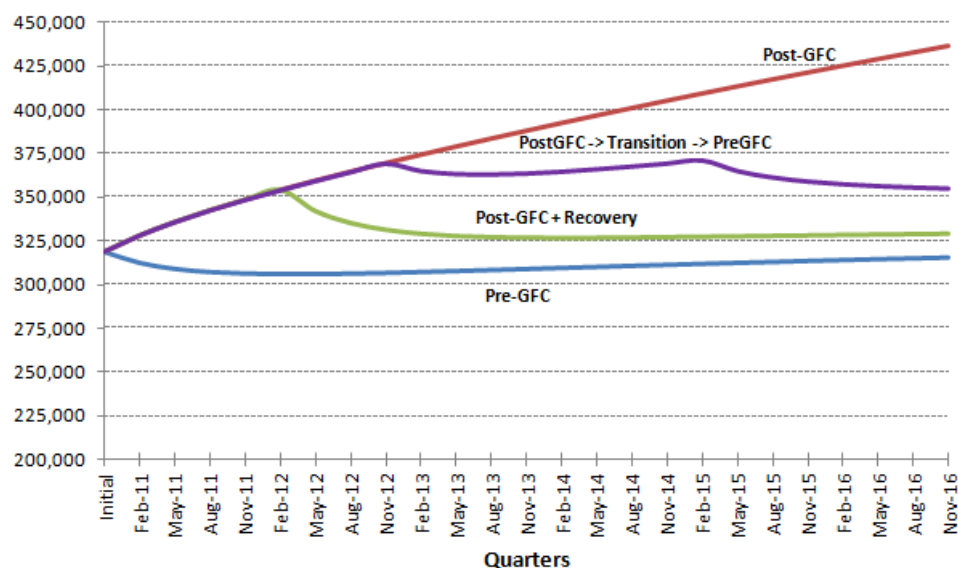
higher at the point where pre-GFC rates finally operate, for the fourth counterfactual above in which there is a transition period from pre- to post-GFC rates.

An important implication of starting from a disequilibrium stock of beneficiaries is that, when switching to a new set of inflows and transitions which imply lower equilibrium stocks in all benefit categories, the numbers in receipt of some of the benefits need not necessarily initially fall. The numbers in some benefit categories may increase for a period, particularly if the 'starting stocks' involve large (disequilibrium) numbers of those benefit types from which there are significant flows into the category of interest.

## 4.2 Stocks by Benefit Type

The time paths of all benefits combined, for each of the counterfactual cases, are shown in Figure 8. The inflows and transition rates observed over the economic cycle clearly have a substantial effect on the total number of benefit recipients and on their changes over time. Even for the three counterfactuals having identical long run equilibrium numbers, there are substantial differences at the end of the projection period. Furthermore, even when the shift to pre-GFC rates implies an immediate fall in total numbers the movement towards the equilibrium is not monotonic. The aggregate number of beneficiaries decreases for about four quarters, until gradually increasing towards the equilibrium.

**Figure 8 – All Benefits Combined**



**Figure 9 – Domestic Purposes Benefit**

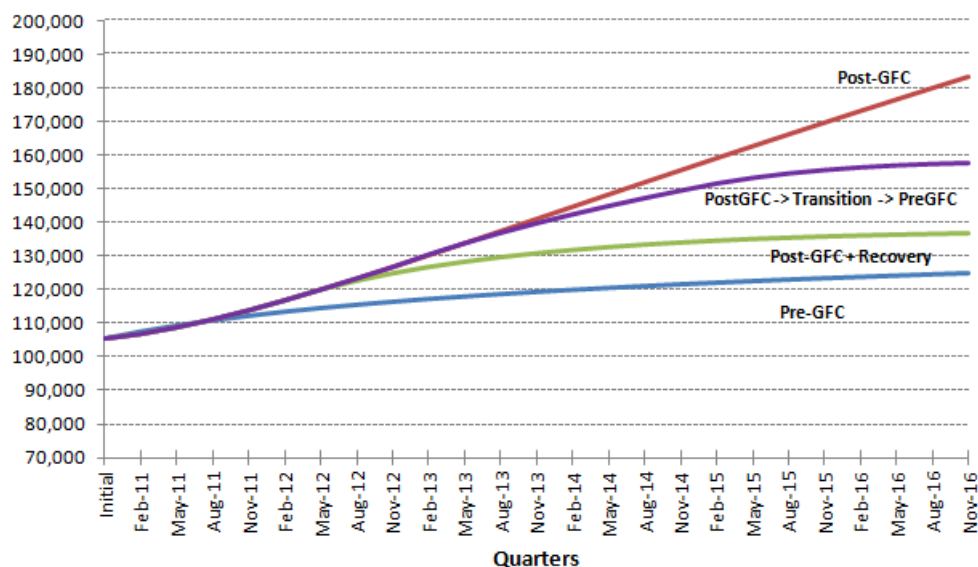


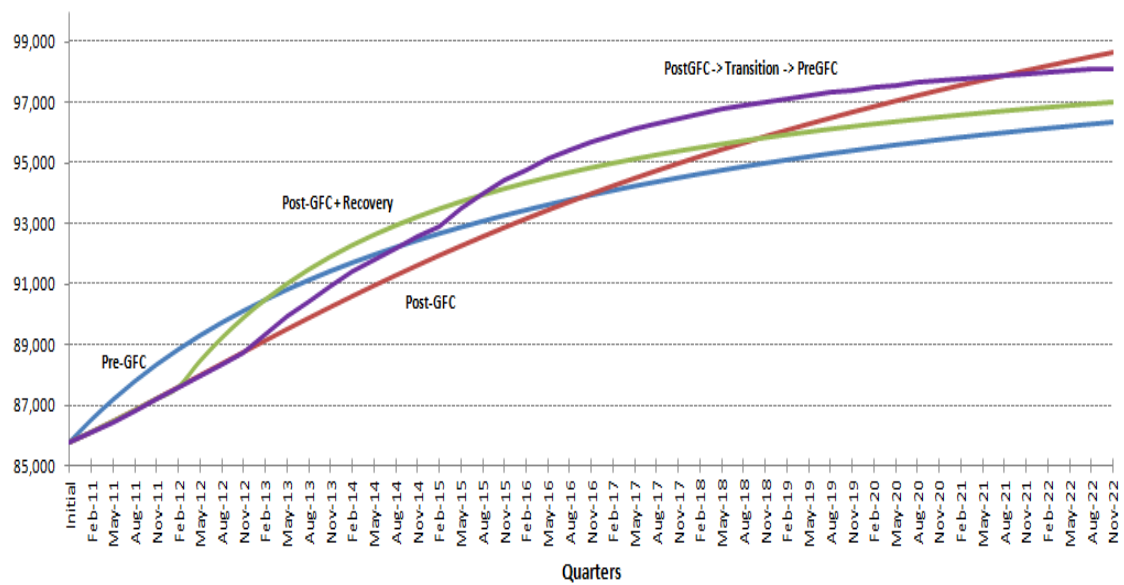
Figure 9 shows the implications for DPB recipients. In this case, the shift from post-GFC inflows and transition rates to pre-GFC rates does not imply a reduction in numbers, but simply a slowing down in their rate of increase, for each of the three less-pessimistic cases. At the end of the projection period, the three counterfactuals continue to produce quite different stocks.

The importance of allowing for the dynamics of inter-beneficiary-category movements is shown in Figure 10 for the case of Invalid's Benefit numbers. This displays the situation where a shift to pre-GFC inflows and transition rates actually leads to higher numbers in receipt of IB than under post-GFC conditions, for all the three relevant counterfactuals. This result is perhaps counter-intuitive, particularly when it is considered that the flows onto IB from outside the benefit system are generally higher under post-GFC conditions and, furthermore, the average time spent in each of the IB categories is higher in the post-GFC transitions than for the pre-GFC transitions. However, the higher IB stock is only a temporary phenomenon, and the fact that equilibrium stocks are eventually lower in the three more optimistic counterfactuals is indicated in Figure 10 which, unlike the other diagrams, extends the projection period further out to November 2022.

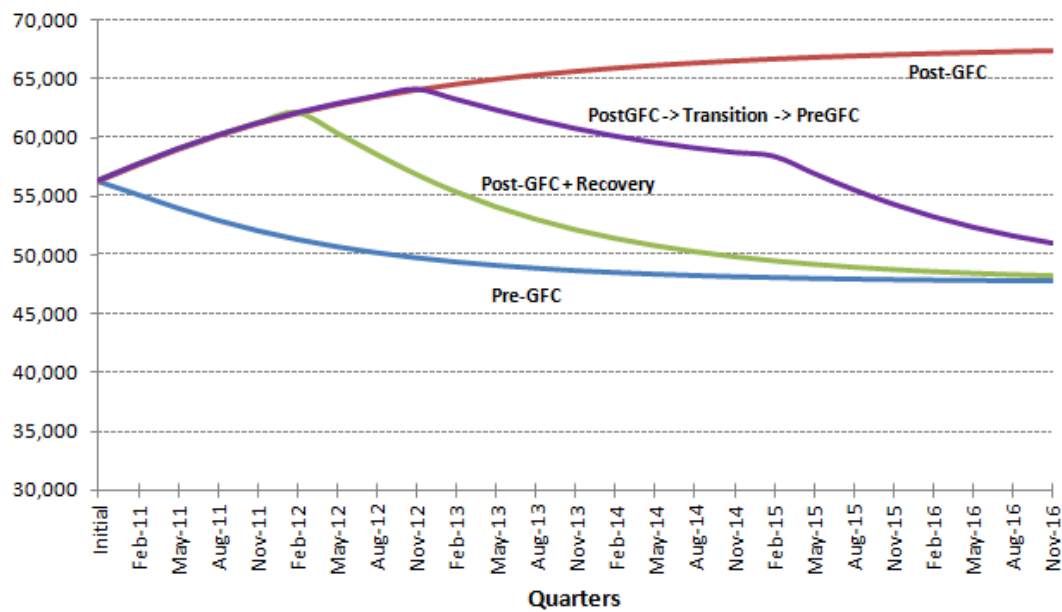
As shown in Table 2 of the previous section, the average flows onto SB are very much higher than for any other benefit category, and the increase in the inflows as a result of the GFC is much higher than for the other benefit types. This is especially true of the younger SB categories. A characteristic of the inter-benefit transitions, as shown by the matrices in Appendix C, is that the movement from SB to IB is higher in the pre-GFC period than in post-GFC conditions. These features combine to generate the temporary rise in IB numbers above the post-GFC counterfactual.

The large differences in the inflows to SB categories produce, as expected, quite rapid reductions in SB numbers following the shift from post-GFC to pre-GFC conditions. These are illustrated in Figure 11. Indeed, the two most optimistic counterfactual cases converge quite rapidly towards their long run equilibrium, in view of the dominance of the inflows from outside the benefit system.

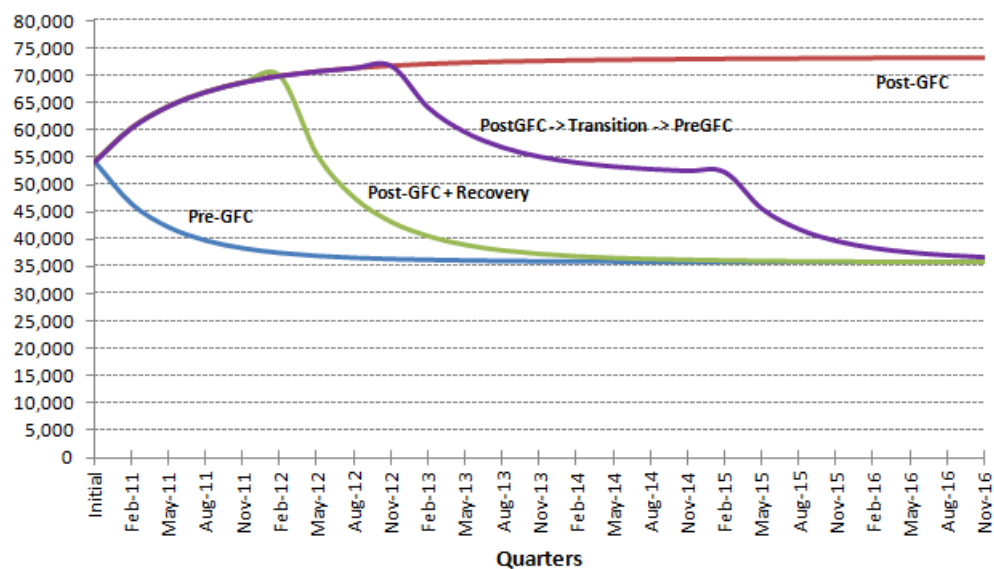
**Figure 10 – Numbers in Receipt of Invalid's Benefit**



**Figure 11 – Numbers in Receipt of Sickness Benefit**

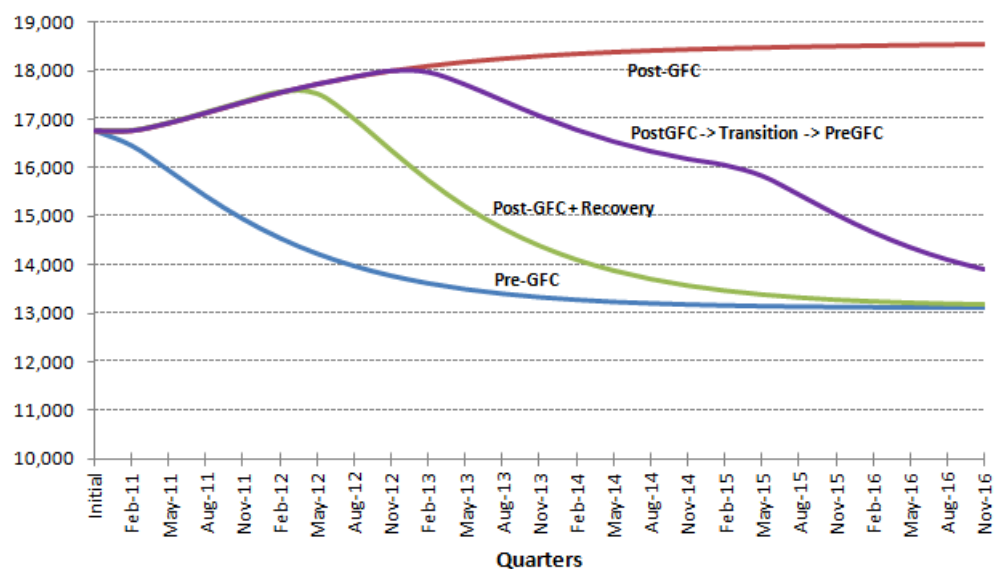


**Figure 12 – Numbers in Receipt of Unemployment Benefit**



The substantial differences between the inflows to unemployment between the pre- and post-GFC conditions, combined with the small number of movements into the UB categories from other benefit types, means that the three most optimistic counterfactuals shift quite quickly to the long-run equilibrium. These simulations are shown in Figure 12. Finally, Figure 13 shows the results for Miscellaneous and Under 18 Benefits.

**Figure 13 – Miscellaneous and Under 18 Benefits**



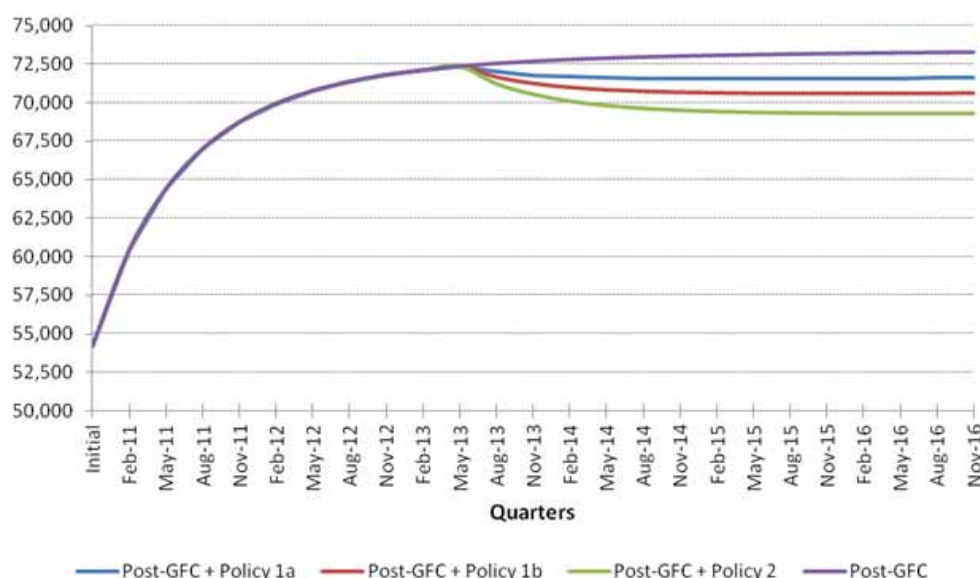
## 5 Effects of Welfare Reforms

The social accounting model itself does not of course explicitly deal with behavioural responses to changes either in the benefit rates, income thresholds or abatement rates, or indeed in the regulations regarding eligibility or those designed to deal with moral hazard aspects. The transition rates are not based on econometric models in which various rates are estimated as functions of a range of relevant variables, including features of the tax and benefit system: they are based simply on observed flows over a period of time. Indeed, econometric models are seldom capable of handling the precise administrative details of many benefit structures, and to the extent that reforms involve various innovations, empirical evidence regarding behavioural responses are not available anyway.

The counterfactuals reported in the previous section involve simulations. They answer the question, ‘what if the inflows and transitions among benefit categories change in well-specified particular ways?’ Hence the model provides a useful tool for looking at the broad implications of changes in inflows or transitions which are thought likely to occur. The advantage, as stressed above, is that implications can be examined for benefit types other than those for which reforms are being debated. Furthermore, the dynamics of a system, which is out of equilibrium when a change arises, can be investigated. Given a specified change to one or more features of the benefit system, the potential impact on inflows to selected benefit categories and associated exit rates may be considered, drawing on a range of extraneous information.

Suppose a change in circumstances is expected to arise in May 2013 which influences only the quarterly rate of entrants to the range of unemployment benefits, while all other flows and transition rates remain at the observed post-GFC levels. The details – whether of a change in market circumstances or a change in the eligibility conditions – need not be specified here. Figure 14 illustrates the subsequent time profile of the stock of unemployment benefit recipients over all UB categories, for a range of percentage reductions in the inflows: policies 1a, 1b and 1c respectively involve 2.5, 4 and 6 per cent reductions ‘across the board’ in UB entrants.

**Figure 14 – Projected Unemployment Benefit Stocks over Time**



It has been seen earlier that unemployment stocks move relatively more quickly than other benefit types towards new steady-state values, and this is also observed for this simple change. Changes in other broadly defined benefit types are relatively small in this case.<sup>13</sup>

At the stage when the change is expected to take place, the stock of UB recipients is not in equilibrium even though the various rates were constant, because of the build-up in stocks resulting from the lower post-GFC exit rates (compared with those before the GFC), along with the fact that some movements into UB categories arise from other benefit types within the system, and the stocks in those 'source' categories are not in equilibrium. It is clear from the diagram that the reduction in the stock over time (for each percentage change in the inflow rate), when compared with the stock when the change arises, is smaller than the reduction when measured against the counterfactual of no change in inflows. The contrast between such comparisons would be much greater if the assumed change in the inflow rate were to occur while the counterfactual profile is rising much more steeply. A key point is that the effectiveness of a policy reform needs to be based on a sound counterfactual. In other words, simple *ex post* comparisons of changing stocks of benefit recipients may therefore not provide an accurate measure of the effectiveness of a policy reform.

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13 However, more substantial changes can be observed for particular types of UB claimant, where there are larger movements to other categories.

## 6 Conclusions

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This paper has presented a social accounting framework designed to examine benefit flows in New Zealand. Quarterly entry, transition and exit rates for 47 benefit types were obtained using average values observed for a number of years before and after the global financial crisis. Simulations over time of the numbers of individuals in receipt of a range of benefits were obtained under alternative assumptions about the recovery from the financial crisis.

One advantage of the approach presented here is that the dynamics and complexities of benefit flows can be investigated in detail. The approach recognises that a change is imposed on a dynamic system that is not in equilibrium. Existing stocks need to ‘work their way’ through the revised structure, of which just a small number of transition rates are affected by any policy change. The final effect on the number of benefit recipients are not apparent immediately, but may take some time to settle down. In the medium term of three or four years, the stocks can be substantially affected by the economic conditions at the time of the change, and the assumed conditions over the projection period (even when the equilibrium stocks are expected to be the same – as with the three most optimistic counterfactual cases considered above).

The dynamics of adjustments to revised inflow and exit rates, consequent on policy changes, mean that the *ex post* evaluation of policy initiatives is far from straightforward. The speed and indeed the direction of adjustments to benefit numbers depend on a vast range of flows, not only those flows which are targeted by a policy change. Furthermore, it may in some cases appear that a reform has little or no effect, if the numbers in receipt of a benefit a year or so after the reform are only slightly below those when the reform was enacted. However, the need to consider the numbers in relation to a well-specified counterfactual, not the stock at the time of implementation, is paramount. If the counterfactual suggests that the numbers would increase substantially without a policy change, a policy change which involves only a slight increase, from the time of implementation, might wrongly be judged a failure. Alternatively, and perhaps even more worryingly, a policy change which results in beneficiary stocks that are only slightly below or similar to the counterfactual, which itself implies a large fall in the absence of any intervention, may wrongly be judged to have been successful.

It is suggested that the approach examined here can provide a useful tool for the analysis of alternative policies and exogenous changes in the economy which are expected (or designed) to lead to changes in the pattern of transitions into and among different benefit categories.

## Appendix A. Adjustment of Exit Frequencies

In examining the reasons for leaving each benefit type, it was mentioned above that the data relating to reasons for leaving benefits contain many cases where no code is given. This appendix explains how extraneous information about the distribution of reasons for exit in aggregate, for each group of benefits, can be used to adjust the data.

Let  $a_j^0$  denote the number of individuals in benefit category  $j$  who exit the benefit system at the end of the quarter, for whom no reason is given. As above, let  $d_{i,j}$  denote the number moving from benefit type  $j$  for reason  $i$ . The number for whom a reason is known is thus:

$$g_j = \sum_i d_{i,j} \quad (9)$$

The aggregate proportion leaving for reason  $i$ , for those for whom a reason is known, is given by:

$$r_i = \frac{\sum_j d_{i,j}}{\sum_j g_j} \quad (10)$$

In addition, information about these proportions is available from another data source. Denote the extraneous values by  $r_i^*$ . It is desired to adjust the  $d_{i,j}$  by allocating the unknown values in such a way that the new aggregate proportions approximately match the values from the additional data source.

First, adjust all  $d_{i,j}$  using:

$$d'_{i,j} = d_{i,j} \left( 1 + \frac{a_j^0}{g_j} \right) \quad (11)$$

And then obtain:

$$g'_j = \sum_i d'_{i,j} \quad (12)$$

Along with new values of  $r$  using:

$$r'_i = \frac{\sum_j d'_{i,j}}{\sum_j g'_j} \quad (13)$$



Finally, adjust the  $d'_{i,j}$  using:

$$d^*_{i,j} = d'_{i,j} \left( \frac{r^*_i}{r_i} \right) \quad (14)$$

This procedure was used to benchmark the exit rates in the social accounting framework. As mentioned earlier, there are many reasons for a person on benefit to leave the benefit system. The four main reasons are: finding work; death; migration and; a change in circumstances such as re-partnering.

The data for exits in the Benefit Dynamics Dataset were accurate in aggregate; they correctly captured the total number of people leaving the benefit system in a particular quarter. However, they did not provide much detail on why they were leaving. Therefore exit rates were derived from the 2008 'Linked Employer-Employee Data' feasibility study. This study documented the reasons why people left the benefit system in great detail. For example the study found that of the people who moved off the Unemployment Benefit between July 1999 and June 2005, 48 per cent left because they had obtained work, 0.1 per cent died, 5.1 per cent left New Zealand and the rest left for a variety of other reasons. Similar statistics were available for other benefit types.

It was assumed that the exit statistics detailed in the study applied to the corresponding aggregates of all the benefits in the model. However, since the model further divides these benefits into sub-categories (for example, UB is divided into 8 sub-categories), the above procedure was used to derive exit rates for each of the sub-categories without altering the overall exit rate for a particular benefit. This accounts for the fact that exit rates are not uniform across the sub-categories, for example older beneficiaries in receipt of a particular benefit are more likely to exit due to 'death' than beneficiaries in lower age-groups. Similarly, lower-age groups are more likely to exit due to migration or finding work. The procedure described above was used to account for this unevenness in the reasons for people leaving the benefit system.

## Appendix B. The Benefit Dynamics Dataset

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The BDD dataset is derived from the SWIFTT benefit payments system. Historical data generated by taking snapshots of SWIFTT data at given points in time are held on the Information Analysis Platform (IAP). In their raw form, the historical data do not readily permit analysis of benefit dynamics. The variables of interest are distributed across a number of different structures and complex matching routines are required to link them with spells on benefit. In addition, the structures are characterised by a considerable amount of “noise”: multiple records must be examined to establish a chain of events and, in some cases, retrospective action means that these cannot be established by working through records chronologically. The BDD links information recorded in SWIFTT for the same individual over time, strips away the noise in the historical data, and organises the data in a form amenable to longitudinal analysis. In the December 2003 update, the data set was enhanced to incorporate selected variables from the job seeker register system SOLO and the Unified Client View Phase Two (UCVII) system, other administrative data systems held by MSD.

The BDD set is stored in the secure environment of the IAP and access is restricted to a small number of authorised analysts. The data set contains no name and address information that could be used to identify individual benefit recipients.

The dataset covers the period from 1 January 1993 to the date of the most recent update. From October 2010, the data are updated at the end of each month (previously updates were quarterly). These updates are each created with a lag of at least two to three months to allow retrospective action to ‘bed down’ records for the end of the period.

Because of retrospective action, successive versions of the BDD will give a different benefit history for small numbers of individuals, and analyses repeated on a later version of the data set may produce slightly different results. In order to minimise interruption to projects using a given version of the data set, the most recent update and the one that preceded it are both available through the IAP. The year and month of the update is indicated by the four digits at the end of the name of each file – 1006 indicates the update to 30 June 2010 for example.

For the period up to 1 June 1996, the data set is based on consolidated files of historical SWIFTT data. The consolidated files reflect a snapshot of the situation of each individual in SWIFTT at monthly intervals only. For variables which do not have a change date recorded (such as the partnership status indicator APORT and the district office variable DIST), this leads to some imprecision in the timing of events.

# Appendix C. Forward Coefficients Matrices

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This appendix presents the forward coefficients matrices for quarterly movements among benefit categories. Two sets of tables are reported, covering pre-GFC and post-GFC periods. An entry of 0.000 indicates that the proportion moving between the relevant categories was zero to 3 decimal places. Where the values were zero to 4 decimal places, there is a blank entry in the table: in most of these cases there were in fact no recorded flows.

**Table 4 – Transition Rates from DPB Part 1: Pre GFC**

	DPB 18_0_e	DPB 18_0_f	DPB 18_0_no	DPB 18_5+_no	DPB 18_5+_wrk	DPB 18_nc_no	DPB 18_nc_wrk	DPB 30_0_e	DPB 30_0_f	DPB 30_0_no
DPB18_0_e	0.670	0.392	0.035	0.000	0.005		0.001			
DPB18_0_f	0.007	0.127	0.001							
DPB18_0_no	0.140	0.177	0.824	0.022	0.003	0.004	0.001			
DPB18_5+_no	0.006	0.007	0.021	0.775	0.118	0.002	0.001			
DPB18_5+_wrk	0.027	0.012	0.001	0.046	0.687		0.001			
DPB18_nc_no	0.001		0.005	0.008	0.001	0.947	0.169			
DPB18_nc_wrk	0.001	0.001	0.000	0.000	0.002	0.024	0.796			
DPB30_0_e	0.013	0.004	0.001		0.000		0.000	0.680	0.330	0.038
DPB30_0_f	0.000	0.009						0.007	0.174	0.001
DPB30_0_no	0.003	0.003	0.013	0.001				0.107	0.174	0.792
DPB30_14_e					0.000			0.001		
DPB30_14_f									0.002	
DPB30_14_no				0.001				0.000		0.002
DPB30_5_e	0.001	0.001		0.002	0.040			0.064	0.025	0.003
DPB30_5_f				0.000	0.001			0.001	0.013	
DPB30_5_no	0.000		0.001	0.044	0.007			0.009	0.011	0.051
DPB30_nc_e					0.000	0.001	0.023	0.001	0.002	0.000
DPB30_nc_f							0.000			
DPB30_nc_no				0.000		0.020	0.005	0.001	0.002	0.003
DPB60_no										0.000
DPB60_wrk										
IB18_e										
IB18_f										
IB18_no			0.000	0.001						
IB30_e										
IB30_f										
IB30_no								0.000		0.002
IB60_no										
IB60_wrk										
SB18_e					0.000					
SB18_f										
SB18_no	0.001	0.001	0.003	0.003	0.000	0.001				
SB30_e								0.000		
SB30_f										
SB30_no				0.000	0.000		0.000	0.001		0.003
SB60_no										
SB60_wrk										
u18										
UB18_e	0.001		0.000	0.000	0.000					
UB18_f										
UB18_no	0.001	0.001	0.004	0.004	0.001	0.001	0.000			
UB30_e								0.001		0.000
UB30_f										
UB30_no				0.000	0.000			0.001	0.002	0.004
UB60_no										
UB60_wrk										
Misc	0.000		0.001	0.001	0.000			0.001		0.002

**Table 5 – Transition Rates from DPB Part 2: Pre GFC**

	DPB 30_14_e	DPB 30_14_f	DPB 30_14_no	DPB 30_5_e	DPB 30_5_f	DPB 30_5_no	DPB 30_nc_e	DPB 30_nc_f	DPB 30_nc_no	DPB 60_no	DPB 60_wrk
DPB18_0S_e											
DPB18_0_f											
DPB18_0_no											
DPB18_5+_no											
DPB18_5+_wrk											
DPB18_nc_no											
DPB18_nc_wrk											
DPB30_0_e	0.001			0.001		0.000	0.000				
DPB30_0_f											
DPB30_0_no	0.000	0.001	0.003	0.001	0.001	0.006			0.001		
DPB30_14_e	0.784	0.380	0.042	0.030	0.016	0.002	0.003	0.004	0.000		
DPB30_14_f	0.008	0.247	0.001	0.000	0.009			0.003			
DPB30_14_no	0.081	0.132	0.844	0.004	0.003	0.035	0.001		0.005		
DPB30_5_e	0.002		0.000	0.746	0.384	0.054	0.001	0.001			
DPB30_5_f				0.008	0.209	0.002					
DPB30_5_no	0.000		0.004	0.094	0.137	0.803	0.000		0.002		
DPB30_nc_e	0.014	0.013	0.001	0.001	0.000	0.000	0.853	0.460	0.038		
DPB30_nc_f	0.000	0.002			0.001		0.008	0.235	0.001		
DPB30_nc_no	0.004	0.002	0.023	0.000	0.002	0.004	0.092	0.182	0.925		
DPB60_no			0.001			0.000	0.001	0.004	0.010	0.879	0.058
DPB60_wrk	0.001			0.000			0.015	0.021	0.000	0.025	0.847
IB18_e											
IB18_f											
IB18_no											
IB30_e	0.001		0.000	0.000	0.000	0.000	0.000		0.000		
IB30_f											
IB30_no	0.001		0.004	0.000	0.000	0.003	0.001	0.003	0.002		
IB60_no										0.006	0.001
IB60_wrk										0.000	0.001
SB18_e											
SB18_f											
SB18_no											
SB30_e	0.002	0.002	0.000	0.000			0.000				
SB30_f	0.000										
SB30_no	0.002	0.002	0.008	0.001	0.001	0.003	0.000		0.001		
SB60_no										0.000	0.000
SB60_wrk											0.000
u18											
UB18_e											
UB18_f											
UB18_no											
UB30_e	0.003	0.001	0.001	0.000		0.000	0.000				
UB30_f	0.000										
UB30_no	0.003	0.002	0.009	0.001	0.000	0.003			0.001		
UB60_no										0.001	0.000
UB60_wrk											0.000
Misc	0.002	0.001	0.003	0.001	0.001	0.002	0.000		0.001	0.001	0.001

**Table 6 – Transition Rates from IB: Pre GFC**

	IB18_e	IB18_f	IB18_no	IB30_e	IB30_f	IB30_no	IB60_no	IB60_wrk
DPB18_0_e								
DPB18_0_f		0.004						
DPB18_0_no			0.000					
DPB18_5+_no	0.000							
DPB18_5+_wrk								
DPB18_nc_no	0.000		0.000					
DPB18_nc_wrk								
DPB30_0_e								
DPB30_0_f								
DPB30_0_no								
DPB30_14_e					0.001			
DPB30_14_f					0.001			
DPB30_14_no								
DPB30_5_e								
DPB30_5_f								
DPB30_5_no								
DPB30_nc_e								
DPB30_nc_f								
DPB30_nc_no								
DPB60_no								
DPB60_wrk								
IB18_e	0.819	0.422	0.022					
IB18_f	0.006	0.168	0.001					
IB18_no	0.101	0.194	0.928					
IB30_e	0.021	0.009	0.001	0.861	0.425	0.015		
IB30_f	0.000	0.009		0.004	0.189	0.000		
IB30_no	0.002	0.004	0.022	0.093	0.188	0.954		
IB60_no				0.001	0.001	0.012	0.932	0.082
IB60_wrk				0.010	0.004		0.008	0.861
SB18_e	0.001							
SB18_f	0.000	0.004						
SB18_no	0.000		0.001					
SB30_e				0.001				
SB30_f				0.000	0.001			
SB30_no				0.001	0.001	0.001		
SB60_no							0.000	0.000
SB60_wrk								0.000
u18								
UB18_e	0.000							
UB18_f								
UB18_no	0.000		0.000					
UB30_e								
UB30_f					0.001			
UB30_no				0.000		0.000		
UB60_no								
UB60_wrk								
Misc								

**Table 7 – Transition Rates from SB: Pre GFC**

	SB18_e	SB18_f	SB18_no	SB30_e	SB30_f	SB30_no	SB60_no	SB60_wrk
DPB18_0_e	0.002		0.001					
DPB18_0_f								
DPB18_0_no	0.017	0.015	0.039					
DPB18_5+_no	0.000		0.001					
DPB18_5+_wrk	0.000	0.003						
DPB18_nc_no	0.008	0.008	0.021					
DPB18_nc_wrk	0.001		0.000					
DPB30_0_e				0.000	0.001			
DPB30_0_f								
DPB30_0_no			0.000	0.001	0.001	0.002		
DPB30_14_e				0.001				
DPB30_14_f								
DPB30_14_no				0.001	0.001	0.001		
DPB30_5_e				0.001		0.000		
DPB30_5_f								
DPB30_5_no				0.001	0.001	0.002		
DPB30_nc_e	0.000			0.001	0.001			
DPB30_nc_f								
DPB30_nc_no	0.000		0.000	0.001		0.002		
DPB60_no							0.001	0.000
DPB60_wrk							0.000	0.002
IB18_e	0.006	0.003	0.000					
IB18_f								
IB18_no	0.007	0.003	0.013					
IB30_e	0.000			0.017	0.007	0.001		
IB30_f				0.000	0.002			
IB30_no	0.000		0.000	0.012	0.008	0.029		
IB60_no				0.000		0.000	0.054	0.016
IB60_wrk				0.000			0.001	0.028
SB18_e	0.524	0.271	0.013					
SB18_f	0.013	0.124	0.001					
SB18_no	0.148	0.243	0.671					
SB30_e	0.014	0.003	0.000	0.710	0.335	0.016		
SB30_f	0.000	0.010		0.015	0.203	0.002		
SB30_no	0.002		0.014	0.112	0.221	0.816		
SB60_no				0.001	0.003	0.007	0.814	0.078
SB60_wrk				0.011	0.004	0.000	0.015	0.765
u18								
UB18_e	0.004	0.010	0.001					
UB18_f	0.001		0.000					
UB18_no	0.013	0.005	0.025					
UB30_e	0.000			0.002	0.001	0.001		
UB30_f	0.000			0.000	0.002			
UB30_no	0.000		0.000	0.007	0.004	0.015		
UB60_no							0.009	0.004
UB60_wrk							0.000	0.003
Misc	0.003	0.003	0.005	0.002	0.001	0.003	0.001	0.000

**Table 8 – Transition Rates from UB: Pre GFC**

	u18	UB18_e	UB18_f	UB18_no	UB30_e	UB30_f	UB30_no	UB60_no	UB60_wrk	misc
DPB18_0_e	0.001	0.000	0.001	0.000						
DPB18_0_f										
DPB18_0_no	0.026	0.002	0.003	0.005						0.002
DPB18_5+_no		0.000		0.001						0.000
DPB18_5+_wrk		0.000								
DPB18_nc_no	0.016	0.001	0.001	0.002						0.001
DPB18_nc_wrk	0.001	0.000								
DPB30_0_e					0.001	0.000				
DPB30_0_f										
DPB30_0_no					0.001		0.002			0.001
DPB30_14_e					0.001	0.001	0.000			0.000
DPB30_14_f										
DPB30_14_no					0.001	0.000	0.001			0.001
DPB30_5_e					0.002	0.001	0.000			0.000
DPB30_5_f						0.000				
DPB30_5_no					0.002	0.001	0.003			0.002
DPB30_nc_e					0.001					0.000
DPB30_nc_f						0.000				
DPB30_nc_no					0.001		0.002			0.002
DPB60_no								0.002	0.001	0.001
DPB60_wrk								0.000	0.002	0.000
IB18_e	0.004	0.000								
IB18_f										
IB18_no	0.039	0.000		0.001						0.000
IB30_e					0.001	0.001	0.000			
IB30_f										
IB30_no					0.001	0.001	0.003			0.001
IB60_no								0.006	0.001	0.000
IB60_wrk								0.000	0.001	
SB18_e	0.000	0.000		0.001						0.000
SB18_f										
SB18_no	0.009	0.004	0.004	0.034						0.010
SB30_e					0.000	0.000	0.003			0.001
SB30_f							0.000			
SB30_no				0.000	0.003	0.002	0.037			0.010
SB60_no							0.000	0.019	0.000	0.001
SB60_wrk								0.003	0.000	
u18	0.695									
UB18_e	0.003	0.307	0.177	0.017						0.002
UB18_f	0.000	0.011	0.071	0.002						0.000
UB18_no	0.031	0.092	0.144	0.464						0.036
UB30_e		0.006	0.003	0.000	0.522	0.246	0.019			0.002
UB30_f		0.000	0.002		0.021	0.139	0.003			0.000
UB30_no		0.002	0.002	0.008	0.092	0.163	0.630			0.025
UB60_no					0.001	0.001	0.005	0.835	0.080	0.001
UB60_wrk					0.007	0.004	0.000	0.014	0.761	
Misc	0.012	0.003	0.001	0.042	0.004	0.003	0.024	0.003	0.001	0.745



**Table 9 – Transition Rates from DPB Part 1: Post GFC**

	DPB 18_0_e	DPB 18_0_f	DPB 18_0_no	DPB 18 _5+_no	DPB 18 _5+_wrk	DPB 18_nc_no	DPB 18 _nc_wrk	DPB 30_0_e	DPB 30_0_f	DPB 30_0_no
DPB18_0_e	0.617	0.235	0.024	0.000	0.005		0.001			
DPB18_0_f	0.007	0.140	0.001							
DPB18_0_no	0.132	0.203	0.772	0.018	0.005	0.003	0.000			
DPB18_5+_no	0.005	0.010	0.018	0.728	0.119	0.002	0.000			
DPB18_5+_wrk	0.024	0.028	0.001	0.030	0.629		0.001			
DPB18_nc_no	0.004	0.005	0.020	0.041	0.005	0.955	0.192			
DPB18_nc_wrk	0.004	0.005	0.001	0.001	0.011	0.018	0.774			
DPB30_0_e	0.011	0.005	0.000		0.000			0.626	0.299	0.028
DPB30_0_f								0.008	0.144	0.002
DPB30_0_no	0.002	0.003	0.012	0.001	0.000			0.100	0.179	0.735
DPB30_14_e					0.001			0.001		
DPB30_14_f										
DPB30_14_no				0.001	0.000			0.001		0.004
DPB30_5_e	0.001			0.002	0.042			0.060	0.021	0.002
DPB30_5_f				0.000	0.001			0.000	0.007	0.000
DPB30_5_no	0.000		0.001	0.040	0.005			0.009	0.003	0.046
DPB30_nc_e	0.000			0.000	0.001	0.001	0.025	0.007	0.010	0.000
DPB30_nc_f							0.000			
DPB30_nc_no			0.000	0.003	0.000	0.020	0.005	0.003	0.014	0.017
DPB60_no										0.000
DPB60_wrk										
IB18_e										
IB18_f										
IB18_no			0.001	0.001						
IB30_e										
IB30_f										
IB30_no								0.000		0.002
IB60_no										
IB60_wrk										
SB18_e	0.000		0.000		0.000		0.000			
SB18_f										
SB18_no	0.002		0.006	0.005	0.001	0.001				
SB30_e										
SB30_f										
SB30_no				0.000				0.000		0.006
SB60_no										
SB60_wrk										
u18										
UB18_e	0.001		0.000	0.000	0.001					
UB18_f										
UB18_no	0.002	0.005	0.009	0.008	0.002	0.000				
UB30_e					0.000			0.001	0.003	0.000
UB30_f										
UB30_no	0.000		0.000	0.000	0.000			0.001		0.009
UB60_no										
UB60_wrk										
misc	0.001		0.002	0.003	0.001			0.002		0.005

**Table 10 – Transition Rates from DPB Part 2: Post GFC**

	DPB 30_14_e	DPB 30_14_f	DPB 30_14_no	DPB 30_5_e	DPB 30_5_f	DPB 30_5_no	DPB 30_nc_e	DPB 30_nc_f	DPB 30_nc_no	DPB 60_no	DPB 60_wrk
DPB18_0_e											
DPB18_0_f											
DPB18_0_no											
DPB18_5+_no											
DPB18_5+_wrk											
DPB18_nc_no											
DPB18_nc_wrk											
DPB30_0_e	0.001			0.001		0.000	0.000				
DPB30_0_f											
DPB30_0_no	0.000		0.002	0.001		0.006	0.000		0.001		
DPB30_14_e	0.725	0.354	0.029	0.026	0.018	0.001	0.002	0.001	0.000		
DPB30_14_f	0.010	0.218	0.001	0.001	0.007	0.000		0.001			
DPB30_14_no	0.085	0.143	0.789	0.004	0.007	0.030	0.001	0.001	0.004		
DPB30_5_e	0.001		0.000	0.683	0.302	0.040	0.001				
DPB30_5_f				0.011	0.199	0.002					
DPB30_5_no	0.000		0.003	0.089	0.149	0.744	0.000		0.001		
DPB30_nc_e	0.048	0.030	0.002	0.008	0.005	0.001	0.841	0.498	0.028		
DPB30_nc_f	0.000	0.011		0.000	0.003		0.009	0.299	0.001		
DPB30_nc_no	0.014	0.014	0.080	0.003	0.009	0.021	0.129	0.158	0.953		
DPB60_no	0.000		0.001			0.000	0.001	0.001	0.004	0.890	0.075
DPB60_wrk	0.001			0.000			0.006	0.008	0.000	0.023	0.837
IB18_e											
IB18_f											
IB18_no											
IB30_e	0.000		0.000	0.000							
IB30_f											
IB30_no	0.001		0.003	0.000		0.003	0.000	0.001	0.000		
IB60_no										0.005	0.000
IB60_wrk										0.000	0.001
SB18_e											
SB18_f											
SB18_no											
SB30_e	0.003	0.001	0.000	0.001			0.000				
SB30_f											
SB30_no	0.004	0.003	0.013	0.001		0.006	0.000		0.001		
SB60_no										0.001	0.001
SB60_wrk											
u18											
UB18_e											
UB18_f											
UB18_no											
UB30_e	0.005	0.004	0.001	0.001		0.000					
UB30_f	0.000	0.001									
UB30_no	0.006	0.003	0.015	0.002		0.008	0.000		0.001		
UB60_no										0.001	0.000
UB60_wrk											0.000
misc	0.002	0.003	0.004	0.002		0.005	0.000		0.000	0.001	0.001

**Table 11 – Transition Rates from IB: Post GFC**

	IB18_e	IB18_f	IB18_no	IB30_e	IB30_f	IB30_no	IB60_no	IB60_wrk
DPB18_0_e								
DPB18_0_f								
DPB18_0_no			0.000					
DPB18_5+_no								
DPB18_5+_wrk								
DPB18_nc_no	0.000	0.006	0.000					
DPB18_nc_wrk								
DPB30_0_e								
DPB30_0_f								
DPB30_0_no								
DPB30_14_e								
DPB30_14_f					0.003			
DPB30_14_no								
DPB30_5_e								
DPB30_5_f								
DPB30_5_no								
DPB30_nc_e				0.000				
DPB30_nc_f								
DPB30_nc_no				0.000		0.000		
DPB60_no								
DPB60_wrk								
IB18_e	0.808	0.370	0.013					
IB18_f	0.005	0.173	0.000					
IB18_no	0.113	0.161	0.942					
IB30_e	0.019	0.012	0.000	0.846	0.409	0.009		
IB30_f		0.006		0.004	0.202	0.000		
IB30_no	0.002		0.020	0.113	0.165	0.959		
IB60_no				0.001		0.013	0.939	0.094
IB60_wrk				0.009	0.006		0.005	0.840
SB18_e	0.002							
SB18_f		0.006						
SB18_no	0.001		0.002					
SB30_e				0.002	0.006			
SB30_f					0.004			
SB30_no				0.001	0.001	0.002		
SB60_no							0.001	0.001
SB60_wrk								0.001
u18								
UB18_e								
UB18_f								
UB18_no	0.001		0.000					
UB30_e					0.001			
UB30_f								
UB30_no				0.000		0.000		
UB60_no								0.000
UB60_wrk								
misc								

**Table 12 – Transition Rates from SB: Post GFC**

	SB18_e	SB18_f	SB18_no	SB30_e	SB30_f	SB30_no	SB60_no	SB60_wrk
DPB18_0_e	0.002		0.000					
DPB18_0_f	0.000							
DPB18_0_no	0.010	0.003	0.017					
DPB18_5+_no	0.000		0.001					
DPB18_5+_wrk	0.000							
DPB18_nc_no	0.018	0.011	0.036					
DPB18_nc_wrk	0.002	0.003	0.000					
DPB30_0_e				0.000				
DPB30_0_f								
DPB30_0_no	0.000			0.000	0.001	0.001		
DPB30_14_e				0.001	0.001			
DPB30_14_f					0.001			
DPB30_14_no				0.000		0.001		
DPB30_5_e	0.000			0.000				
DPB30_5_f					0.001			
DPB30_5_no				0.000		0.001		
DPB30_nc_e				0.001	0.001	0.000		
DPB30_nc_f								
DPB30_nc_no	0.000		0.000	0.002		0.004		
DPB60_no							0.001	0.000
DPB60_wrk								0.001
IB18_e	0.003		0.000					
IB18_f								
IB18_no	0.007	0.003	0.009					
IB30_e	0.000			0.009	0.006	0.000		
IB30_f				0.000				
IB30_no	0.000		0.000	0.009	0.006	0.020		
IB60_no				0.000		0.000	0.040	0.016
IB60_wrk				0.000			0.001	0.017
SB18_e	0.520	0.261	0.009					
SB18_f	0.014	0.125	0.001					
SB18_no	0.171	0.207	0.712					
SB30_e	0.014	0.011	0.000	0.698	0.304	0.012		
SB30_f	0.000	0.006		0.016	0.193	0.001		
SB30_no	0.003	0.011	0.013	0.135	0.244	0.840		
SB60_no				0.001	0.001	0.007	0.834	0.105
SB60_wrk				0.009	0.005	0.000	0.013	0.745
u18								
UB18_e	0.003	0.006	0.001					
UB18_f	0.000		0.000					
UB18_no	0.021	0.023	0.035					
UB30_e				0.003	0.002	0.001		
UB30_f				0.000	0.002	0.000		
UB30_no	0.000		0.000	0.010	0.008	0.019		
UB60_no							0.009	0.007
UB60_wrk							0.000	0.003
misc	0.002	0.014	0.005	0.002	0.002	0.003	0.001	0.001

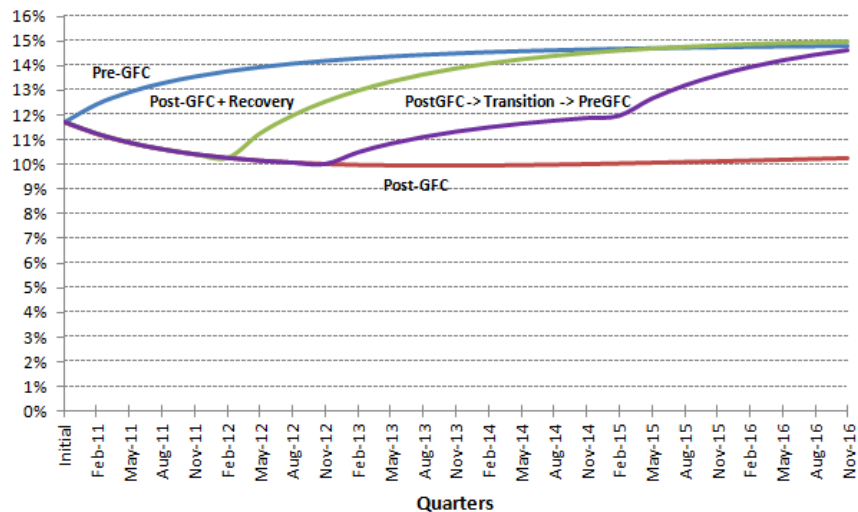
**Table 13 – Transition Rates from UB: Post GFC**

	u18	UB18_e	UB18_f	UB18_no	UB30_e	UB30_f	UB30_no	UB60_no	UB60_wrk	misc
DPB18_0_e	0.001	0.000								
DPB18_0_f			0.001							
DPB18_0_no	0.015	0.001		0.003						0.001
DPB18_5+_no		0.000		0.000						0.000
DPB18_5+_wrk										
DPB18_nc_no	0.034	0.002	0.001	0.004						0.002
DPB18_nc_wrk	0.001	0.001	0.001							
DPB30_0_e					0.000					
DPB30_0_f										
DPB30_0_no					0.001	0.001	0.001			0.001
DPB30_14_e					0.001	0.000				0.000
DPB30_14_f										
DPB30_14_no					0.001	0.000	0.001			0.001
DPB30_5_e		0.000			0.001	0.000	0.000			0.000
DPB30_5_f										
DPB30_5_no					0.001	0.001	0.002			0.001
DPB30_nc_e					0.001	0.001	0.000			0.000
DPB30_nc_f						0.000				
DPB30_nc_no					0.002	0.001	0.004			0.003
DPB60_no								0.003	0.002	0.001
DPB60_wrk								0.000	0.002	0.000
IB18_e	0.002	0.000								
IB18_f										
IB18_no	0.044			0.001						0.000
IB30_e					0.000					
IB30_f										
IB30_no					0.000	0.000	0.002			0.001
IB60_no								0.006	0.001	0.000
IB60_wrk								0.000	0.000	
SB18_e	0.000	0.001		0.001						0.000
SB18_f		0.000								
SB18_no	0.009	0.003	0.003	0.027						0.009
SB30_e					0.001	0.001	0.001			0.000
SB30_f										
SB30_no		0.000		0.000	0.002	0.001	0.027			0.008
SB60_no							0.000	0.024	0.002	0.001
SB60_wrk								0.003	0.000	
u18	0.711									
UB18_e	0.002	0.370	0.212	0.015						0.002
UB18_f		0.009	0.058	0.002						0.000
UB18_no	0.035	0.111	0.201	0.557						0.054
UB30_e		0.006	0.003	0.000	0.562	0.226	0.018			0.001
UB30_f		0.000	0.001		0.021	0.117	0.003			0.000
UB30_no		0.002	0.007	0.008	0.125	0.242	0.700			0.028
UB60_no					0.001	0.001	0.004	0.775	0.110	0.001
UB60_wrk					0.005	0.003	0.000	0.019	0.682	0.000
Misc	0.016	0.003	0.001	0.037	0.003	0.003	0.017	0.005	0.000	0.754

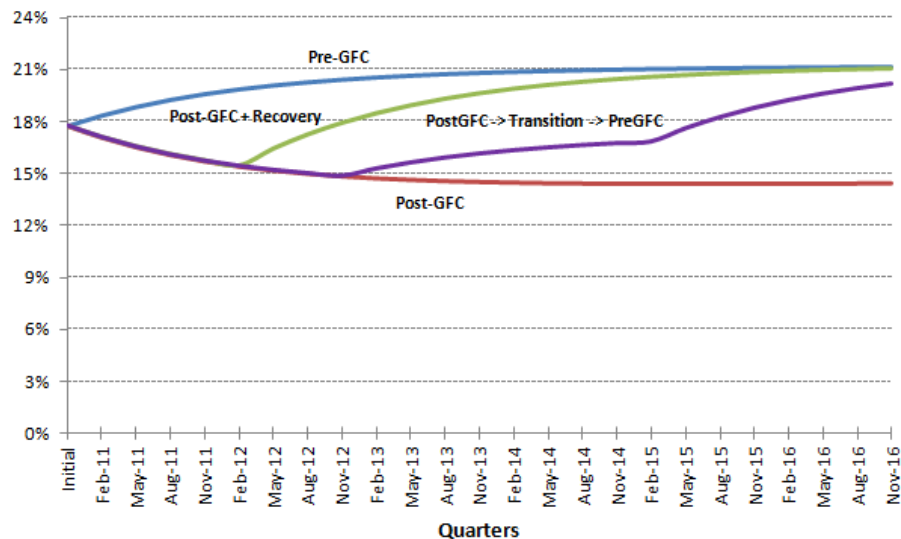
## Appendix D. Beneficiaries Working while Receiving Benefits

This appendix reports simulations, for each of the four cases, of the proportion of beneficiaries who are working, while not earning a sufficient amount to lift them off benefits. Results for all beneficiaries combined are shown in Figure 15.

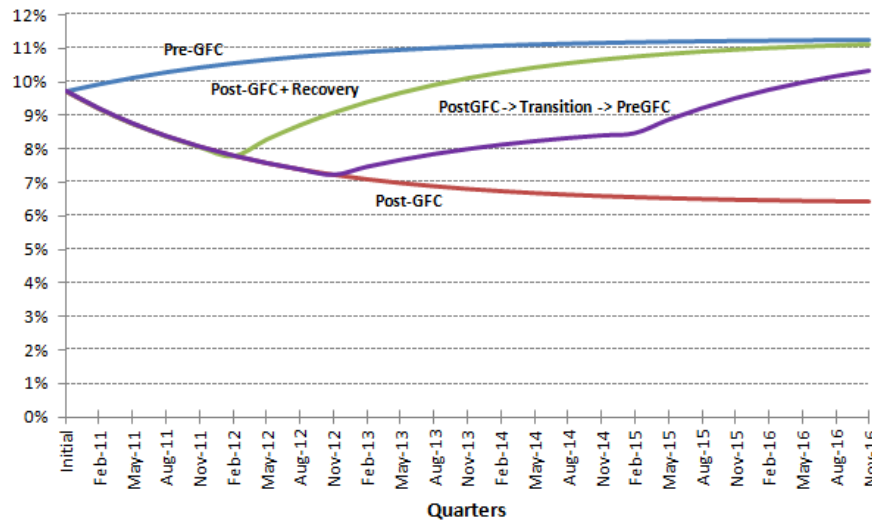
**Figure 15 – All Benefits Combined**



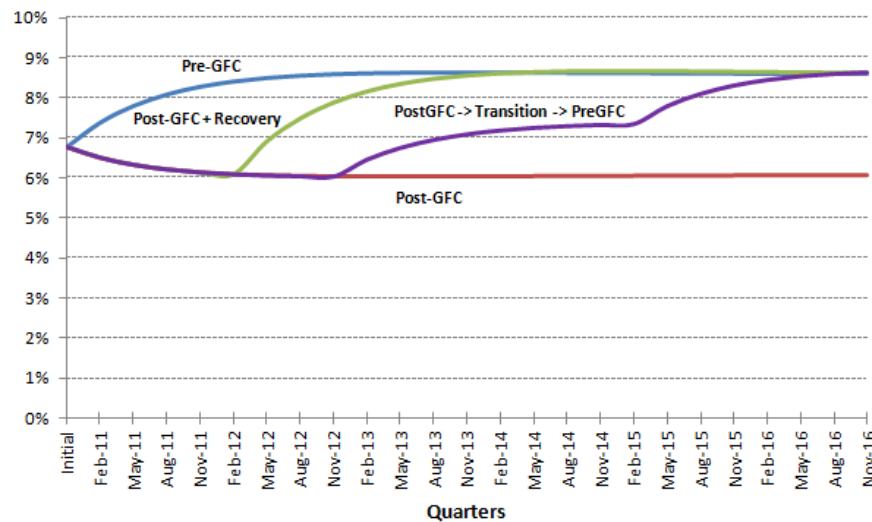
**Figure 16 – Domestic Purposes Benefit**



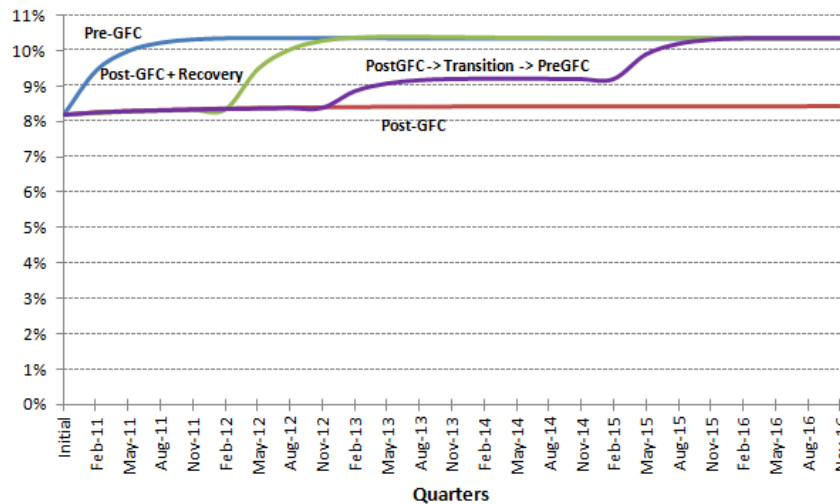
**Figure 17 – Invalid's Benefit**



**Figure 18 – Sickness Benefit**



**Figure 19 – Unemployment Benefit**



## Appendix E. The Matrix Multiplier

Consider the simple case of a two-state social accounting model, where the equilibrium stock,  $n = (I - C)^{-1} b$ , is given by:

$$\begin{bmatrix} n_1 \\ n_2 \end{bmatrix} = \begin{bmatrix} 1 - c_{11} & -c_{12} \\ -c_{21} & 1 - c_{22} \end{bmatrix}^{-1} \begin{bmatrix} b_1 \\ b_2 \end{bmatrix} \quad (15)$$

and:

$$\begin{bmatrix} n_1 \\ n_2 \end{bmatrix} = \frac{1}{(1 - c_{11})(1 - c_{22}) + c_{12}c_{21}} \begin{bmatrix} 1 - c_{22} & c_{12} \\ c_{21} & 1 - c_{11} \end{bmatrix} \begin{bmatrix} b_1 \\ b_2 \end{bmatrix} \quad (16)$$

The effect of a change in the vector of 'inflows' is thus straightforward, and is measured by the appropriate elements of the matrix  $M = (I - C)^{-1}$ : in matrix terms  $\frac{dn}{db} = M$ . Consider the effect on, for example,  $n_1$ , of a change in the forward coefficient,  $c_{11}$ , where:

$$n_1 = \frac{b_1(1 - c_{22}) + b_2c_{12}}{(1 - c_{11})(1 - c_{22}) + c_{12}c_{21}} \quad (17)$$

Differentiation gives:

$$\frac{\partial n_1}{\partial c_{11}} = \frac{n_1(1 - c_{22})}{(1 - c_{11})(1 - c_{22}) + c_{12}c_{21}} \quad (18)$$

And using:

$$dn_1 = \frac{\partial n_1}{\partial c_{11}} dc_{11} \quad (19)$$

$$\frac{dn_1}{n_1} = \frac{(1 - c_{22})}{(1 - c_{11})(1 - c_{22}) + c_{12}c_{21}} dc_{11} \quad (20)$$

Given the definition,  $M = (I - C)^{-1}$ , the proportional change in the equilibrium stock of individuals in state 1 arising from the combination of a change in inflows and a change in the proportion remaining in the state from one period to the next is given by:

$$\frac{dn_1}{n_1} = m_{11} \left( dc_{11} + \frac{db_1}{n_1} \right) \quad (21)$$



## Appendix F. Benefit Costs per Period

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The accounting framework can be extended to cover the costs associated with the stocks and flows. Suppose the payment received by individuals in state  $j$  in period  $t$  is denoted,  $q_{j,t}$ . In view of the role of income-testing in New Zealand, the existence of some differences in earnings within some benefit categories means that a precise cost per period cannot be given. The term  $q_{j,t}$  can therefore be regarded as an average. However, in view of the definitions of states, the range within any category is small. The total cost of transfers during period  $t$ , denoted  $B_t$  is thus given by:

$$B_t = q_t ' n_t \quad (22)$$

Furthermore there are administrative costs associated with the flows of individuals through the system. Suppose that the cost per person of dealing with someone moving from state  $j$  to state  $i$  from period  $t$  to  $t+1$  is equal to  $p_{i,j,t}$ . The total administrative cost in period  $t$ , denoted  $A_t$ , is thus:

$$A_t = \sum_{i=1}^m s_{i,j,t} p_{i,j,t} \quad (23)$$