

Disaggregated Migration Flow Analysis for New Zealand: Forecast of Arrivals and Departures by Citizenship and Destination

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Abstract

Migration flows are important for monitoring the New Zealand labour market and feature prominently in a range of labour market reports from the Department of Labour (DoL). The purpose of this paper is to outline estimation methods used and report results of an attempt to forecast migration flows for New Zealand. Migration flows are decomposed into thirteen components: seven relating to arrivals by citizenship and origins and six components relating to departures by citizenship and destinations. Australia and the UK are the two main destinations of long-term permanent departures from New Zealand. Linear time series regression methods or autoregressive conditional heteroskedasticity models are applied to quarterly data from June 1978 to December 2008. Within-sample mean absolute percentage errors are presented. Full-sample estimates are used to forecast migration flows for each component over the next two years. The aim is to operationalize this framework for quarterly forecast updates at DoL. Vector Autoregression (VAR) methods were tested to estimate and forecast the next eight quarters of migration flows but the forecast results did not improve. The forecasting framework meets the following requirements: (1) Transparent; (2) Technically sound; (3) Ability to forecast out two years; (4) Capable of producing regular updates of forecasts. The results could be considered as promising and assisting the work programme for regular forecasting of migration flows at the Department of Labour.

JEL Codes; C22, C52, J61

Key words; Migration flows, Disaggregated forecasts, Arrivals & Departures

Introduction

Migration flows are important for monitoring the New Zealand labour market and feature prominently in a range of labour market reports from the Department of Labour (DoL). This paper aims to construct an appropriate disaggregated framework for forecasting migrant's arrivals to and departures from New Zealand. This was considered important to understand better the factors that influenced migration flows in the past and likely to do so in the future.

Our forecasting international migration flows as an empirical activity with operational and policy applications has considered a body of literature that has reviewed the underlying theory, models and methods (Bijak, 2006) as well as the sensitivity of parameter estimates in relation to the choice of the estimation procedure (Brucker and Silverstove, 2006). While a number of applications in recent times have concentrated on the European migration scene (Bijak, 2011) other studies over the years have focused on identifying the determinants (Brosnan and Poot, 1987; Gorbey et al, 1999) as well as the causes and consequences (Carmichael, 1993) of the Trans-Tasman migration phenomenon.

Thomson and Chan (1999) undertook the forecasting of migration flows to and from New Zealand. In their paper, they decomposed permanent and long-term migration flows into six components: (1) Arrivals of New Zealanders, (2) Arrivals of non-New Zealanders with restricted access, (3) Arrivals of non-New Zealanders with unrestricted access, (4) Departures of New Zealanders, (5) Departures of non-New Zealanders with restricted access, and (6) Departures of non-New Zealanders with unrestricted access. In addition, they made a distinction between "primary flow" and "return flow". Primary flow meant the first leg of the journey of migrants from the

¹ The views expressed are those of the authors and do not represent the official position of the Department of Labour.

source country. Return flow referred to the second leg journey when migrants return to their source country. Return flow could be forecasted by using the primary flow as an independent variable. However, they did not investigate the likely impact of economic push and pull factors on migration flows in their study.

As an extension of the Thomson and Chan (1999) analysis, we decomposed New Zealand migration flows into thirteen components: seven relating to arrivals and six components relating to departures with the latter identifying three destinations as was already analysed in the previous paper by the authors (Xintao et. al, 2010). For the arrivals flows, the groups are: NZ citizens, Australian citizens, and non-New Zealand and non-Australian citizens. Because Australia and the UK were the two main sources of long-term permanent arrivals, we identify Australia, the UK and the rest of the world. Thus, there would be in principle $3 \times 3 = 9$ migration flows relating to arrivals. But the arrivals numbers of Australian citizens from the UK and the rest of the world were too small. So we combined the arrivals of New Zealand citizens and Australian citizens from the UK. We also combined the arrivals of New Zealand citizens and Australian citizens from the rest of the world together. Finally, we had seven components relating to arrivals as follows: (1) arrivals of New Zealand citizens, Australian citizens, and non-New Zealand & non-Australian citizens from Australia (ANZCFA, AACFA and ANNZACFA), (2) arrivals of New Zealand & Australian citizens, and non-New Zealand & non-Australian citizens from the United Kingdom (ANZACFU and ANNZACFU), and (3) arrivals of New Zealand & Australian citizens, and non-New Zealand & non-Australian citizens from the rest of the world (ANZACFRW and ANNZACFRW).

The six components related to departures were: departures of New Zealanders and non-New Zealanders to (1) Australia (DNZTA and DNNZTA), (2) the United Kingdom (DNZTU and DNNZTU), and (3) the rest of the world (DNZTRW and DNNZTRW). Australia and the UK are the two main destinations of long-term permanent migrants from New Zealand.

In the last four years (from 2007 March year to 2011 March year), the average arrivals from Australia and the UK by New Zealand citizens accounted for about 38% and 29%, respectively. The average arrival from Australia and the UK by non-New Zealand citizens accounted for about 8% and 18%. In addition, the average departures to Australia and the UK by New Zealand citizens accounted for about 69% and 13%, respectively. The average departures to Australia and the UK by non-New Zealand citizens accounted for about 20% and 16%, respectively. Based on the above shares, we decided to study Australia and the UK as separate destinations of long-term permanent migrants arrivals and departures with the remaining included in a combined rest-of the world category. The above decomposition enabled us to apply economic push and pull variables to explain migrants arrivals from and departures to Australia and the UK.

Methodology and Data

In this paper, the forecasting methods we used are linear time series regression and autoregressive conditional heteroskedasticity (ARCH) models. The thirteen migration components estimated covered quarterly data from June 1978 to March 2011. In addition, vector autoregressive model (VAR model) was also considered to forecast the above thirteen migration components.

We examined that all time series exhibited seasonality and were not stationary. In order to construct stationary time series, we first isolated the seasonal difference of log values of every migration component by estimating the changes for same quarters. Then, we transformed this data by deriving the first differences of the seasonal differences. In the thirteen estimated equations, the dependent variables were the differences of log values of the thirteen migration components respectively. The majority of the independent variables were lagged values of the corresponding dependent variables with lags ranging from 1 to 20 quarters being considered. This could be described as capturing the “momentum effect”.

In the case of the migrants arrivals equation of New Zealand & Australian citizens from the UK, an additional independent variable considered was the differences of log values of total departures of New Zealand & Australian citizens in previous quarters. This approach was analogous to the link between primary and return flows made by Thomson and Chan (1999). In addition, for the migrants arrivals equations of New Zealand & Australian citizens and non-New Zealand & non-Australian citizens from the rest of the world, lag values of differences of log values of New Zealand & Australian citizens and non-New Zealand & non-Australian citizens

departures to the rest of the world were used to represent circular migration, respectively. Similarly in the migrants departures equations of non-New Zealanders to Australia and the UK, lag values of differences of log values of total non-New Zealanders arrivals were included.

For the migrants arrivals equations covering New Zealand, Australian, and non-New Zealand & non-Australian citizens from Australia, the following economic push and pull factors were considered as additional independent variables: (i) the ratios between the changes in New Zealand GDP per capita and Australian GDP per capita (RCNZAG), (ii) the ratios between the changes in New Zealand and Australian civilian employment levels (RCNZACEL), (iii) the exchange rates between New Zealand dollar and Australian dollar (ERNZDAD). In terms of the migrants arrivals equations for New Zealand & Australian citizens, and non-New Zealand & non-Australian citizens from the UK, similar economic push and pull factors were included as additional independent variables: (iv) the ratios between the changes in New Zealand GDP per capita and British GDP per capita (RCNZBG) and (v) the ratios between the changes in New Zealand and British civilian employment levels (RCNZBCEL), (vi) the exchange rates between New Zealand dollar and British pound (ERNZDBP).

The ratios of the changes in New Zealand GDP per capita and Australian GDP per capita and the ratios of the changes in New Zealand GDP per capita and British GDP per capita, covered the period from June 1978 to December 2010. The ratios of the changes in New Zealand and Australian civilian employment levels and the ratios of the changes in New Zealand and British civilian employment levels covered the period from December 1985 to December 2010. All of these ratios were stationary.

The quarterly exchange rates between New Zealand dollar and Australian dollar were available from June 1978 to March 2011. The quarterly exchange rates between New Zealand dollar and the British pound available for the same period. Both series were not stationary until we took the first difference of the quarterly exchange rates.

For the four migration equations covering departures of New Zealanders and non-New Zealanders to Australia and the UK, the above economic push and pull factors were also included as additional independent variables respectively.

Our overall forecasting approach used for the thirteen migration components is as follows:

- (A) First we applied linear time series regression or autoregressive conditional heteroskedasticity method for quarterly data from June 1978 to December 2008. Then, we estimated the **within-sample** time series equations for thirteen migration components and used them to forecast thirteen migration components for nine quarters from March 2009 to March 2011.
- (B) The next step was to calculate the mean absolute percentage errors (MAPEs) by comparing the corresponding historical values and forecasts for the nine quarters from March 2009 to March 2011.
- (C) Finally by using quarterly data from June 1978 to March 2011, the thirteen **full-sample** migration components were estimated; time series regression or autoregressive conditional heteroskedasticity method was used for thirteen components and quarterly forecasts were made for the period from June 2011 to March 2013.

The detailed description of data sources used is included in Appendix A. The quarterly forecasts and respective historical data are provided in Appendix B.

Results

Within-sample equations and mean absolute percentage errors (MAPEs)

In Table 1, estimated within-sample equations for seven migrants arrivals components are showed. It can be seen that in 45 different explanatory variables (the majority of the lagged dependent variables) are significant at least at the 10% level of confidence. Out of the 45 coefficients estimated across the seven linear time series regressions, 27 (or 60%) were significant at the (highest) 1% level of confidence and another 6 (or 13%) were significant at the 5% level of confidence.

Table 1: Within-sample (Q2 1978-Q4 2008) Time Series Equations for Seven Migrants Arrivals Components

Within-sample equation	Differences of Log Values of Arrivals of New Zealand, Australian, and Non-New Zealand & Non-Australian Citizens from Australia			Differences of Log Values of Arrivals of New Zealand & Australian and Non-New Zealand & Non-Australian Citizens from the UK		Differences of Log Values of Arrivals of New Zealand & Australian and Non-New Zealand & Non-Australian Citizens from the Rest of the World	
	Eq. 1	Eq. 2	Eq. 3	Eq. 4	Eq. 5	Eq. 6	Eq. 7
Independent Variable							
1. Lagged Dependent Variable							
t-1			-0.253***			-0.163**	-0.256***
t-3	0.160*						
t-4	-0.634***	-0.938***	-0.689***	-0.377***	-0.337***	-0.546***	-0.236***
t-6					-0.262**		
t-8	-0.235*	-0.688***	-0.662***			-0.368***	
t-9				-0.138*			-0.154***
t-10			0.229***				-0.272***
t-12		-0.549***	-0.436***				
t-13							-0.184***
t-14							-0.179**
t-15				0.215**		0.168*	
t-16		-0.423***				-0.225***	-0.290***
t-17					-0.178*		
t-20	-0.172*	-0.395***	-0.233***		-0.182*		-0.376***
2. Differences of Log Values of Total Departures of New Zealand & Australian Citizens							
t-4				0.265***			
3. Differences of Log Values of Departures of New Zealand & Australian Citizens to the Rest of the World							
t-7						0.178*	
t-9						0.189*	
4. Differences of Log Values of Departures of Non-New Zealand & Non-Australian Citizens to the Rest of the world							
t-8							0.119**
5. The Ratios between the Changes of New Zealand GDP per Capita and Australian GDP per Capita							
t-11			0.008*				
6. The Ratios							

between the Changes of New Zealand GDP per Capita and British GDP per Capita							
t-14						-0.001*	
7. The First Difference of the Exchange Rates between New Zealand Dollar and Australian Dollar							
t-5		-0.536*					
8. The First Difference of the Exchange Rates between New Zealand Dollar and British Pound							
t-1				0.153**			
9. The Ratios between the Changes in New Zealand and Australian Civilian Employment Levels							
t-11	0.009***						
t-12	0.008***						
R-squared	0.504	0.584	0.618	0.353	0.278	0.532	0.370
Adjusted R-squared	0.463	0.557	0.578	0.319	0.223	0.497	0.306
F	12.347	21.313	15.469	10.568	5.080	15.283	5.742
AIC	-1.644	-1.624	-0.843	-1.811	-1.653	-1.713	-1.819

*, **, *** denote the coefficients significant at 10%, 5% and 1% respectively.

In Table 2, estimated within-sample equations for six migrants departures components are presented. This resulted in 38 different explanatory variables (majority of the lagged dependent variables) significant at least at the 10% level of confidence. Out of the 38 coefficients estimated across the six time series regressions, 23 (or 61%) were significant at the (highest) 1% level of confidence and another 10 (or 26%) were significant at the 5% level of confidence.

Table 2: Within-sample (Q2 1978-Q4 2008) Time Series Equations for Six Migrants Departures Components

Within-sample equation	Difference of Log Values of Departures of New Zealanders to Australia, the UK and the Rest of the World			Difference of Log Values of Departures of Non-New Zealanders to Australia, the UK and the Rest of the World		
	Eq. 1	Eq. 2	Eq. 3	Eq. 4	Eq. 5	Eq. 6
Independent Variable						
1. Lagged Dependent Variable						
t-1	0.144**		-0.182**			-0.226**
t-3						0.374***
t-4	-0.342***	-0.414***	-0.575***	-0.675***	-0.595***	-0.260***
t-6		0.157*			0.223***	
t-7			-0.190**			
t-8	-0.164***		-0.432***	-0.461***	-0.557***	-0.290***
t-12			-0.263**	-0.284***	-0.355***	
t-13		0.158**		0.175**		

t-16			-0.237***		-0.152*	
t-18		-0.183**				-0.178**
t-19					-0.127*	
t-20	-0.177***			-0.138*	-0.225***	
2. Difference of Log Values of Total Arrivals of Non-New Zealanders						
t-8					0.387***	
t-15				-0.322***		
3. The Ratios between the Changes of New Zealand and Australian Civilians Employment						
t-17				-0.008**		
4. The First Difference of the Exchange Rates between New Zealand Dollar and Australian Dollar						
t-3				-0.820***		
t-16	0.654***					
5. The First Difference of the Exchange Rates between New Zealand Dollar and British Pound						
t-6		-0.188***				
t-8					0.145*	
R-squared	0.276	0.272	0.386	0.592	0.493	0.415
Adjusted R-squared	0.237	0.234	0.348	0.543	0.441	0.383
F	5.020	7.036	9.971	11.994	9.519	13.311
AIC	-1.757	-2.122	-2.060	-1.930	-1.717	-1.891

*, **, *** denote the coefficients significant at 10%, 5% and 1% respectively.

Model Validation

In this section, the estimated results from the within sample and full sample equations are reported and the goodness of fit of the overall equations as well as the significance of the individual coefficients are assessed. This model validation process was critical for evaluating the ability of these estimated equations to produce consistent out of sample forecasts.

Based on these within-sample (from June 1978 to December quarter 2008) equations, quarterly forecasts were derived for the quarterly periods from March 2009 to March 2011 for thirteen migration components. Using historical data and their corresponding forecasts, we calculated mean absolute percentage errors (MAPEs) for all migrants arrivals and departures components (See Tables 3 and 4).

In tables 3 and 4, we see that the MAPEs for equations 2, 5, 8, 9 and 10 were 14.2%, 10.6%, 19.4%, 21.7% and 25.8% respectively. Although their MAPEs were high, they were better than any other estimation that was tried including the VAR approach. The forecast results using the VAR approach were no better than those considered for out-of-sample forecasts in terms of the respective within-sample model validation measures outlined here. The MAPEs were below 10% for the other equations.

Table 3: Mean Absolute Percentage Errors for All Arrivals Flows: Time Series Equations (Within-sample)

Equation	Migration Component	MAPE
Equation 1	Arrivals of Australian Citizens from Australia	8.0%
Equation 2	Arrivals of New Zealanders from Australia	14.2%
Equation 3	Arrivals of Non-New Zealand and Non-Australian Citizens from Australia	7.5%
Equation 4	Arrivals of New Zealand and Australian Citizens from the UK	6.2%
Equation 5	Arrivals of Non-New Zealand and Non-Australian Citizens from the UK	10.6%
Equation 6	Arrivals of New Zealand and Australian Citizens from the Rest of the World	4.0%
Equation 7	Arrivals of Non-New Zealand and Non-Australian Citizens from the Rest of the World	8.3%

Table4: Mean Absolute Percentage Errors for All Departures Flows: Time Series Equations (Within-sample)

Equation	Migration Component	MAPE
Equation 8	Departures of New Zealanders to Australia	19.4%
Equation 9	Departures of New Zealanders to the UK	21.7%
Equation 10	Departures of New Zealanders to the Rest of the World	25.8%
Equation 11	Departures of Non-New Zealanders to Australia	7.0%
Equation 12	Departures of Non-New Zealanders to the UK	4.1%
Equation 13	Departures of Non-New Zealanders to the Rest of the World	6.1%

Table 5 presents the full sample equations for the seven migrants arrivals components.

Table 5: Full-sample (Q2 1978-Q1 2011) Time Series Equations for Seven Migrants Arrivals Components

Full-sample equation	Differences of Log Values of Arrivals of New Zealand, Australian, <u>and</u> Non-New Zealand & Non-Australian Citizens from Australia			Differences of Log Values of Arrivals of New Zealand & Australian <u>and</u> Non-New Zealand & Non-Australian Citizens from the UK		Differences of Log Values of Arrivals of New Zealand & Australian <u>and</u> Non-New Zealand & Non-Australian Citizens from the Rest of the World	
	Eq. 1	Eq. 2	Eq. 3	Eq. 4	Eq. 5	Eq. 6	Eq. 7
Independent Variable							
1. Lagged Dependent Variable							
t-1			-0.264***			-0.170**	-0.220**
t-3	0.141*						
t-4	-0.640***	-0.934***	-0.671***	-0.368***	-0.351***	-0.548***	-0.242***
t-6					-0.253**		
t-8	-0.237*	-0.699***	-0.629***			-0.367***	
t-9				-0.138*			-0.125***
t-10			0.234***				-0.240***
t-12		-0.569***	-0.386***				
t-13							-0.165***
t-14							-0.193***
t-15				0.223**		0.172*	
t-16		-0.438***				-0.210***	-0.270***
t-17					-0.198**		
t-20	-0.195*	-0.402***	-0.237***		-0.175*		-0.388***
2. Differences of Log							

Values of Total Departures of New Zealand & Australian Citizens							
t-4				0.277***			
3. Differences of Log Values of Departures of New Zealand and Australian Citizens to the Rest of the World							
t-7						0.173*	
t-9						0.175*	
4. Differences of Log Values of Departures of Non-New Zealand & Non-Australian Citizens to the Rest of the world							
t-8							0.117***
5. The Ratios between the Changes of New Zealand GDP per Capita and Australian GDP per Capita							
t-11			0.008*				
6. The Ratios between the Changes of New Zealand GDP per Capita and British GDP per Capita							
t-14					-0.001*		
7. The First Difference of the Exchange Rates between New Zealand Dollar and Australian Dollar							
t-5		-0.529***					
8. The First Difference of the Exchange Rates between New Zealand Dollar and British Pound							
t-1				0.166**			
9. The Ratios between the Changes in New Zealand and Australian Civilian Employment Levels							
t-11	0.009***						
t-12	0.008***						
R-squared	0.503	0.580	0.625	0.359	0.280	0.525	0.339

Adjusted R-squared	0.467	0.555	0.591	0.329	0.232	0.493	0.277
F	13.847	23.056	18.120	11.879	5.821	16.285	5.523
AIC	-1.687	-1.664	-0.908	-1.875	-1.713	-1.770	-1.816

*, **, *** denote the coefficients significant at 10%, 5% and 1% respectively.

In Table 5, the same 45 different explanatory variables (majority of the lagged dependent variables) as in Table 1 are shown to be significant at least at the 10% level of confidence. Out of the 45 coefficients estimated across the seven linear time series regressions, 29 (or 64%) were significant at the (highest) 1% level of confidence and another 6 (or 13%) were significant at the 5% level of confidence.

Table 6 shows the full sample equations for the six migrants departures components.

Table 6: Full-sample (Q2 1978-Q1 2011) Time Series Equations for Six Migrants Departures Components

Full-sample equation	Difference of Log Values of Departures of New Zealanders to Australia, the UK and the Rest of the World			Difference of Log Values of Departures of Non-New Zealanders to Australia, the UK and the Rest of the World		
	Eq. 1	Eq. 2	Eq. 3	Eq. 4	Eq. 5	Eq. 6
Independent Variable						
1. Lagged Dependent Variable						
t-1	0.233***		-0.154*			-0.219**
t-3						0.365***
t-4	-0.379***	-0.460***	-0.578***	-0.698***	-0.599***	-0.267***
t-5						
t-6		0.159*			0.213***	
t-7			-0.191**			
t-8	-0.212***		-0.429***	-0.442***	-0.572***	-0.284***
t-12			-0.250**	-0.275***	-0.365***	
t-13		0.199**		0.159**		
t-16			-0.226***		-0.166**	
t-18		-0.181**				-0.166**
t-19					-0.135**	
t-20	-0.151***			-0.129*	-0.236***	
2. Difference of Log Values of Non-New Zealanders Arrivals						
t-8					0.381***	
t-15				-0.299***		
3. The Ratios between the Changes of New Zealand and Australian Civilians Employment						
t-17				-0.008**		
4. The First Difference of the Exchange Rates between New Zealand Dollar and Australian Dollar						
t-3				-0.585**		
t-16	0.652***					
5. The First Difference of the Exchange Rates between New Zealand Dollar and British Pound						
t-6		-0.179***				
t-8					0.145**	

R-squared	0.375	0.273	0.368	0.564	0.502	0.400
Adjusted R-squared	0.344	0.238	0.332	0.518	0.455	0.371
F	8.659	7.743	10.108	12.143	10.848	13.726
AIC	-1.623	-1.924	-2.052	-1.921	-1.804	-1.935

*, **, *** denote the coefficients significant at 10%, 5% and 1% respectively.

In Table 6, the same 38 different explanatory variables (majority of the lagged dependent variables) as in Table 2 are estimated to be significant at least at the 10% level of confidence. Out of the 38 coefficients estimated across the six time series regressions, 23 (or 61%) were significant at the (highest) 1% level of confidence and another 12 (or 32%) were significant at the 5% level of confidence.

The detailed full-sample equations for migrants arrivals and departures flows could be made available on request to the authors. The dependent variables used in the equations reported in tables 5 and 6 covered the June 1978 to March 2011 period.

Forecasts (Including Out-of-sample) and Comparison with Historical Data

A: Arrivals of New Zealand, Australian, and Non-New Zealand & Non-Australian Citizens from Australia

Figure 1: Historical Data and Forecasts of New Zealand, Australian, and Non-New Zealand & Non-Australian Citizens Arrivals from Australia (not seasonally adjusted)

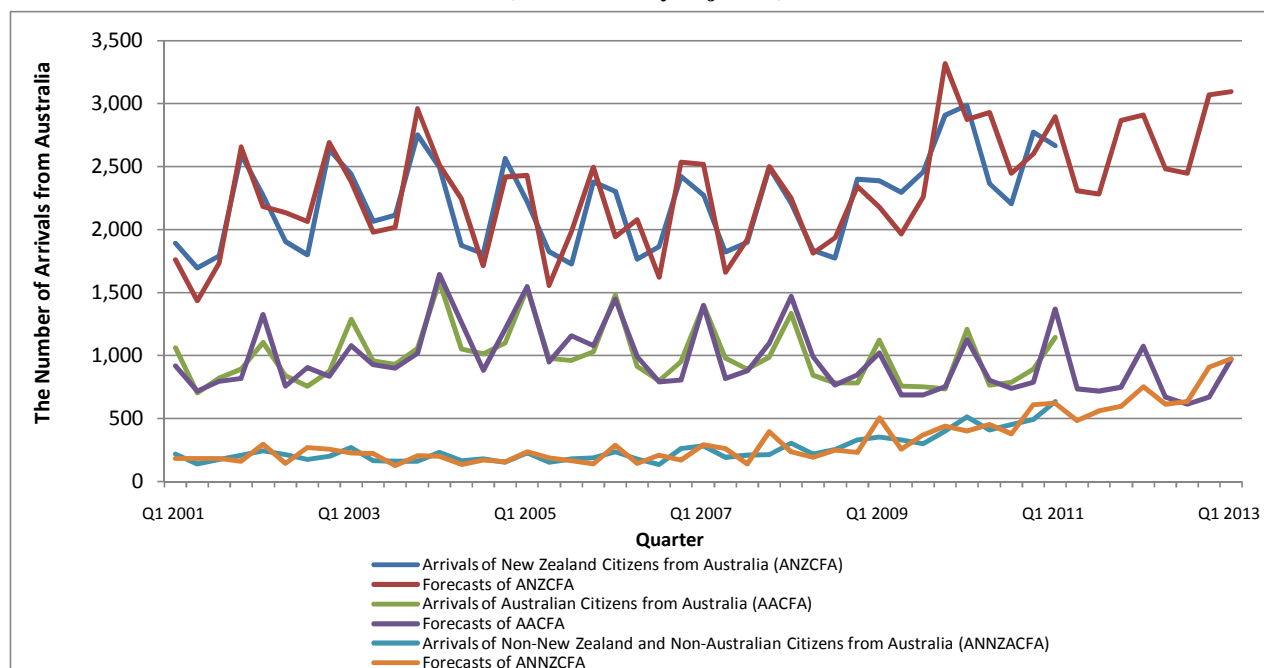


Figure 1 presents historical data and forecasts of arrivals of New Zealand, Australian and non-New Zealand & non-Australian citizens from Australia respectively. In Figure 1, there is significantly more volatility of non-New Zealand & non-Australian citizens arrivals from Australia than those of Australian and New Zealanders arrivals from Australia. Over the period from March 2001 to March 2011 (historical period), the correspondence between historical data and forecasts of Australian citizens arrivals from Australia was tracking less closely among the above three migration components.

The arrivals of New Zealanders from Australia are forecast to March 2013 and are expected to fluctuate between about 2,300 and 3,100 while the arrivals of non-New Zealand & non-Australian citizens from Australia are expected to fluctuate between about 500 and 1,000 and arrivals of Australian citizens from Australia are

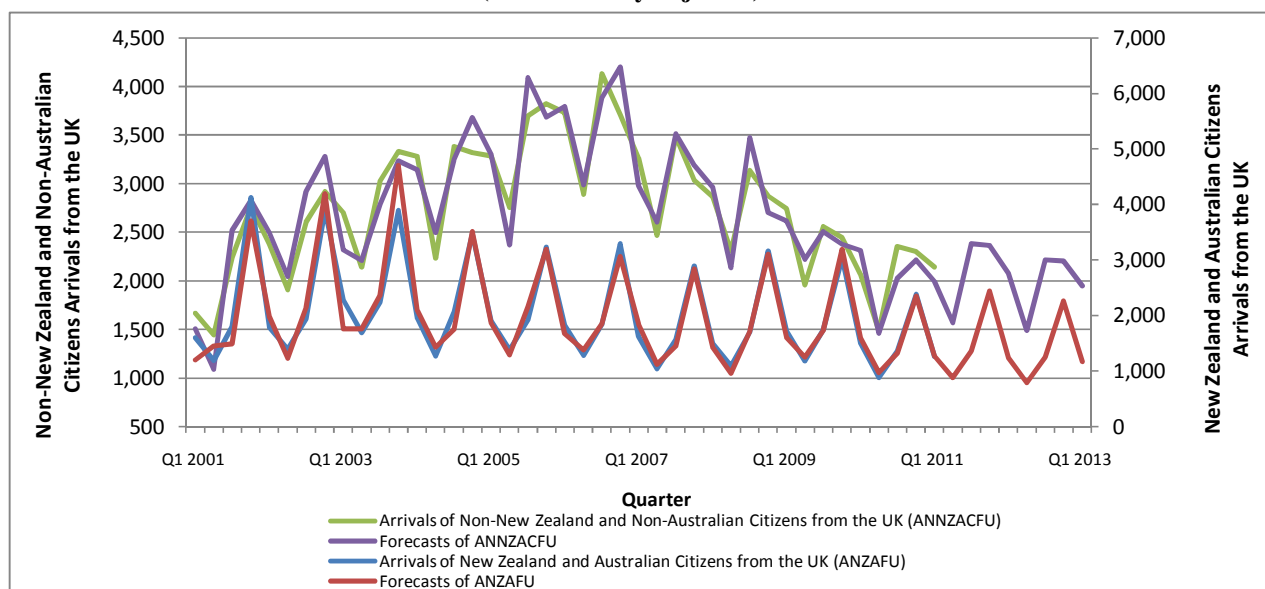
expected to fluctuate between about 600 and 1,100 over the same period. The detailed quarterly forecasts of the above three migration components are provided in Table 1 of Appendix B.

B: Arrivals of New Zealand & Australian and Non-New Zealand & Non-Australian Citizens from the UK

Figure 2 shows historical data and forecasts of New Zealand & Australian citizens, and non-New Zealand & non-Australian citizens arrivals from the UK. There was significantly more fluctuations in arrivals of New Zealand & Australian citizens from the UK than those of non-New Zealand & non-Australian citizens arrivals from the same source. Over the period from March 2001 to March 2011 (historical period), the correspondence between historical data and forecasts of New Zealand & Australian citizens arrivals from the UK was better than that of non-New Zealand & non-Australian citizens arrivals from the UK. One reason is that we account for “round tripping” or return flows while seasonal patterns also appear to be more pronounced for this group.

The arrivals of New Zealand & Australian citizens from the UK are forecast to March 2013 and are expected to fluctuate between 800 and 2,500. The arrivals of non-New Zealand & non-Australian Citizens from the UK are forecast to March 2013 and are expected to fluctuate between about 1,500 and 2,400. The detailed quarterly forecasts of the above two migration components are provided in Table 1 of Appendix B.

Figure 2: Historical Data and Forecasts of New Zealand & Australian and Non-New Zealand & Non-Australian Citizens Arrivals from the UK (not seasonally adjusted)



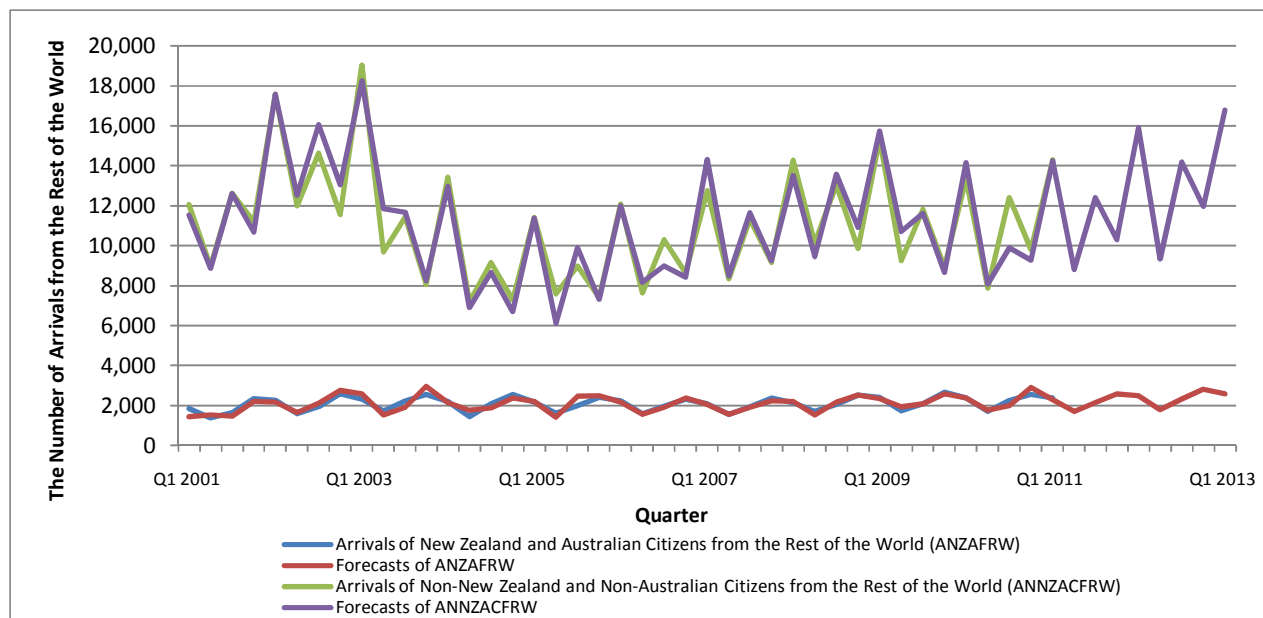
C: Arrivals of New Zealand & Australian and Non-New Zealand & Non-Australian Citizens from the Rest of the World

Figure 3 presents historical data and forecasts of New Zealand & Australian, and non-New Zealand & non-Australian citizens from the rest of the world respectively. There were more fluctuations of non-New Zealand & non-Australian citizens arrivals from the rest of the world than those of New Zealand & Australian citizens arrivals from the rest of the world, possibly for the same reason as mentioned above with regard to return flows from the UK. Over the period from March 2001 to March 2011 (historical period), the correspondence between historical data and forecasts of non-New Zealand & non-Australian citizens arrivals from the rest of the world was better than that of New Zealand & Australian citizens arrivals from the rest of the world.

The arrivals of New Zealand & Australian citizens from the rest of the world are forecast to March 2013 and are expected to fluctuate between about 1,700 and 2,800. The arrivals of non-New Zealand & non-Australian citizens from the rest of the world are forecast to March 2013 and are expected to fluctuate between about 8,800

and 16,800. The detailed quarterly forecasts of the above two migration components are provided in Table 1 of Appendix B.

Figure 3: Historical Data and Forecasts about Arrivals of New Zealand & Australian and Non-New Zealand & Non-Australian Citizens from the Rest of the World (not seasonally adjusted)



D: Departures–New Zealanders

Figure 4: Historical Data and Forecasts of New Zealanders Departures to Australia and to the UK (not seasonally adjusted)

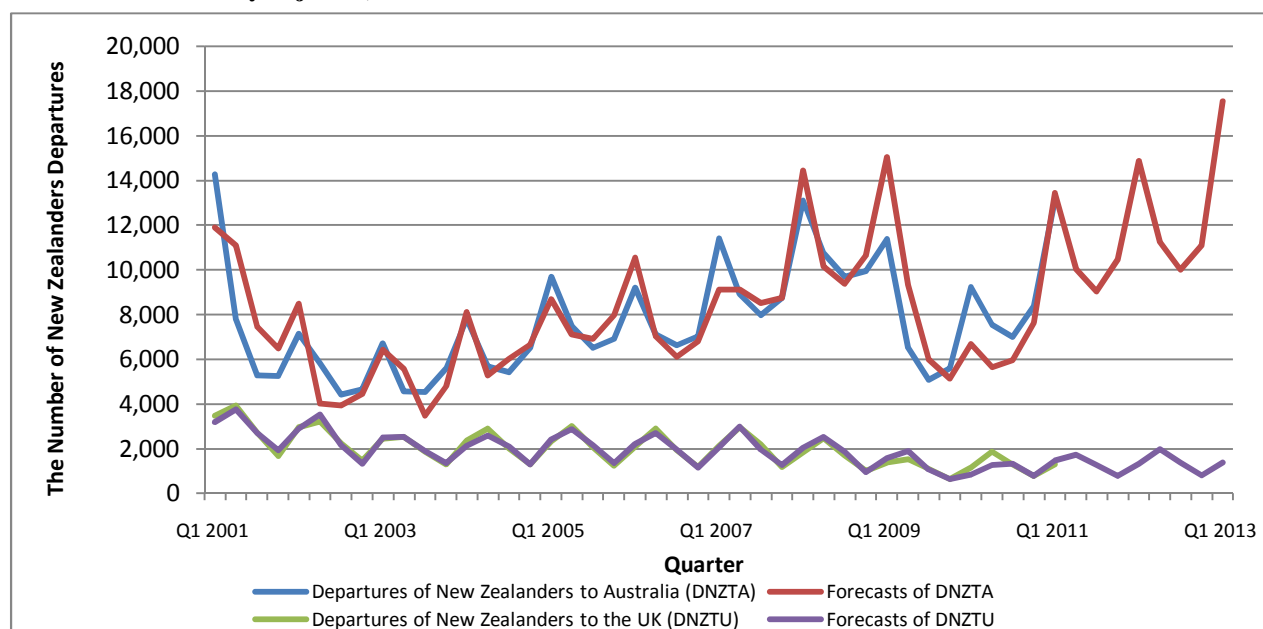
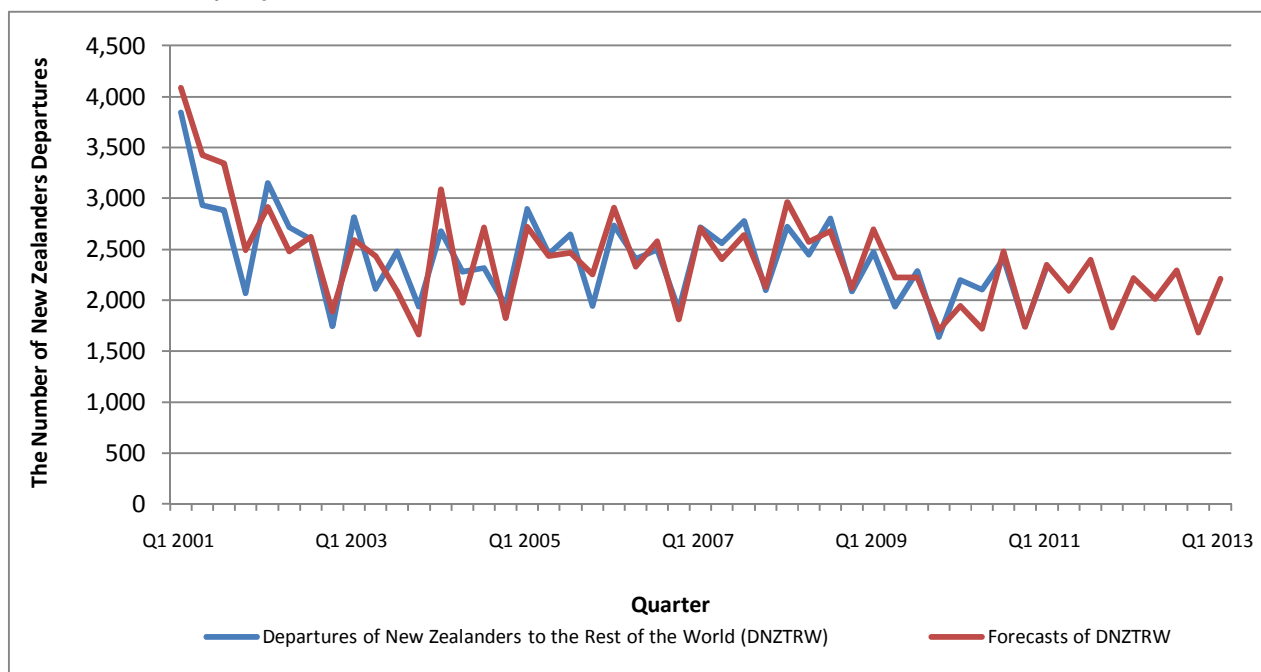


Figure 5: Historical Data and Forecasts of New Zealanders Departures to the Rest of the World (not seasonally adjusted)



Figures 4 and 5 show historical data and forecasts of New Zealanders departures to Australia, the UK and to the rest of the world, respectively. There were more fluctuations of New Zealanders departures to the UK than those of New Zealanders departures to Australia and the rest of the world. Over the period from March 2001 to March 2011 (historical period), the correspondence between historical data and forecasts of New Zealanders departures to the UK was better than those of New Zealanders departures to Australia and the rest of the world. There seems to be a more of a cycle than a trend in the latter, while New Zealander departures to the UK appears to be trending down without much visual evidence of cyclical movement.

The departures of New Zealanders to Australia forecast to March 2013 fluctuate between about 9,000 and 17,500. New Zealanders departures to the UK forecast to March 2013 fluctuate between about 800 and 2,000. The departures of New Zealanders to the rest of the world forecast to March 2013 fluctuate between 1,700 and 2,400. The detailed quarterly forecasts of the above three migration components could be seen in Table 2 of Appendix B.

E: Departures–Non-New Zealanders

Figures 6 and 7 present historical data and forecasts of non-New Zealanders departures to Australia, the UK and the rest of the world, respectively. There were more fluctuations of non-New Zealanders departures to the rest of the world than those of non-New Zealanders departures to Australia and the UK. Over the period from March 2001 to March 2011 (historical period), the correspondence between historical data and forecasts of non-New Zealanders departures to the rest of the world was better than those of non-New Zealanders departures to Australia and the UK.

The departures of non-New Zealanders to Australia forecast to March 2013 fluctuate between about 900 and 1,300. The departures of non-New Zealanders to the UK forecast to March 2013 fluctuate between 800 and 1,200. The departures of non-New Zealanders to the rest of the world forecast to March 2013 fluctuate between 4,100 and 4,500. The detailed quarterly forecasts of the above three migration components could also be seen in Table 2 of Appendix B.

Figure 6: Historical Data and Forecasts of Non-New Zealanders Departures to Australia (not seasonally adjusted)

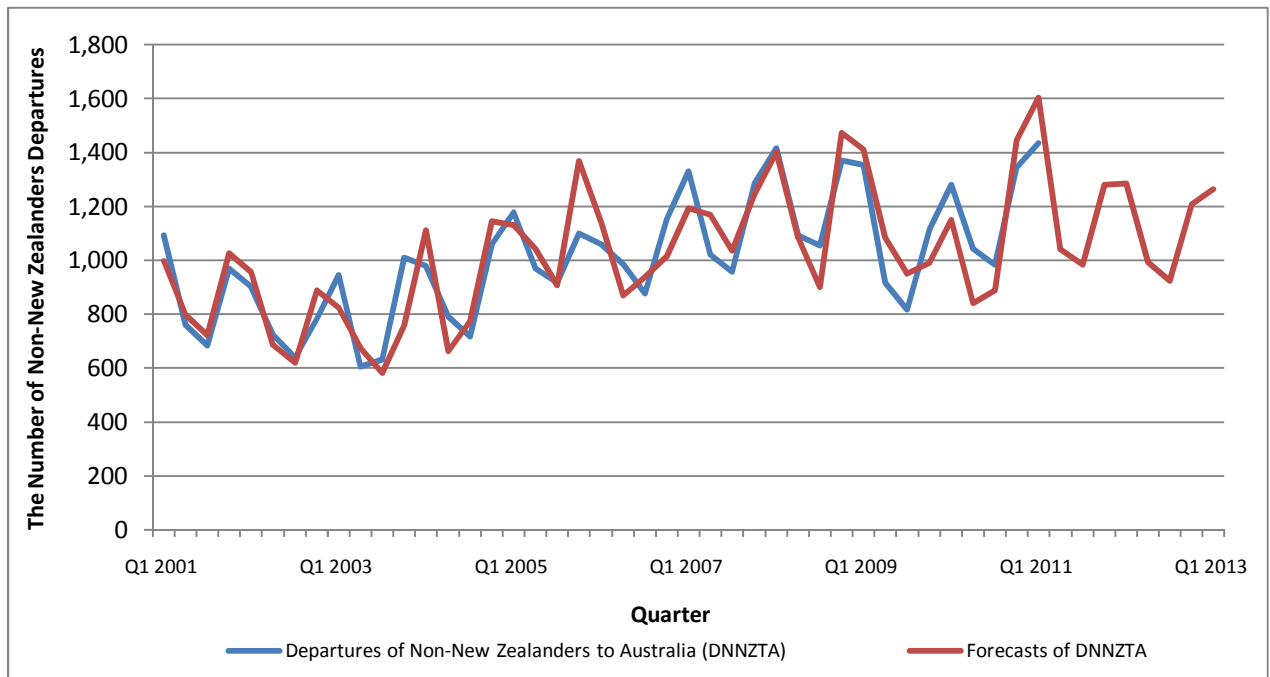
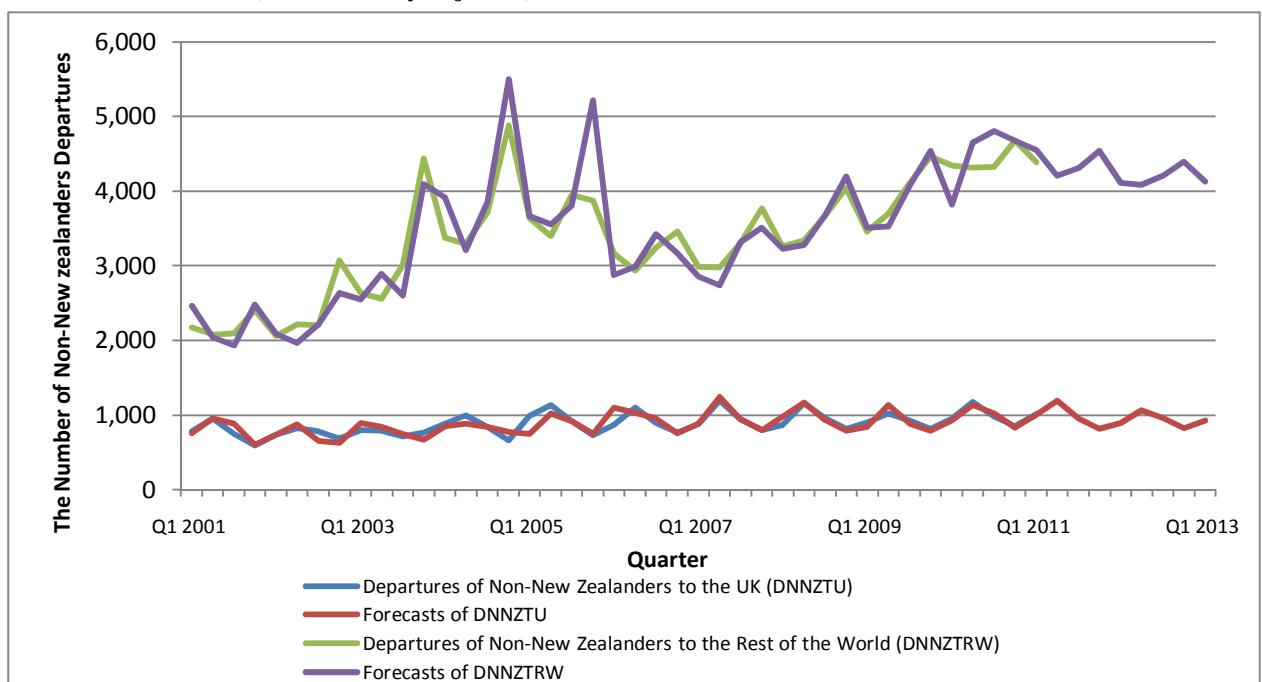


Figure 7: Historical Data and Forecasts of Non-New Zealanders Departures to the UK and to the Rest of the World (not seasonally adjusted)



Summary

In summary, forecasts of total arrivals and total departures for 2012 and 2013 March years and all years in between can now be derived. In Table 7, it can be seen that historical total arrivals for 2009, 2010 and 2011 March years were 88,900, 84,300 and 83,000, respectively. There was a decline from 2009 March year to 2011 March year. For 2012 and 2013 March years, forecasts of total arrivals are about 86,700 and 92,200, respectively, which suggested some recovery in arrivals during 2012 March year in particular. Considering the historical data and forecasts, total arrivals peaked in 2009 March year. Following this, total arrivals decreased during 2010 and 2011 March year but are forecast to rise somewhat during 2012 March year and 2013 March year.

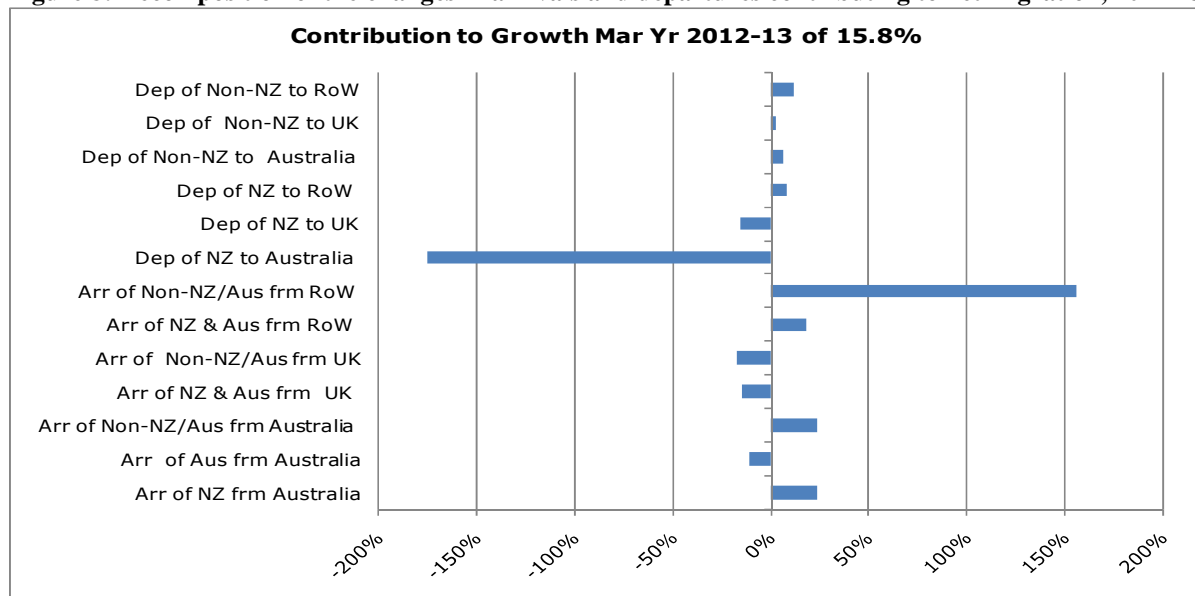
Historical total departures of 2009, 2010 and 2011 March years were 81,400, 63,400 and 76,500, respectively. Forecasts of total departures for 2012 and 2013 March years are about 83,600 and 88,600 respectively. In the case of annual total departures, it decreased from 2009 March year to 2011 March year and was in a trough in 2010 March year. It is expected to increase in the 2012 and 2013 March years.

Table 7: Historical Data and Forecast of Total Arrivals, Total Departures and Net Arrivals

Year Ended	Historical Total Arrivals	Forecasts of Total Arrivals	Historical Total Departures	Forecasts of Total Departures	Historical Net Arrivals	Forecasts of Net Arrivals
March 2009	88,873	89,631	81,391	85,492	7,482	4,373
June 2009	88,251	91,570	75,736	83,904	12,515	7,799
Sept. 2009	87,209	88,932	70,166	79,683	17,043	9,439
Dec. 2009	86,410	87,573	65,157	73,314	21,253	14,417
March 2010	84,336	86,433	63,363	63,590	20,973	22,927
June 2010	82,305	83,858	65,801	59,652	16,504	18,179
Sept. 2010	82,412	81,414	68,498	60,970	13,914	18,644
Dec. 2010	82,469	80,839	72,018	64,278	10,451	16,461
March 2011	83,015	80,670	76,461	73,327	6,554	6,330
June 2011		84,035		78,701		5,334
Sept. 2011		84,054		80,627		3,426
Dec. 2011		84,748		82,444		2,305
March 2012		86,669		83,558		3,111
June 2012		87,324		84,633		2,691
Sept. 2012		89,158		85,472		3,686
Dec. 2012		91,153		85,869		5,284
March 2013		92,218		88,616		3,602

Based on these forecast results, annual net arrivals which were about 7,500, 21,000 and 6,500 during 2009, 2010 and 2011 March years, respectively are forecast to decline to about 3,100 during 2012 March year and increase to about 3,600 during 2013 March year. Thus, after reaching a peak in 2010 March year, net arrivals declined. It is forecast to reach a trough in 2012 March year and then recover during 2013 March year.

Figure 8: Decomposition of the changes in arrivals and departures contributing to net migration, 2012-13



It can be seen that the negative contribution of New Zealander citizens departing for Australia to net migration levels is expected to be offset by positive contributions mainly from arrivals of non-New Zealand and Australian citizens (i.e. new migrants) from the Rest of the World. Arrivals of returning New Zealanders from Australia and the Rest of the World and arrivals of non-New Zealand and Australian citizens from Australia also contributed to the net migration gain. Surprisingly, the latter is expected to make the second largest positive contribution (in percent terms) to net PLT arrivals and reflects the rising trend, albeit from a low base (see Figure 1). The rise in this migration component of non-New Zealanders from Australia is largely attributed to working holiday permit holders coming over to New Zealand after visiting Australia.

Conclusions

We used a linear time series regression method or autoregressive conditional heteroskedasticity model to estimate the thirteen migration components disaggregated for analysis and to forecast the next eight quarterly migration flows (seven inflows and six outflows). In our view, the forecasting framework meets the following requirements: (1) Transparent; (2) Technically sound; (3) Ability to forecast out two years; (4) Capability for regular updates of forecasts.

The results could be considered as promising and as a useful starting point for forecasting migration flows at the Department of Labour. For the arrival (migration inflow), equations were estimated at a disaggregate level by origins and destinations. There were seven equations. For the arrivals equations of New Zealanders from Australia and non-New Zealand & non-Australian citizens from the UK, the MAPEs were 14.2% and 10.6% respectively. The MAPEs for other five equations are all below 10%.

The departure (migration outflow) equations considered those who are New Zealand citizens separate from others. Here again the departure equations of non-New Zealanders (or new migrants) also resulted in the MAPE values at 10% below. The departure equations of New Zealand citizens to Australia and to the UK are estimated and their MAPEs are superior compared to those using a Holt-Winters exponential smoothing method. For the departures equation of non-New Zealanders to the rest of the world the MAPE was 25.8%.

Future research should focus on improving the forecast equations by reducing further some of the MAPEs of within-sample forecasts. In addition, we will consider the use of the number of residence applications as an additional independent variable of non-New Zealanders arrivals from Australia, the UK and the rest of the world. This data could provide further insights and improve our estimates. However at this stage this administrative dataset only goes back (electronically) to 1997 while the equations are generally estimated with quarterly data from 1978.

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Appendix A: Variables, Data Sources & Periods of their Availability

1. Dependent Variables

- Arrivals of New Zealand Citizens from Australia (ANZCFA) – **SNZ** – (Quarterly; June 1978 – March 2011)
- Arrivals of Australian Citizens from Australia (AACFA) – **SNZ** – (Quarterly; June 1978 – March 2011)
- Arrivals of Non-New Zealand & Non-Australian Citizens from Australia (ANNZACFA) – **SNZ** – (Quarterly; June 1978 – March 2011)
- Arrivals of New Zealand & Australian Citizens from the UK (ANZACFU) – **SNZ** – (Quarterly; June 1978 – March 2011)
- Arrivals of Non-New Zealand & Non-Australian Citizens from the UK (ANNZACFU) – **SNZ** – (Quarterly; June 1978 – March 2011)
- Arrivals of New Zealand & Australian Citizens from the Rest of the World (ANZACFRW) – **SNZ** – (Quarterly; June 1978 – March 2011)

- Arrivals of Non-New Zealand & Non-Australian Citizens from the Rest of the World (ANNZACFRW) – SNZ – (Quarterly; June 1978 – March 2011)
- Departures of New Zealanders to Australia (DNZTA) – SNZ (Quarterly; June 1978 – March 2011)
- Departures of New Zealanders to the UK (DNZTU) – SNZ (Quarterly; June 1978 – March 2011)
- Departures of New Zealanders to the Rest of the World (DNZTRW) – SNZ (Quarterly; June 1978 – March 2011)
- Departures of Non-New Zealanders to Australia (DNNZTA) – SNZ (Quarterly; June 1978 – March 2011)
- Departures of Non-New Zealanders to the UK (DNNZTU) – SNZ (Quarterly; June 1978 – March 2011)
- Departures of Non-New Zealanders to the Rest of the World (DNNZTRW) – SNZ (Quarterly; June 1978 – March 2011)

2. Independent Variables

- Corresponding Lagged Dependent Variables – SNZ (Quarterly; September 1978 – March 2011)
- Departures of New Zealand & Australian Citizens to the Rest of the World (DNZACTRW)– SNZ (Quarterly; June 1978 – March 2011)
- Departures of Non-New Zealand & Non-Australian Citizens to the Rest of the World (DNZACTRW)– SNZ (Quarterly; June 1978 – March 2011)
- The Exchange Rates between New Zealand Dollar and Australian Dollar (ERNZDAD) – SNZ (Quarterly; June 1978 – March 2011)
- The Exchange Rates between New Zealand Dollar and British Pound (ERNZDBP)– SNZ (Quarterly; June 1978 – March 2011)
- The Ratio between the Changes of New Zealand and Australian GDPs (RCNZAG) – SNZ (Quarterly; June 1978 – December 2010)
- The Ratio between the Changes of New Zealand and Australian Civilian Employment Levels (RCNZACEL) – SNZ (Quarterly; December 1985 – December 2010)
- The Ratio between the Changes of New Zealand and British GDPs (RCNZBG) – SNZ (Quarterly; June 1978 – December 2010)
- The Ratio between the Changes of New Zealand and British Civilian Employment Levels (RCNZBCEL) – SNZ (Quarterly; December 1985 – December 2010)
- Total Arrivals of Non-New Zealanders (TANNZ) – SNZ – (Quarterly; June 1978 – March 2011)
- Total Departures of New Zealand & Australian Citizens (TDNZAC) – SNZ (Quarterly; June 1978 – March 2011)

Appendix B: Quarterly Historical Data and Quarterly Forecasts

Table 1: Quarterly Historical Data and Forecasts of Seven Arrivals Migration Components

Quarter	Arrivals of New Zealanders from Australia	Arrivals of Australian Citizens from Australia	Arrivals of Non-New Zealand & Non-Australian Citizens from Australia	Arrivals of New Zealand & Australian Citizens from the UK	Arrivals of Non-New Zealand & Non-Australian Citizens from the UK	Arrivals of New Zealand & Australian Citizens from the Rest of the World	Arrivals of Non-New Zealand & Non-Australian Citizens from the Rest of the World
Mar. 2009	2,386	1,121	351	1,726	2,741	2,405	15,320
June 2009	2,294	756	331	1,179	1,957	1,731	9,258
Sept. 2009	2,457	754	300	1,739	2,560	2,076	11,827
Dec. 2009	2,907	735	401	3,046	2,443	2,658	8,951
Mar. 2010	2,984	1,208	515	1,504	2,069	2,372	13,324
June 2010	2,362	766	407	879	1,488	1,705	7,868
Sept. 2010	2,203	787	451	1,359	2,353	2,271	12,396

Dec. 2010	2,773	893	493	2,388	2,301	2,540	9,810
Mar. 2011	2,663	1,142	635	1,262	2,143	2,372	14,305
June 2011	2,309	736	483	879	1,570	1,711	8,807
Sept. 2011	2,283	717	559	1,361	2,383	2,128	12,407
Dec. 2011	2,865	747	594	2,444	2,364	2,586	10,292
Mar. 2012	2,906	1,072	751	1,247	2,078	2,488	15,901
June 2012	2,480	670	614	790	1,489	1,785	9,323
Sept. 2012	2,445	611	634	1,257	2,215	2,312	14,199
Dec. 2012	3,068	668	906	2,259	2,203	2,817	11,967
Mar. 2013	3,096	969	975	1,168	1,947	2,574	16,779

Table 2: Quarterly Historical Data and Forecasts of Six Departures Migration Components

Quarter	Departures of New Zealanders to Australia	Departures of New Zealanders to the UK	Departures of New Zealanders to the Rest of the World	Departures of Non-New Zealanders to Australia	Departures of Non-New Zealanders to the UK	Departures of Non-New Zealanders to the Rest of the World
Mar. 2009	11,385	1,394	2,470	1,353	901	3,456
June 2009	6,510	1,542	1,939	916	1,018	3,699
Sept. 2009	5,077	1,103	2,286	816	932	4,113
Dec. 2009	5,605	627	1,641	1,114	819	4,462
Mar. 2010	9,226	1,148	2,201	1,281	956	4,345
June 2010	7,554	1,870	2,103	1,043	1,178	4,313
Sept. 2010	7,010	1,308	2,411	984	978	4,324
Dec. 2010	8,388	775	1,747	1,344	855	4,676
Mar. 2011	13,148	1,289	2,329	1,435	1,012	4,387
June 2011	10,045	1,722	2,094	1,041	1,196	4,202
Sept. 2011	9,037	1,264	2,399	983	954	4,304
Dec. 2011	10,458	777	1,731	1,281	815	4,539
Mar. 2012	14,870	1,336	2,216	1,286	892	4,113
June 2012	11,229	1,997	2,013	993	1,064	4,081
Sept. 2012	10,016	1,383	2,290	923	962	4,206
Dec. 2012	11,087	809	1,679	1,206	829	4,389
Mar. 2013	17,534	1,397	2,209	1,263	931	4,126