MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

SCIENCE, SKILLS AND INNOVATION

Labour Supply Forecasting by Age, Gender and Qualification

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MINISTRY OF BUSINESS,
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Ministry of Business, Innovation and Employment
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PO Box 3705
Wellington
New Zealand
www.dol.govt.nz
www.mbie.govt.nz

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The forecasts and other results reported are preliminary in nature and subject to change.

Access to the data used in this study was provided by Statistics New Zealand under conditions designed to give effect to the security and confidentiality provisions of the Statistics Act 1975. The results presented in this study are the work of the authors, not Statistics New Zealand.

EXECUTIVE SUMMARY

This report presents forecasts to 2015 for labour supply, working age population and labour force participation rates. The report describes the methdology and the conceptual framework for the forecasting process. These are designed to enable annual updates.

The forecast methodology is new, both because of its level of detail and because it accounts for the qualification profile of the labour force, as well as age and gender profiles. The qualification dimension is important since qualifications of the labour force influence the proportion of people who participate in the labour force and their productivity. These, together with the level of working age population, strongly influence economic growth.

Forecasts in a nutshell

Labour supply is forecast to increase by: 21,600 (0.9 per cent); 47,900 (2.0 per cent); and 39,600 (1.6 per cent) for 2013, 2014 and 2015 respectively. The increase is underpinned by:

- increases in the working age population for persons with a "school and level 1-3" or higher qualification
- rising participation rates of older persons and females
- increasing 50+ age group numbers due to an ageing cohort of baby boomers
- females constituting about two-thirds of the increase in labour supply.

Drivers of Forecasts

Labour supply forecasts for 2013 to 2015 are mostly driven by:

- increases in the working age population
- changes in the composition of the working age population from less qualified to more qualified persons with higher participation rates.

Females play an important role in rises in working age population, and their forecast rise is underpinned by rises in "school and level 1-3" qualified persons.

Participation rate changes have less impact on overall labour supply. The level of 68.6 per cent for 2015 is similar to that for 2012 (68.5 per cent). Underlying the steady overall rate, the female participation rate is forecast to rise from 62.8 per cent in 2012 to 63.6 per cent in 2015. The male participation rate is forecast to fall from 74.4 per cent to 74.0 per cent.

Gender Profile

Female labour supply for 2013 to 2015 is forecast to rise by 72,000 compared with 37,000 for males. Underlying this are larger rises in both working age population and labour force participation rates for females.

Age Profile

Labour supply forecasts for 2013 to 2015 are mainly influenced by age groups showing:

- participation rate changes: 55-59 (2.3 percentage points), 60-64 (3.0 percentage points), 65+ (3.2 percentage points), and 15-19 (-4.0 percentage points)
- working age population changes: 20-34 (64,400), 50-64 (40,500), 65+ (53,300), and 35-44 (-13,600).

Qualification Profile

Labour supply growth is largely comprised of:

- 44,000 "degree" qualified females (up 15.8 per cent)
- 28,600 "school and level 1-3" qualified males (up 6.9 per cent)
- 34,600 "school and level 1-3" qualified females (up 7.9 per cent).

Insights from historical data

Interestingly, participation rates show clear differences by qualification. Over the 21 years to 2012, these were typically:

- 85 per cent for "degree" qualified
- 77 per cent for "level 4-7" qualified
- 67 per cent for "school and level 1-3" qualified
- 49 per cent for unqualified.

Participation rates for males are generally higher than for females, but are almost the same for degree qualified persons.

Methodology

The methodology develops forecast equations for highly detailed subgroups of the working age population. This accounts for 86 combinations of age-gender and highest qualification.

Working age populations and labour force participation rates are forecast for each of the 86 combinations. Labour supply is forecast from these.

The high level of detail allows labour market analysts to:

- interpret how subgroups are driving the overall labour supply and labour force participation rate
- fill a gap in the current understanding of the role of qualifications in influencing labour supply and labour force participation rates.

Conclusions

The forecast growth in labour supply in the period to 2015 is supported mainly by increases in working age population. The female working age population increases more than that for males. The forecasts show steady overall participation rates in the medium term. By comparison, female labour force participation rates show continued growth, particularly as proportionately more females have qualifications, especially degree qualifications. Participation rates rise as qualification levels rise.

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1. HEADLINE RESULTS

1.1 Introduction

This report presents forecasts of labour supply, labour force participation rates and working age population for the June years 2013, 2014 and 2015.

The report also presents:

- insights from analysis of historic labour force participation rates
- an overview of the conceptual model and the data used
- specification tests for the forecast equations
- comparison of the forecasts with Statistics New Zealand projections.

Labour supply (LS) is the number of people either working or available for, and actively seeking, work. It is a product of:

- the total number of people who can possibly work, called the working age population (WAP) and
- the proportion of WAP who are available and willing, called the labour force participation rate (LFPR).

The forecasts are made for 86 subgroups of each of LS, WAP and LFPR. These comprise:

- 11 age groups (15-19,….60-64, 65+)
- 2 genders
- 4 levels of highest qualification (degree, level 4-7, school and level 1-3, no qualification)

less 2 empty groups of males and females aged 15-19 years who possess a degree qualification.

The forecasts use Household Labour Force Survey (HLFS) data of Statistics New Zealand.

The above level of detail, together with accounting for the qualification dimension, are new. The qualifications possessed by the labour force are important determinants of its productivity. Hence the forecasts can reveal important insights for understanding future economic growth.

While detailed, the technical methodology is uncomplicated yet robust. This preserves the simplicity and transparency required for easy interpretation by end-users. The methodology accounts for:

- changes in the business cycle for LFPR
- changes in inward and outward flows of migration for WAP.

The analysis of the historic data revealed new insights on labour supply behaviour. These improve the understanding of how labour market properties of subgroups underpin future changes in LS and LFPR.

This section presents headline results of forecasts and analysis of historical data. The Appendices contain the econometric specifications for the forecasting equations together with charts of forecasts (2013 to 2015) and historical data (1993 to 2012) for each of LS, LFPR and WAP.

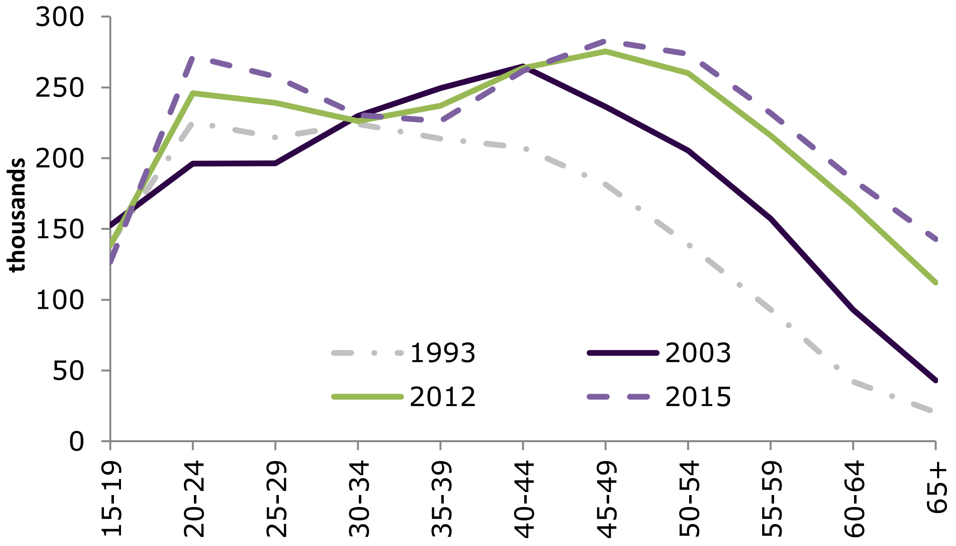
1.2 Labour Supply Forecasts

Overall, the LS profile by age generally shows an inverted U-shape. LS is low for 15-19, and declines over the 55+ years. There are two high areas at 20-24 and at 50-54, attributable to baby-boomer blips which raise WAP.

Age Effect: Compared with 2012, the 2015 forecasts (Fig 1) show:

- LS rises for the 20-24 and 25-29 groups, consistent with the trend of the past ten years that is mainly attributable to rises in WAP
- LS falls for the 35-39 group driven by falls in WAP
- LS rises for ages 45+, consistent with the trend since 1993, driven by higher WAP and higher LFPR.

Figure 1: Labour supply by age



Source: Statistics New Zealand, Ministry of Business, Innovation and Employment
* HLFS data, MBIE forecasts for 2015

Gender Effect: LS rises in 2013, 2014 and 2015 respectively:

- for males by 0.8 per cent, 1.1 per cent , and 1.1 per cent, despite a falling LFPR for males
- for females by 1.1 per cent, 3.0 per cent, and 2.2 per cent.

LS is higher in 2014 for females than males. Due to a higher growth rate in WAP, LS is higher for females than males in 2015 largely due to a higher growth in LFPR that comes mostly from the 55+ age group.

Qualification Effect: LS rises (see Table 1) from 2012 to 2015, for:

- males in terms of: degree (8,700), level 4-7 (2,500), school and level 1-3 (28,600)
- females in terms of: degree (44,000), level 4-7 (-4,400), school and level 1-3 (34,600).

LS falls for both males (-2,800) and females (-2,000) over the forecast period for no qualifications.

Table 1: Labour supply changes by qualification

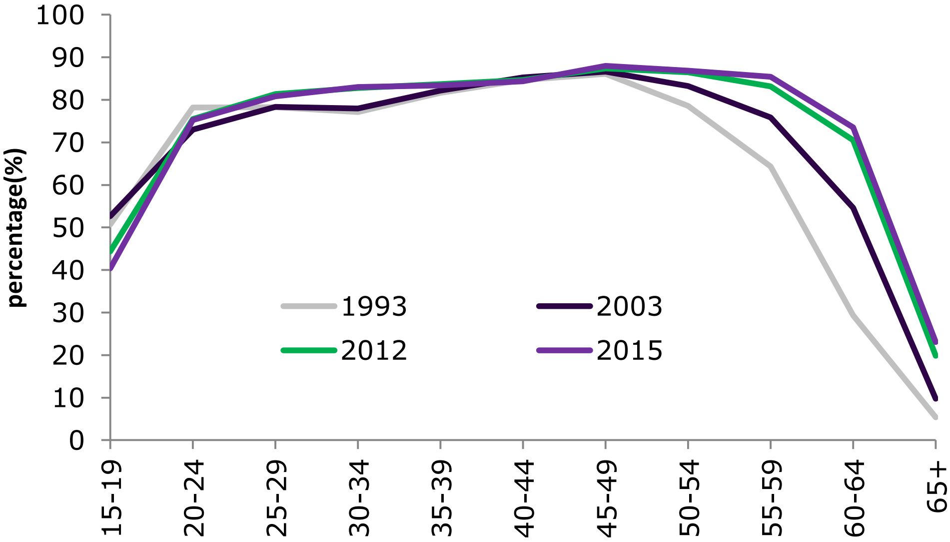
000's	Degree	Level 4-7	School and level 1-3	No qual	Total
Male					
2009-12	11.9	-0.3	46.8	-12.7	45.7
2012-15	8.7	2.5	28.6	-2.8	37.0
Female					
2009-12	45.7	-17.5	37.7	-20.9	45.1
2012-15	44.0	-4.4	34.6	-2.0	72.2
Total					
2009-12	57.6	-17.8	84.6	-33.6	90.8
2012-15	52.6	-1.9	63.2	-4.8	109.1

Source: Statistics New Zealand, Ministry of Business, Innovation and Employment
* HLFS data, MBIE forecasts from 2013

1.3 Labour Force Participation Rate Forecasts

Overall the LFPR by age generally shows an inverted U shape, corresponding to lower LFPRs for younger and older workers.

Figure 2: Labour force participation rates by age



Source: Statistics New Zealand, Ministry of Business, Innovation and Employment
* HLFS data, MBIE forecasts for 2015

Age Effect: In the period 1993 to 2012 (Fig 2), LFPR:

- increases sharply from the 15-19 age group to the 20-24 age group
- increases slowly from age 25 to age 49
- decreases sharply in the 60+ age range.

The MBIE 2015 forecasts (Fig 2) also show this age-related pattern. Relative to the 2012 data, the 2015 forecasts also show:

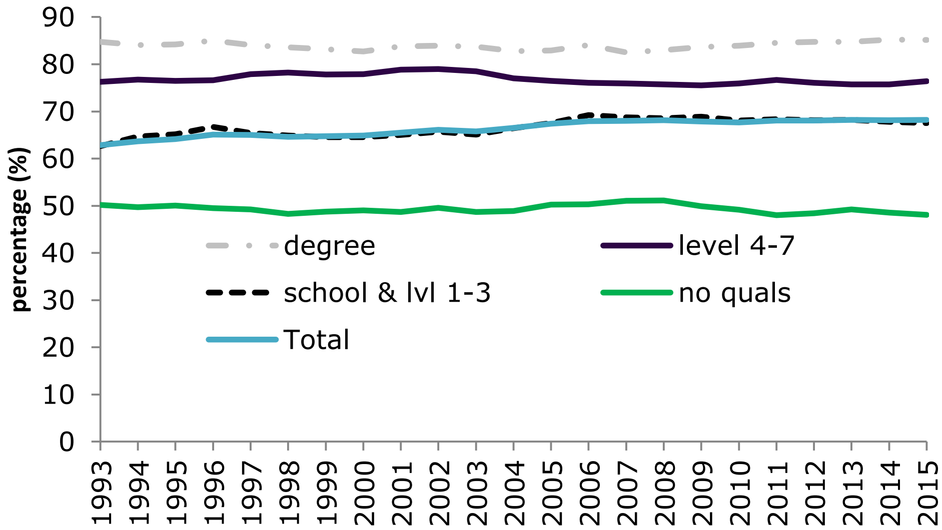
- LFPR falls further for the 15-19 age group
- LFPR rises further for the 50+ age group.

Gender Effect: Compared with 2012, the LFPR forecasts in 2015 rise more for females aged 55+ than for males aged 55+.

Qualification Effect: Forecasts to 2015 show small changes by qualification (see Fig 3). The gap in LFPRs between males and females changes according to qualification. Forecasts to 2015 (Fig 4) show that gaps between males and females:

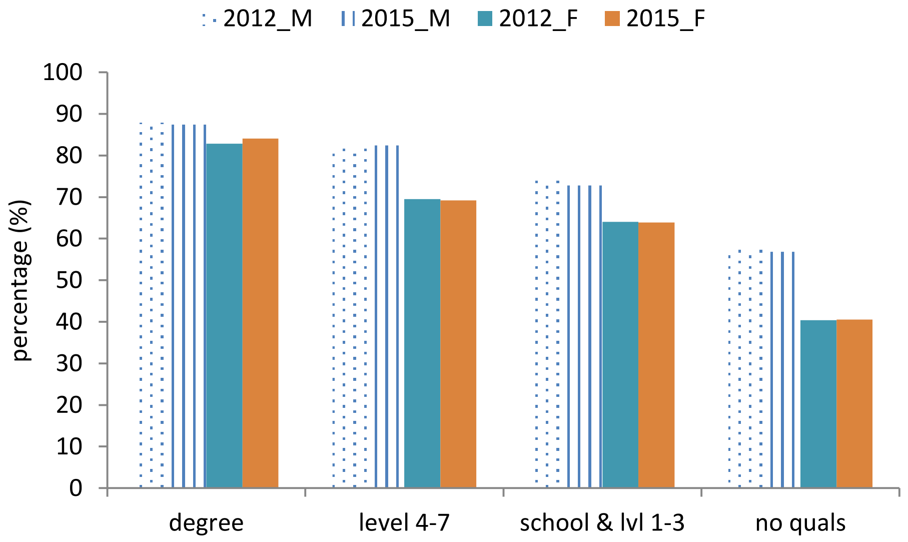
- reduce for the "degree" qualified group
- increase for the "level 4-7" qualified group
- reduce for the "school and level 1-3" qualified group
- are unchanged for the "no qualification" group.

Figure 3: Labour force participation rates by qualification (degree, level 4-7, school and level 1-3, and no qualification)



Source: Statistics New Zealand, Ministry of Business, Innovation and Employment
* HLFS data, MBIE forecasts from 2013

Figure 4: Labour force participation rates by qualification and gender



Source: Statistics New Zealand, Ministry of Business, Innovation and Employment
* HLFS data, MBIE forecasts for 2015

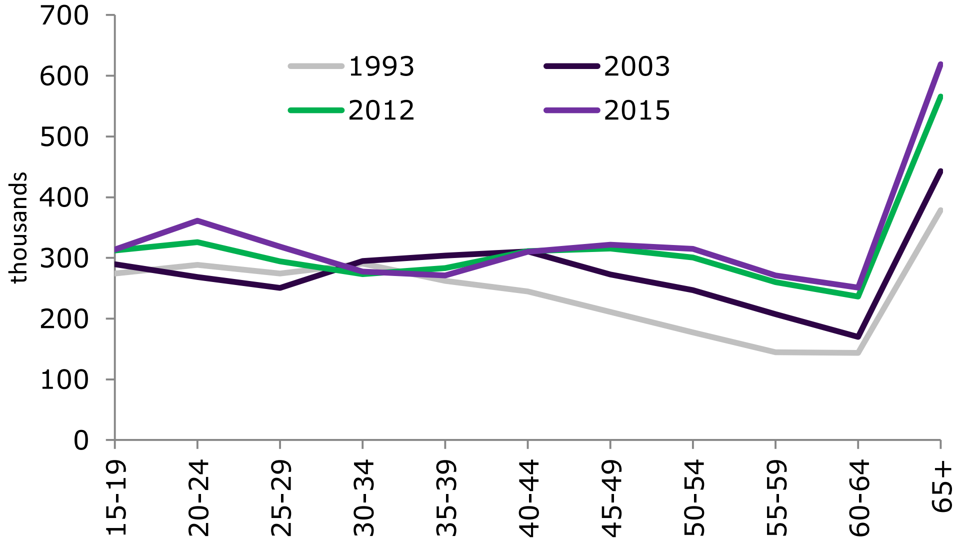
1.3 Working Age Population Forecasts

Overall, WAP is shaped by a rise at the 20-24 age and a rise at the 50+ age that are attributable to baby boomer and baby blip cohort effects. WAP generally declines with age therafter.

Age Effect: WAP forecasts for 2015 are shown in Fig 5 together with selected historic results for comparison. Historically, WAP varies with age until falling sharply at the: 30-34 (in 1997), 40-44 (in 2007), and 50-54 (in 2012) age groups. This coincidence of a ten-year shift in the point at which trend changes with a ten-year change in age suggests that the trend change is an age-cohort effect. That is, one due to an age cohort of WAP that ages and thereby shows up in progressively older age groups as years increase.

The forecast for 2015 from 2012 shows that WAP rises for ages up to 30-34 and for ages from 45-49, that are consistent with the trend over the last ten years.

Figure 5: Working age population by age



Source: Statistics New Zealand, Ministry of Business, Innovation and Employment
* HLFS data, MBIE forecast for 2015

Qualification Effect: Forecasts by qualification (Table 2) show that WAP increases (2013 to 2015) are due to large rises in "school and level 1-3" qualified persons (104,600) and "degree" qualified females (47,300).

The forecasts in 2015 are consistent with the increasing share of these two types of qualifications in the overall distribution of WAP across the 4 qualification types (Table 3).

Table 2: Working age population changes by qualification

000's	Degree	Level 4-7	School and level 1-3	No qual	Total
Male					
2009-12	12.7	-6.9	72.5	-11.4	66.9
2012-15	11.3	-1.2	48.6	2.4	61.1
Female					
2009-12	47.9	-22.1	62.2	-30.7	57.3
2012-15	47.3	-5.0	56.0	-6.9	91.5
Total					
2009-12	60.6	-29.0	134.7	-42.1	124.2
2012-15	58.6	-6.2	104.6	-4.5	152.6

Source: Statistics New Zealand, Ministry of Business, Innovation and Employment
* HLFS data, MBIE forecasts from 2013

Table 3: Working age population shares by qualification

Percentage (%)	Degree	Level 4-7	School and level 1-3	No qual	Total
2009	16	24	33	26	100
2010	17	23	33	26	100
2011	18	23	35	25	100
2012	18	22	36	24	100
2013	18	22	36	24	100
2014	18	21	37	24	100
2015	19	21	37	23	100

Source: Statistics New Zealand, Ministry of Business, Innovation and Employment
* HLFS data, MBIE forecasts from 2013

1.4 Source of labour supply growth

LS forecasts for 2013, 2014 and 2015 are mostly driven by increases in WAP. This is shown in Table 4. This impact holds at the detailed level of individual combinations of age, gender and qualification. It is not an artefact of the aggregation of the data.

Table 4: Composition of annual percentage change of labour supply

Percentage (%)	Annual % change Labour force participation rate (apc_LFPR)	Annual % change Working age population (apc_WAP)	Annual % change Labour supply
Male			
2009	-0.8	1.3	0.5
2010	-0.3	1.6	1.3
2011	0.3	1.4	1.8
2012	-0.4	1.0	0.6
2013	0.1	0.7	0.8
2014	-0.2	1.3	1.1
2015	-0.5	1.6	1.1
Female			
2009	0.0	1.1	1.1
2010	-0.4	1.3	0.9
2011	0.9	1.2	2.1
2012	0.3	0.8	1.1
2013	0.3	0.8	1.1
2014	0.2	2.8	3.0
2015	0.8	1.4	2.2

Source: Statistics New Zealand, Ministry of Business, Innovation and Employment
* HLFS data, MBIE forecasts from 2013

2. INSIGHTS FROM HISTORIC LABOUR FORCE PARTICIPATION RATES

2.1 Introduction

This section presents analyses of historic LFPR data. It provides insights into behaviours of LFPRs of subgroups by age, gender and qualification that aid understanding of forecasts.

The analyses reveal that unique LFPRs characterise specific levels of qualifications and genders.

This section presents and discusses these as a gender effect and a qualification effect.

Interestingly, participation rates show clear differences by qualification. Over the 21 years to 2012, these were typically:

- 85 per cent for "degree" qualified
- 77 per cent for "level 4-7" qualified
- 67 per cent for "school and level 1-3" qualified
- 49 per cent for unqualified.

Participation rates for males are generally higher than for females, but are almost the same for degree qualified persons.

2.2 Gender effect on labour force participation rate

A "gender effect" (Fig 6 to Fig 9) is calculated as the average annual difference (over the 21 years from 1992 to 2012) between LFPRs for males and females for each age-qualification combination. This measures gender dispartiy in LFPRs.

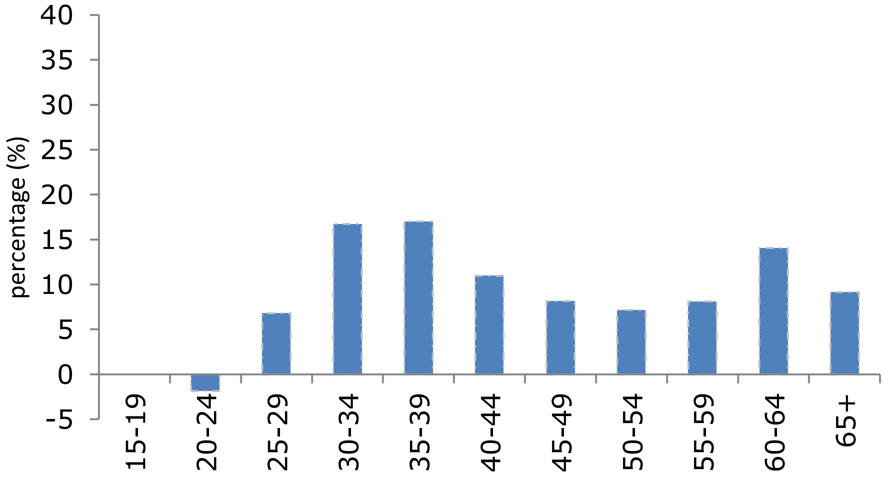
In algebraic terms, we can express this average annual difference in LFPR for males (LFPR_M) and that for females (LFPR_F) in the years from i=1992 to i=2012, for each age-qualification combination as:

$$AVG\_GEN\_DIFF = \left(\frac{1}{21}\right)\sum_{i=1992}^{i=2012}\left(LFPR_{M_i} - LFPR_{F_i}\right) . \qquad (1)$$

The data show that avg-gen-diff (average difference due to gender) is:

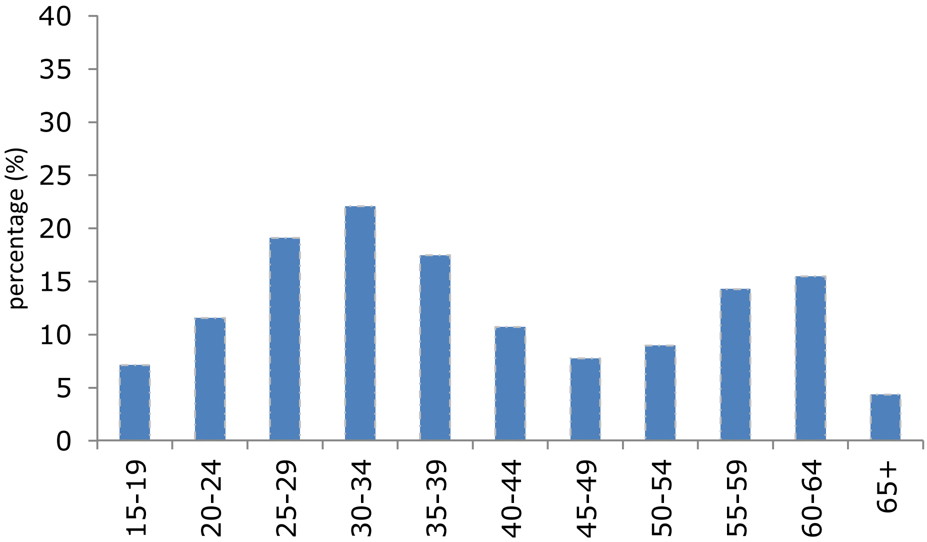
- generally positive in favour of males, indicating that on average, males showed higher LFPRs for all age groups and qualifications compared to females over the 1992 to 2012 period
- generally in favour of males, this difference is highest for "no quals" followed by "school and level 1-3", "level 4-7" and "degree". This indicates that, in general, possessing a "level 4-7" or "degree" qualification reduces the gender disparity in LFPR by approximately similar amounts
- higher for the 3 age groups in the 25-39 age range (covering those of child bearing age) than for other age groups
- similar for all qualifications for the older ages covering the 45-65+ range, but rising with age up to 60-64 then falling for the 65+ age group
- varied across the different qualifications for younger age groups covering those in the 15-19 and 20-24 categories. LFPR is higher for females 15-19 years with "school and level 1-3" and for 20-24 years with "degree" qualifications.

Figure 6: Gender gap for males over females, of labour force participation rate by age for degree qualified



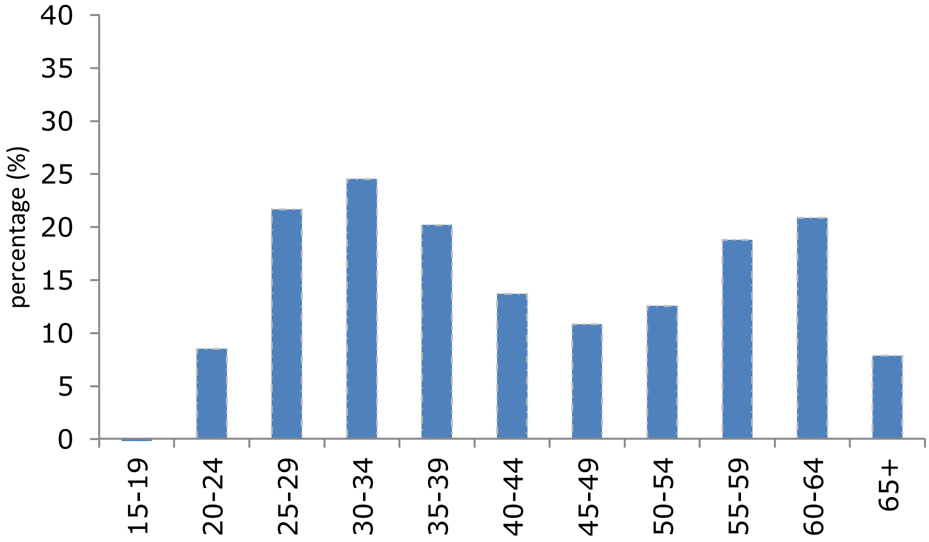
Source: Statistics New Zealand, Ministry of Business, Innovation and Employment
* average of annual differences for 1993 to 2012

Figure 7: Gender gap for males over females, of labour force participation rate by age for level 4-7 qualified



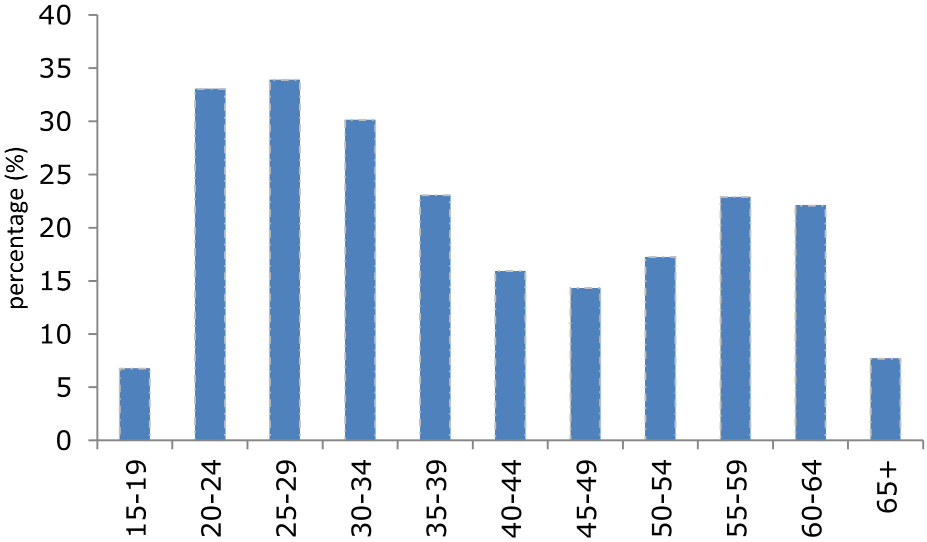
Source: Statistics New Zealand, Ministry of Business, Innovation and Employment
* average of annual differences for 1993 to 2012

Figure 8: Gender gap for males over females, of labour force participation rate by age for school and level 1-3 qualified



Source: Statistics New Zealand, Ministry of Business, Innovation and Employment
* average of annual differences for 1993 to 2012

Figure 9: Gender gap for males over females, of labour force participation rate by age for unqualified



Source: Statistics New Zealand, Ministry of Business, Innovation and Employment
* average of annual differences for 1993 to 2012

2.3 Qualification effect on labour force participation rate

A "qualification effect" (qual_eff) is calculated as the average annual difference (over the 21 years from 1992 to 2012) between LFPRs for persons by age and gender with a qualification ("degree", "level 4-7", and "school and level 1-3") and the corresponding LFPR for the case of no qualification.

In algebraic terms, we can use LFPR_Q to denote the LFPR for persons with a qualification and LFPR_N for the corresponding persons with no qualification, in the years from i=1992 to i=2012. Then the qualificatio effect, for each age-qualification combination, is:

$$QUAL\_EFF = \left(\frac{1}{21}\right) \sum_{i=1992}^{i=2012} (LFPR\_Q_i - LFPR\_N_i) \quad (2)$$

The results for each age-gender combination are shown in Table 5 below.

Table 5: Change in labour force participation rate, from having a qualification, by age, gender and qualification

Percentage points (%)	Male degree	Male level 4-7	Male school & level 1-3	Female degree	Female level 4-7	Female school & level 1-3
15-19	n/a	43	14	n/a	42	22
20-24	2	11	-4	37	32	20
25-29	10	11	7	37	26	19
30-34	11	12	8	25	20	14
35-39	11	11	8	17	17	11
40-44	11	11	8	16	16	10
45-49	10	10	8	17	17	12
50-54	12	11	9	22	20	13
55-59	13	13	10	28	21	14
60-64	20	14	10	28	21	11
65+	17	4	2	16	7	2

Source: Statistics New Zealand, Ministry of Business, Innovation and Employment
* HLFS data
* average of annual changes for years 1993 to 2012

Males

The results show that "degree" and "level 4-7" qualifications provide similar premiums in percentage points for LFPR over no qualification (ranging from 10 per cent to 13 per cent for males for the 25-59 age groups. This is larger than the premiums in LFPR for "school and level 1-3" qualification (ranging from 7 per cent to 10 per cent). In general, this suggests that:

- a qualification of some kind provides a premium for LFPR over "no qualification" for males covering a large portion of the working age groups
- premiums for "degree" and "level 4-7" are similar but larger than those for "school and level 1-3".

All qualifications provide a premium in terms of LFPR for the 60-64 and 65+ age groups with "degrees" providing the highest, followed by "level 4-7" and then "school and level 1-3".

By comparison "level 4-7" (43 per cent) and "school and level 1-3" (14 per cent) qualifications provide premiums for LFPR for the 15-19 age group.

The 20-24 age group benefits little from a "degree" (2 per cent) qualification and a "school and level 1-3" qualification lowers LFPR (-4 per cent) from the case of "no qualification".

Females

“Degree” and “level 4-7” qualifications provide similar premiums for LFPR (ranging from 16 per cent to 37 per cent) for females for the same 20-59 age groups. This is larger than the premium for the “school and level 1-3” qualification (ranging from 10 per cent to 20 per cent).

Similar to the result for males, the trend for female LFPRs suggests that:

- a qualification of some kind provides a similar LFPR premium over “no qualification” for females
- the premiums for “degree” and “level 4-7” qualifications are similar but larger than those for the “school and level 1-3” qualification.

Unlike the results for males, the premiums for females from having a qualification are generally higher and show greater variation across the age groups. This possibly reflects the influence of other factors including being primary child carers.

All qualifications provide a premium in terms of LFPR for the 60-64 and 65+ age groups with “degrees” providing the highest, followed by “level 4-7” and then “school and level 1-3”. These premiums are similar to those for the corresponding male age groups.

By comparison, “level 4-7” (42 per cent) and “school and level 1-3” (22 per cent) qualifications provide premiums for LFPR for the 15-19 age group that are comparable to the corresponding male premiums (43 per cent and 14 per cent).

Interestingly, the premium in terms of LFPR for the 20-24 age group with a “degree” (37 per cent) qualification and with a “school and level 1-3” qualification (20 per cent) are very different to those observed for males (2 per cent and -4 per cent respectively).

3. CONCEPTUAL MODEL AND DATA

3.1 Introduction

The Ministry of Business, Innovation and Employment (MBIE) has previously reported studies of LFPRs. MBIE has also provided regular monitoring reports with analysis of LFPRs.

MBIE and other agencies have previously reported forecasts of LS by age and gender. This work is extended in the present study by explicitly accounting for qualification levels of the labour force.

Qualifications in the labour force influence its productivity and thereby the nation's economic growth. Qualifications shape the workforce's readiness to participate as well as its capacity to provide skills.

This section describes the simple conceptual model used to derive forecasts for 86 age, gender, qualification combinations for each of WAP and LFPR and LS.

The propensity of individuals to participate in the labour market is measured by the labour force participation rate (LFPR), being LS divided by WAP. We can also write this as:

$$LS = LFPR * WAP \qquad (3)$$

LFPR is influenced by each individual's willingness and capacity for work. LFPR varies by age, gender, qualifications gained, ethnicity, household status, etc. LFPR also varies with job search activities. Participation in the labour market is influenced by perceptions of the state of the economy, drawn from views of the state of the business cycle.

By comparison WAP is influenced by factors that change the population, including fertility and mortality. In the short to medium term (3 years), WAP is mainly influenced by external migration.

Globally (OECD 2013; "Affording Our Future" Conference, 2012) there is widespread interest in raising LS for economic growth, particularly to meet rising fiscal costs for health and welfare due to higher longevity. In New Zealand, labour intensity in economic activity is already high by OECD standards and recent increases in LS are coming from specific demographic groups such as older workers.

3.2 Literature Guidance

In general, series of historic LFPRs and projections of future LFPRs for the aggregate labour force are well reported. Labour force projections are regularly updated by Statistics New Zealand classified by age and gender (2012a Statistics New Zealand). MBIE reported studies of general trends and features of specific age groups in previous studies (2012b SriRamaratnam et al; 2012c SriRamaratnam et al; 2010 Department of Labour) and in regular monitoring reports (2013 Ministry of Business, Innovation and Employment).

Significant support for the importance and relevance of including measures of qualification levels comes from the report of the European Centre for the Development of Vocational Training (2009 European Centre).

The European Centre (p100) models the qualification structure of the population separately and independently from the qualification structure in the labour force using changing patterns over time within each subgroup. Labour force participation rates are then calculated for each qualification group.

This can lead to implausible outcomes in some cases. To avoid this problem, the European Centre suggests that a useful development would be to separately and directly model labour force participation rates by age, gender and qualification.

The European Centre (p26) also notes that from a macroeconomic modelling context the main drivers of labour supply are demographic factors, real wage output levels, unemployment rates, social benefits, and the industrial composition of the economy (eg level of manufacturing versus services). These are reflected in the labour supply components of the European Centre's E3ME macroeconomic model (E3ME Model, 2009).

Interestingly, other work (2008 Pollitt and Chewpreecha), cited by the European Centre (p27) acknowledges that the qualification mix is an important factor together with hours worked, unemployment, and other factors, in explaining changing patterns of labour-market participation.

The European Centre (p30) also notes that best practice for developing projections of labour supply by qualification, involves a full stock-flow analysis. This is where stocks in one period are related to stocks in an earlier period, plus inflows less any outflows. The flows can be linked to demographic developments, migration and to a range of behavioural drivers, including economic and social factors.

One main issue with estimating flows is that there is limited information available on flows for lower-level qualifications. Various methods are used to overcome this barrier, including developing projections using trends in historic time series. However, limited data and the lack of consistency between databases make it difficult to produce robust forecasts (p38). For this reason, the European Centre focuses on stock-based models.

In line with this guidance, the method used for this report's work:

- separately and directly accounts for age, gender and qualification
- includes variables to represent demographic changes from migration
- includes variables to represent business cycle effects characteristic of the structure of the economy
- is based on an autoregressive approach where stocks of forecast labour market variables are assumed to grow from past stocks, where the growth path is influenced by other explanatory variables.

3.3 Labour Supply

The following simple equation is the basis for the conceptual model underlying the forecasts:

$$LS_t(i,j,k) = LFPR_t(i,j,k) * WAP_t(i,j,k) \qquad (4)$$

Where LS_t is labour supply, WAP_t is working age population and $LFPR_t$ is the labour force participation rate at time t.

LS is assumed to be determined by LFPR and WAP. LFPR and WAP are assumed to be independent of each other for each age (i), gender (j), and qualification (k) subgroup selected. The subgroups within them are also assumed to be independent.

Taking logs of both sides of the equation yields

$$\ln(LS_t) = \ln(LFPR_t) + \ln(WAP_t) \qquad (5)$$

Differentiating both sides with respect to time reduces to the familiar percentage change result for log-log equations. In this study "annual percentage change (apc)" is the relevant variable in the estimated equations.

$$apc(LS_t) = apc(LFPR_t) + apc(WAP_t) \qquad (6)$$

In general, equations (4) and (6) are useful for forecasting LS_{t+1}. We can either:

- forecast apc's of $LFPR_{t+1}$ and WAP_{t+1}, to derive the apc of LS_{t+1} using (6) and then calculate LS_{t+1} from LS_t accordingly, or
- forecast levels of $LFPR_{t+1}$ and WAP_{t+1} and then derive LS_{t+1} directly by (4).

The former method is used in this study, since the time series of the data in levels are non-stationary and the time series of the data in apc form are stationary. The data in apc form are used for estimating the econometric equations.

3.4 Labour Force Participation Rate

A simple structural model is used to forecast apc($LFPR_t$) variables for each subgroup. This model has:

- an autoregressive term
- a moving average term, and
- a selected explanatory variable that is a proxy for the state of the business cycle.

The structural model is the basis for a general econometric model used to develop forecasting equations. This econometric model, with no restriction on the number of variables, for each age, gender, qualification subgroup, for age class i, gender class j, and qualification class k is:

$$apc(LFPR_{ijk,t}) \;=\; \sum_p \alpha_{ijk,t-p}\, apc(LFPR_{ijk,t-p}) + \sum_q \beta_{ijk,t-q} apc(ER_{ijk,t-q}) + \gamma_{ijk,r} MA_{ijk,r} + \epsilon_{ijkt} \qquad (7)$$

In practice, restrictions are placed to limit the number of explanatory variables to 3 (sometimes 4) terms.

This specification expresses the apc of the participation rate $LFPR_{ijk,t-p}$ for subgroup *i,j,k* at any time t as: (i) a linear combination of past apc's, (ii) a linear combination of past apcs of the employment rate $ER_{ijk,t-q}$ used as a proxy for the influence of the state of the business cycle, and (iii) a moving average term $MA_{ijk,r}$. The employment rate used is age specific and sometimes age and gender specific, where this improves the fit of the model.

Estimating this equation for each subgroup provides estimates of coefficients $\alpha_{ijk,t-p}$ and $\beta_{ijk,t-q}$ and $\gamma_{ijk,r}$.

This specification is selected to reflect the following assumptions that $apc(LFPR_{ijkt})$:

- has an autoregressive behaviour since in the absence of any change influences, it will follow recent past patterns that we observe but cannot specify. This behaviour can be explained by the cumulative effect of past participation decisions of individuals to participate in the labour force at time t
- is determined by the decisions of individuals who are influenced by their perceptions or experiences of the state of the business cycle that is proxied by the employment rate
- is influenced by past trends, specified by moving average terms of the residuals.

3.5 Working Age Population

The *apc(WAP_t)* is similarly forecast for each subgroup. as with LFPR a simple structural model covers all subgroups.

The general econometric model, corresponding to the structural model, with no restriction on the number of variables, for each subgroup, corresponding to age class i, gender class j, and qualification class k is:

$$apc(WAP_{ijkt}) = \sum_{p} \alpha_{ijk,t-p}\, apc(WAP_{ijk,t-p}) + \sum\nolimits_{q} \beta_{ijk,t-q}\, apc(A_{t-q})$$
$$+ \sum\nolimits_{r} \gamma_{ijk,t-r}\, apc(D_{t-r}) + \quad \delta_{ijk,s} MA_{ijk,s} + \epsilon_{ijkt} \qquad (8)$$

In practice, restrictions are placed to limit the number of explanatory variables to 3 (sometimes 4) terms.

This specification expresses the apc of the working age population $WAP_{ijk,t-p}$ for subgroup *i,j,k* at any time *t* as: (i) a linear combination of past apcs, (ii) a linear combination of past apcs of migration variables covering permanent and long-term arrivals $apc(A_{t-q})$, and permanent and long-term departures $apc(D_{t-r})$, and (iii) a moving average term $MA_{ijk,s}$.

Estimating this equation for each subgroup yields unique estimates of coefficients $\alpha_{ijk,t-p}$, $\beta_{ijk,t-q}$, and $\gamma_{ijk,t-r}$ and $\delta_{ijk,s}$.

This specification is selected to reflect the following assumptions that $apc(WAP_{ijkt})$:

- has an autoregressive behaviour since in the absence of any change influences, it will follow recent past patterns that we observe but cannot specify. This behavior can be explained by the cumulative effect of factors affecting growth in WAP, including fertility and mortality
- is determined by apcs of permanent and long-term arrivals and departures, to represent the migration impacts on the WAP
- is influenced by past trends, specified by moving average terms of the residuals.

3.6 Database

As noted above, LS is forecast by estimating the apc of LS for a given sub-group. These are the sums of the corresponding forecasts of the apcs of WAP and LFPR.

Both WAP and LFPR series are obtained from HLFS unit record data disaggregated by age, gender and qualification.

Two databases of apcs of WAP and LFPR were obtained for 86 time series from 1992 to 2012.

The 86 time series consist of:

- 11 age cohorts (15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, and 65+)
- 4 highest qualification levels (degree, level 4-7, school and level 1-3, no qualification)
- 2 genders

less two combinations, considered as non-existent, for males and females of 15 to 19 years with degrees.

The LFPR is the number of persons employed or unemployed divided by the corresponding working age population for the 86 combinations. This represents a common concept of actual labour supply rather than potential labour supply.

The 86 time series for each of LFPR and WAP were extracted from the HLFS unit record data of Statistics New Zealand using a SAS program. Unit record counts were aggregated for each of the above combinations and the LFPR and WAP calculated accordingly. The data for each age, gender, qualification combination were annual data from 1991 to 2012, being averages of four quarters of data for the year ending in the June quarter. The data used to estimate the econometric models were annual percentage changes of WAP and LFPR from 1992 to 2012 as discussed.

4. FORECAST EQUATIONS

4.1 Forecasts to 2015

Forecast equations for WAP and LFPR estimated for the 1992 to 2012 period are shown in Appendix A. The forecasts (2013 to 2015) and historic data (1993 to 2012) for LS, LFPR and WAP are shown in Appendices B, C and D as charts for each of the age, gender, qualification combinations estimated.

4.2 Forecast Equations for annual percentage change in WAP

The model specification for WAP is shown in section 3.5 above. Equations for 86 different age, gender, qualification combinations were estimated using least squares estimation methods. Results from estimating this model are provided in Appendix A. Tables in Appendix A show the estimated coefficients and the levels of significance together with diagnostic criteria for each combination of age, gender and qualification.

The modelling technique constructs each equation with a selection of three parameters. In the notation of Appendix A, the "A_" prefix denotes annual percentage change. There is:

- usually one (at times two) autoregressive term, A_WAP_{t-i}
- one migration flow term, selected from one of four possibilities denoted as: A_AAMIG_{t-j} , A_DAMIG_{t-j} , A_AOMIG_{t-j} , A_DOMIG_{t-j} (for arrivals from Australia (AA); departures to Australia (DA); arrivals from other countries (AO); and departures to other countries (DO)
- one moving average of residuals term.

The migration data are counts of persons of all ages and not restricted to WAP.

The length of the lags in parameters and the period of the moving average term are selected in order to produce the best test statistics as follows:

- t-tests for the significance of the parameters
- F-tests for the significance of the equation as a whole.

Residuals tests are then applied to test for the presence of autocorrelation (Q-statistic test) and heteroscedasticity (ARCH and White tests). Heteroscedasticity and autocorrelation consistent corrections (Newey-West HAC corrections) are applied to arrive at the best possible equation.

All coefficients are significant at least at the 10 per cent level and many at the 1 per cent level. The specification of the equations is evaluated by F-statistics significant at least at the 10 per cent level. The overall goodness of fit measured by the R-squared and adjusted R-squared and the standard errors of the regressions are reported for equations estimated.

4.3 Forecast Equations for annual percentage change in LFPR

Equations for 86 different age, gender, qualification combinations were estimated using least squares estimation methods. Tables in Appendix A show the estimated coefficients and the levels of significance together with diagnostic criteria for each combination. The modelling technique constructs each equation with a selection of three parameters. As before, the "A_" prefix denotes annual percentage change. There is:

- usually one (at most two) autoregressive terms, A_LFPR_{t-i}
- one age specific or age and gender specific employment rate term, A_EMP_{t-j}
- one moving average of residuals term.

In general the equations use the apc of the overall employment rate for both genders (A_EMP). In some cases the apc's of the gender specific employment rates (eg A_EMP_M for males and A_EMP_F for females) were used in order to improve the fit of the equations estimated.

The lags in parameters and the period of the moving average term were selected as described above. Residuals tests were applied as described above.

All coefficients are significant at least at the 10 per cent level and many at the 1 per cent level. The specification of each equations is evaluated by an F-statistic significant at least at the 10 per cent level. The overall goodness of fit as measured by the R-squared and adjusted R-squared statistics are reported.

4.4 Correlation Analysis

A small number of explanatory variables are used to specify the 86 estimated equations for each of LFPR and WAP. While the lag lengths of these differ for the equations, it is helpful to assess the extent to which equations are correlated in that they describe the same underlying behaviour in LS or LFPR.

In order to assess the level of inter-dependence of the variables used in carrying out the single equation multivariate regression analysis, a partial correlation analysis was carried out over 1993 to 2012 for the original variables in the levels and the apc of the variables.

The incidence of partial correlation among the original variables (levels of WAP and LFPR) assessed at or above 70 per cent was reasonably high being about 35 per cent (males) and 55 per cent (females) of the WAP, and 20 per cent of the LFPR.

By comparison, the incidence of this level of partial correlation for the estimated dependent variables of LFPR and WAP in apc terms was only around 0.6 to 0.7 per cent for WAP and 0.2 to 0.3 per cent for LFPR.

In general, these results indicate a lack of correlation across the apc variables that were forecast and supports the retention of a high level of disaggregation in subgroups resulting in the 86 equations for each of LS, LFPR and WAP.

4.5 Within-Sample Model Validation

In order to assess the forecasting accuracy of the equations, tests of within-sample forecasts were made. These were carried out for all forecast WAPs and LFPRs.

Mean absolute percentage errors (MAPE) for all estimated equations are reported in Appendix A tables. The MAPEs were calculated by comparing the corresponding forecast and actual values for the two in-sample June years ending 2011 and 2012.

In general the MAPEs were below 5 per cent in most cases for LFPR equations and below 10 per cent for WAP in most cases.

These results indicate that we can expect to achieve reasonable forecasts using the current set of equations. In practice, as the forecasts are produced and checked against actual out-turns, they can be further refined.

4.6 Error Estimates for the Estimated Equations

The standard errors of the apc of the regression equations are also shown in the Tables in Appendix A. These form the basis of the error estimates for the forecasts of WAP and LFPR and therefore of LS.

In general the standard errors of regressions for WAP are of the order of about 4.7 per cent for males and 5.2 per cent for females, estimated by excluding a few outlier standard errors of 10 per cent or more. By comparison the standard errors of regressions for LFPR are of the order of about 2.1 per cent for males and 3.0 per cent for females. The standard errors are expressed in the same units as the apc of the dependent variables.

It is useful to note that in order to generate a forecast of LFPR in the next period, the forecast apc of LFPR is applied to the current period LFPR. The associated forecast error in the forecast LFPR is the same as the forecast error in the apc.

In general, differences between forecast LFPRs, of different age, gender, qualification subgroups, is often larger than the sum of the associated error margins. This is especially true in many cases of interest (such as in comparing groups of no qualifications with qualifications, or in investigating gender differences).

The same error analysis outlined above applies to the case of forecast WAPs. However for these forecasts, the associated standard errors are somewhat larger.

The above error analysis suggests the LFPR and LS forecasts produced by age, gender, qualification subgroups have estimated errors of about:

- +/- 2.5 per cent for LFPR
- +/- 7.5% for LS, due mostly to an error margin for WAP of about +/- 5.0 per cent.

4.7 Process for updating Forecasts with new data

All forecasts developed in the project are easily updated by including latest actual data and applying the forecast equations. This will produce a new set of 3 year ahead forecasts. When the disaggregated WAP and LFPR data for the year ended June 2013 are available after the release of the June 2013 quarter data, they can be compared with the forecasts.

It would be helpful to re-estimate the forecast equations, after two years, incorporating two years of additional data and any improvements considered necessary with model specification as well as estimation. New forecasts based on these models will then be developed.

5. COMPARISON OF FORECASTS WITH STATISTICS NZ PROJECTIONS

5.1 Introduction

This chapter reports selected comparisons of the MBIE data sets and forecasts with data derived from the working age population and labour force estimates and projections (2012) of Statistics New Zealand (2012a, Statistics New Zealand).

Comparing different data used is a helpful way to highlight the fact that different trends and assumptions are made by MBIE forecasts and Statistics New Zealand projections (2012a, Statistics New Zealand).

Statistics New Zealand reports that the main features of its updated (in 2011) median LFPR assumptions are:

- significant increases in LFPRs for males aged 55+ years and females aged 50+ years. This reflects increased flexibility in the age of retirement (with no compulsory age of retirement), changing attitudes to retirement, and increasing life expectancy and well-being in the older ages
- a small increase in LFPRs for females in main childbearing ages, 21-49 years. This partly reflects declines in completed family size and increases in childlessness
- small decreases in LFPRs for males and females aged 15-20 years. This reflects the impact of the global economic recession, as well as increasing rates of participation in tertiary education
- static LFPRs for males at ages 21-54 years.

5.2 MBIE Forecasts and Statistics NZ Estimates and Projections (2012)

The historic data (HLFS unit record data) and the forecasts prepared in this project (referred to as MBIE estimates) differ from the historic population estimates and projections of similarly aggregated populations of LS and WAP from Statistics New Zealand. This is primarily due to the different definition or the scope of the datasets used.

The HLFS-based estimates of WAPs are based on national resident population estimates adjusted to be within the scope of the HLFS (the non-institutionalised, civilian population of New Zealand aged 15 years and over, who represent the HLFS sample). The HLFS working-age population therefore excludes:

- long-term residents of homes for older people, hospitals, and psychiatric institutions
- inmates of penal institutions
- members of the permanent armed forces
- members of the non-New Zealand armed forces
- overseas diplomats.

MBIE estimates of WAP are based on an annual dataset for June years constructed from an average over four sets of quarterly HLFS data for the corresponding June year. By comparison, (i) national population estimates use derived WAP estimates and (ii) 2012 (stochastic) projections of future WAP derived by Statistics New Zealand that are recorded at the end of the June year (not as an average over the year).

Due to these two considerations, of wider scope and an assessment at the end of the year (rather than representing an average for the year), the Statistics New Zealand WAP estimates are somewhat higher than the MBIE estimates of WAP.

A measure of labour supply which is representative of the whole year rather than at the end of the year is consistent with the labour demand estimates and forecasts produced by MBIE and other forecasters.

A comparison of MBIE (HLFS-based) data and Statistics New Zealand WAP (estimates and projections based) data is shown in Table 6. The apcs of the two historic datasets are quite similar. MBIE forecasts LS using a forecast apc of LS. This is derived from apcs of WAP and LFPR. Since the apcs of the two historic data series are similar and because MBIE forecasts are based on apcs, a comparison of the changes in MBIE forecasts with the corresponding changes in Statistics New Zealand projections is valid rather than a comparison of the corresponding levels.

Table 6: Working age population comparisons

	MBIE HLFS basis[1] (000s)	Annual change(%) HLFS basis	Stats NZ Est & Proj basis[2] (000s)	Annual change (%) Est & Proj basis
2009	3,354	1.2	3,402	1.2
2010	3,403	1.5	3,453	1.5
2011	3,447	1.3	3,511	1.7
2012	3,478	0.9	3,541	0.9
2013	3,503	0.7	3,572	0.9
2014	3,577	2.1	3,609	1.0
2015	3,631	1.5	3,650	1.1

Source: Statistics New Zealand, Ministry of Business, Innovation and Employment

1. HLFS data as average of 4 quarters (MBIE forecasts from 2013)
2. Statistics New Zealand population estimates and projections (2012)

5.3 Comparison at age-gender and age levels

MBIE estimates of annual LFPR are derived from econometrically estimated structural models. Statistics New Zealand LFPRs are derived from projections of WAP and LS at the end of each June year similar to the estimates. They are also reported only at the age-gender level.

In order to compare the MBIE forecasts with Statistics New Zealand projections, the MBIE forecasts of WAP and LS are aggregated up to an age-gender level and a corresponding LFPR is calculated from them. The comparison of these LFPRs is shown in Table 7, where the two series are quite similar, although numerical differences between the two series are evident. They likely reflect the different times at which the LFPRs are assessed.

5.4 Comparison at total population level

MBIE data for LS and its forecasts for total populations are shown in Table 8. The apcs of the forecasts and projections differ due to (i) different scope-related definitions of WAP as noted above, (ii) different points in time assessments of the LFPRs referred to above, and (iii) different definitions of LS (HLFS compared with Statistics NZ estimates and projections).

Table 7: Labour force participation rate comparisons

	MBIE HLFS basis[1] (%)	Annual change(%) HLFS basis	Stats NZ Est & Proj basis[2] (%)	Annual change (%) Est & Proj basis
2009	68.3	-0.4	68.5	-0.3
2010	68.1	-0.3	68.3	-0.2
2011	68.5	0.6	67.9	-0.4
2012	68.5	0.0	68.1	0.2
2013	68.6	0.2	68.2	0.1
2014	68.5	-0.1	68.4	0.2
2015	68.6	0.1	68.5	0.1

Source: Statistics New Zealand, Ministry of Business, Innovation and Employment
1. HLFS data as average of 4 quarters (MBIE forecasts from 2013)
2. Statistics New Zealand population estimates and projections (2012)

Table 8: Labour supply comparisons

	MBIE HLFS basis[1] (000s)	Annual change(%) HLFS basis	Stats NZ Est & Proj basis[2] (000s)	Annual change (%) Est & Proj basis
2009	2,291	0.8	2,331	0.8
2010	2,316	1.1	2,359	1.2
2011	2,361	1.9	2,385	1.1
2012	2,381	0.9	2,410	1.1
2013	2,403	0.9	2,437	1.1
2014	2,451	2.0	2,467	1.2
2015	2,490	1.6	2,500	1.3

Source: Statistics New Zealand, Ministry of Business, Innovation and Employment
1. HLFS data as average of 4 quarters, MBIE forecasts from 2013
2. Statistics New Zealand population estimates and projections (2012)

6. CONCLUDING REMARKS

6.1 Discussion

This report presents a process for forecasting LS and LFPR by its age, gender, qualification components in the medium term. The main outputs of that process are 86 forecast equations covering LFPR and WAP. LS forecasts are derived from these. The process and the estimated equations will become an integral part of MBIE's labour supply forecasting programme. Labour supply is an important labour market measure and it is also an important labour market constraint considered when developing labour demand forecasts.

This report concludes that LS growth is supported in the forecast period to 2015 mainly by increases in WAP. Female WAP increases more than male WAP. Female LFPRs show continued growth, particularly as proportionately more females have qualifications, especially degree qualifications. Higher LFPRs are associated with higher qualifications.

6.2 Remarks

The opportunities and limitations of the forecasting process and the outputs were canvassed in discussions with experts and in a workshop of public sector agency officials. Since then, the authors, when completing this report, reflected on helpful comments.

One comment was whether HLFS data measuring individual behaviour, were representative of actual labour market behaviour. Job search behaviour is often influenced by household circumstances that are not reflected in the forecast equations.

HLFS data are official labour force data and most relevant to the purpose of the project. Hence for this reason, the authors acknowledge that the forecasts are constrained by the HLFS data framework which for some purposes may not sufficiently encompass actual labour market behaviour.

Another group of related comments asked: (i) whether there were too many forecast equations, (ii) whether the data have been over-parameterised, (iii) whether forecast equations could be better specified for more aggregated data, and (iv) whether the forecast equations were independent. These comments are at the core of one objective of the forecasting process. That is, the level of disaggregation covering 86 combinations. This level was chosen, in order to interpret and account for the separate behaviour of subgroups by age, gender and qualification. The forecasts reveal a number of insights that prior aggregation would conceal. It is mainly for this reason that the high level of disaggregation was sought.

The main role of the forecast equations is to produce medium term forecasts. The authors acknowledge that the labour supply behaviour of some groups will influence and be influenced by that of other groups over time.

The low prevalence of correlation between the apc of variables reported in section 4 suggests the risks to misspecification arising from inter-equation dependence are low.

Another comment centred on whether the forecasting approach accounted for cohort effects, that is of the movement of a cohort of people through the age groups over time. The authors identified the baby boomer and baby blip effects in the WAP data (refer section 1.3). The authors conclude that the three year forecasts are unlikely to be strongly affected by cohort effects.

One comment noted the long lag lengths of up to 7 years in some of the autoregressive terms in the forecast equations. The authors consider that such lag lengths are not excessively long for LFPRs since they span a period of time that is consistent with the span for business cycles. Labour supply and migration measures may in some part be dependent on decisions made in earlier periods of the business cycle.

Similarly, the authors consider that lag lengths are not excessively long in the WAP equations. Migration flows consist of those aged 15+ years in WAP as well as those in younger age groups. These latter and younger migrants, while not immediatedly relevant to WAP, become relevant in later years. The time period over which this happens matches the long lag periods selected. In addition, reducing the lag length while achieving similar level of specification criteria for the equations would require more complex equations. This would be reduce the transparency of the equations.

6.3 Future development

The work presented in this report can potentially develop in a number of areas including:

- updating the forecasts and testing forecasting accuracy, once 2013 June quarter unit record HLFS data are available
- checking the estimated populations against 2013 Census data when these are available
- periodically monitoring HLFS results against the forecasts
- incorporating the labour supply forecasting process in the medium to long-term labour demand forecasting process
- estimating forecast equations for more aggregated groups of data
- accounting for characteristics typical of households in the forecasts using other data in the HLFS.

REFERENCES

2013: OECD, "Policies to Support Sustainable Long-Term Growth in New Zealand" ECO/WKP(2013)68, unclassified, Economics Department Working Papers No. 1076.

2013: Statistics New Zealand http://www.stats.govt.nz/browse_for_stats/income-and work/employment_and_unemployment/Labour-force-categories-in-HLFS.aspx

2013: Ministry of Business, Innovation and Employment, "Quarterly Labour Market Report", May 2013, Wellington.

2012: "Affording Our Future" Conference, Victoria University of Wellington, New Zealand. http://www.victoria.ac.nz/sacl/about/cpf/events/affording-our-future-conference-2012/papers

2012a: Statistics New Zealand, "National Labour Force Projections". http://www.stats.govt.nz/browse_for_stats/population/estimates_and_projections/NationalLabourForceProjections_HOTP06-61Augupdate/Data%20Quality.aspx#review

2012b: SriRamaratnam, R.; Zhao, X. and W. Bell, "Employment Growth and Unemployment Rate Reduction: Historical Experiences and Future Labour Market Outcomes", prepared for 2012 New Zealand Association of Economists' Conference, Department of Labour, Wellington.

2012c: SriRamaratnam, R.; Zhao, X. "Impacts of Employment Rates (Demand) and Participation Rates (Supply) on Unemployment Rates: a Disaggregated Analysis", prepared for 2012 Labour, Employment and Work in New Zealand Conference, Department of Labour, Wellington.

2010: Department of Labour, "Labour Force Participation in New Zealand: Recent Trends, Future Scenarios and the Impact on Economic Growth" http://dol.govt.nz/publications/lmr/participation/

2009: European Centre for the Development of Vocational Training, "Future Skill Supply in Europe, medium term forecast up to 2020 Synthesis Report" http://www.cedefop.europa.eu/EN/publications/5069.aspx),

2009: E3ME Model http://www.camecon.com/AnalysisTraining/suite_economic_models/E3ME/purpose_and_design.aspx

2008: Pollitt H. and U. Chewpreecha, "Development of Labour Supply Projections with the E3ME Framework". Paper presented at the workshop on medium-term forecast of occupational skill supply in Europe: final results. Technical workshop organised by Cdefop in Cambridge, 11-12 December 2008.

APPENDIX A : ESTIMATED EQUATIONS

Labour Force Participation Rate (LFPR) Male

Model Type : A_LFPR = A_LFPR (Gen, Age, Qual)

Model Specification : $A\_LFPR_t = \alpha_{t-i} * A\_LFPR_{t-i} + \beta_{t-j} * A\_EMP_{t-j} + \gamma_{t-k} * A\_EMP\_M_{t-k} + \delta_l * MA(l) + \varepsilon_t$

Significance : * 10% ; ** 5%; *** 1%

	Model Type			Estimated Coefficients				Diagnostic Criteria				
	Gen	Age	Qual	α(i)	β(j)	γ(k)	δ(l)	RSQ	Adj RSQ	F	S.E. of Regression	MAPE
1	Male	15_19	4-7	0.775 (7)**	0.315 (1)**		-1.000 (1)***	0.718	0.641	9.320	3.7%	7.1%
2	Male	15_19	sch	-0.861 (4)*	0.633 (4)*		0.897 (7)***	0.414	0.289	3.298	3.1%	5.2%
3	Male	15_19	no q	0.271 (3)*		0.915(0)*	0.731 (7)***	0.823	0.788	23.291	2.8%	4.5%
4	Male	20_24	deg	0.772 (7)**	1.024 (4)**		-0.918(7)***	0.779	0.720	12.973	2.4%	6.6%
5	Male	20_24	4-7	0.773 (3)***	0.482 (5)*		0.681(7)*	0.696	0.626	9.910	1.9%	6.8%
6	Male	20_24	sch	-0.668 (1)***		-0.479 (4)**	0.054(2)***	0.657	0.583	8.928	2.5%	1.6%
7	Male	20_24	no q	-0.598 (7)***		-0.738 (3)***	-0.843(5)***	0.723	0.647	9.553	2.3%	5.8%
8	Male	25_29	deg	-0.429 (1)**		0.917 (7)**	-0.893(4)***	0.516	0.384	3.912	1.9%	1.0%
9	Male	25_29	4-7	-0.301 (2)**		0.573 (0)***	0.999 (3)***	0.386	0.270	3.347	1.1%	0.3%
10	Male	25_29	sch	0.495 (5)**		-0.452 (3)**	0.894 (3)***	0.506	0.392	4.441	1.3%	3.9%
11	Male	25_29	no q	0.509 (3)**	0.631 (2)*		0.084 (4)***	0.369	0.242	2.920	3.0%	3.8%
12	Male	30_34	deg	-0.802 (1)***		-0.426 (3)**	0.939 (1)***	0.398	0.278	3.306	1.3%	0.6%
13	Male	30_34	4-7	-0.462 (1)***	0.438 (5)***		-0.876 (7)***	0.660	0.582	8.413	0.7%	1.8%
14	Male	30_34	sch	-0.550 (1)***		0.181 (5)*	0.969 (1)***	0.467	0.344	3.793	1.1%	0.3%
15	Male	30_34	no q	0.807 (4)***	-2.676 (1)***		-0.880 (6)***	0.766	0.716	15.294	2.4%	8.3%
16	Male	35_39	deg	-0.664 (1)***	1.057 (6)***		-0.900 (3)***	0.528	0.410	4.470	1.4%	1.3%
17	Male	35_39	4-7	0.500 (4)***	-0.424 (3)***		-0.998 (4)***	0.620	0.539	7.613	0.5%	0.2%
18	Male	35_39	sch	-0.422 (1)**	0.340 (1)**			0.320	0.245	4.241	1.0%	1.0%
19	Male	35_39	no q	-0.656 (2)***	-0.460 (4)**		-0.867 (3)***	0.562	0.468	5.987	1.6%	1.6%
20	Male	40_44	deg	-0.749 (1)***	0.406 (3)*		0.523 (3)**	0.705	0.646	11.973	1.0%	1.2%
21	Male	40_44	4-7	-0.892 (1)***	-0.359 (7)**		1.000 (1)***	0.469	0.309	2.942	1.0%	1.2%
22	Male	40_44	sch	-0.916 (5)***	-0.650 (7)***		-0.924 (4)***	0.724	0.649	9.629	0.9%	1.7%
23	Male	40_44	no q	-0.507 (1)**	-0.855 (4)**		0.382 (4)***	0.503	0.397	4.729	1.6%	0.6%
24	Male	45_49	deg	0.488 (5)***	0.654 (2)*		0.812 (5)***	0.706	0.638	10.402	0.8%	0.4%
25	Male	45_49	4-7	-0.526 (1)***	-0.424 (3)**		-0.909 (3)***	0.618	0.541	8.072	0.6%	0.6%
26	Male	45_49	sch	-0.567 (1)***	1.195 (5)***		-0.995 (5)***	0.667	0.590	8.667	1.0%	1.1%
27	Male	45_49	no q	-0.547 (2)*	-1.027 (2)*		-0.837 (6)***	0.396	0.283	3.504	1.5%	3.7%
28	Male	50_54	deg	0.228 (7)**		-0.743 (7)***	-0.574 (1)*	0.737	0.665	10.251	0.8%	1.3%
29	Male	50_54	4-7	-0.770 (1)**		-0.250 (2)***	-0.894 (3)***	0.702	0.646	12.547	0.6%	0.5%
30	Male	50_54	sch	-0.637 (1)***		-0.424 (4)**	0.659 (1)**	0.411	0.285	3.254	1.4%	2.0%
31	Male	50_54	no q	0.497 (3)***		0.559 (3)*	0.823 (4)***	0.557	0.468	6.283	1.4%	0.7%
32	Male	55_59	deg	-0.613 (1)***		0.659 (4)**	0.240 (7)***	0.532	0.432	5.302	1.8%	1.2%
33	Male	55_59	4-7	-0.590 (3)***	-0.606 (4)*		-0.510 (4)***	0.515	0.411	4.947	1.5%	0.3%
34	Male	55_59	sch	-0.494 (7)*		1.207 (7)**	0.888 (3)***	0.652	0.557	6.869	1.8%	2.5%
35	Male	55_59	no q	-0.565 (4)**	0.557 (1)**		-0.913 (1)***	0.658	0.585	8.997	2.0%	3.4%
36	Male	60_64	deg	-0.358 (6)**		0.658 (5)***	0.283 (4) ***	0.431	0.289	3.305	4.0%	4.9%
37	Male	60_64	4-7	-0.408 (2)*	0.814 (1)***		-0.847 (7)***	0.745	0.697	15.593	4.0%	1.4%
38	Male	60_64	sch	0.807 (6)***		-0.735 (6)**	0.732 (3)*	0.518	0.398	4.299	5.4%	5.3%
39	Male	60_64	no q	0.299 (5)*		0.460 (3)**		0.365	0.274	4.018	4.1%	1.3%
40	Male	65+	deg	-0.471 (1)**		1.049 (7)**	-0.797 (4)***	0.592	0.480	5.315	11.4%	24.6%
41	Male	65+	4-7	0.491 (4)**		0.606 (6)**		0.448	0.363	5.282	8.0%	2.0%
42	Male	65+	sch	0.239 (6)**	-1.119 (6)***		-0.951 (3)***	0.793	0.741	15.312	6.3%	5.8%
43	Male	65+	no q	-0.361 (4)*		0.730 (5)**	0.815 (3)***	0.602	0.510	6.542	10.4%	18.7%

Labour Force Participation Rate (LFPR) Female

Model Type : **A_LFPR = A_LFPR (Gen, Age, Qual)**

Model Specification : $A\_LFPR_t = \alpha_{t-i} * A\_LFPR_{t-i} + \beta_{t-j} * A\_EMP_{t-j} + \gamma_{t-k} * A\_EMP\_F_{t-k} + \delta_l * MA\ (l) + \varepsilon_t$

Significance : * 10% ; ** 5%; *** 1%

Model Type				Estimated Coefficients				Diagnostic Criteria				
	Gen	Age	Qual	α(i)	β(j)	γ(k)	δ(l)	RSQ	Adj RSQ	F	S.E. of Regression	MAPE
1	Female	15_19	4-7	0.590 (3)**	0.270 (3)*		0.421 (5)**	0.389	0.267	3.188	5.4%	1.0%
2	Female	15_19	sch	0.559 (4)*	0.011 (1)**		-0.911 (4)***	0.376	0.243	2.816	3.1%	2.1%
3	Female	15_19	no q	-0.876 (8)**	1.023 (7)*		-0.894 (5)***	0.713	0.627	8.282	4.7%	10.8%
4	Female	20_24	deg	0.524 (3)*	0.733 (4)***		-0.979 (4)***	0.622	0.541	7.686	2.7%	2.3%
5	Female	20_24	4-7	0.581 (3)*		-0.932 (3)**		0.354	0.274	4.393	3.4%	3.6%
6	Female	20_24	sch	-0.756 (1)***	-0.419 (3)*		0.887 (3)***	0.487	0.385	4.751	3.1%	2.4%
7	Female	20_24	no q	-0.554 (2)**		-1.302 (4)*	-0.316 (2)***	0.571	0.479	6.212	6.2%	2.1%
8	Female	25_29	deg	-0.905 (4)*	1.078 (1)**		-0.891 (7)**	0.490	0.381	4.488	2.2%	8.4%
9	Female	25_29	4-7	-0.487 (1)***		0.455 (0)***	-0.932 (2)***	0.711	0.659	13.907	1.9%	5.6%
10	Female	25_29	sch	-0.611 (7)*	-1.071 (3)***		0.704 (4)***	0.533	0.405	4.178	2.7%	8.2%
11	Female	25_29	no q	-0.574 (4)*		-1.006(7)*	0.696 (5)**	0.564	0.446	4.751	5.1%	8.4%
12	Female	30_34	deg	-0.462 (1)*	0.810 (6)*		-0.823 (4)	0.633	0.541	6.890	1.6%	8.9%
13	Female	30_34	4-7	-0.434 (1)*	-0.902 (2)*		-0.815 (6)***	0.606	0.515	6.658	1.9%	5.0%
14	Female	30_34	sch	-0.995 (1)*	1.396 (1)***		-0.429 (4)*	0.744	0.699	16.478	2.1%	1.1%
15	Female	30_34	no q	-0.509 (4)**		0.916 (5)*	-0.953 (3)***	0.530	0.422	4.896	3.4%	3.6%
16	Female	35_39	deg	-0.461 (1)**	1.594 (3)**		-0.845 (3)***	0.463	0.356	4.311	3.4%	4.2%
17	Female	35_39	4-7	-0.946 (4)***	0.913 (1)**		-1.000 (3)***	0.575	0.484	6.313	1.9%	1.7%
18	Female	35_39	sch	0.548 (3)*	-0.681 (2)***		-1.000 (2)***	0.706	0.647	12.021	1.6%	0.7%
19	Female	35_39	no q	-0.382 (6)*		-0.688 (6)*	-0.921 (3)***	0.529	0.411	4.491	4.0%	6.0%
20	Female	40_44	deg	-0.819 (2)***		-0.334 (5)*	-0.992 (4)***	0.720	0.655	11.143	1.7%	1.4%
21	Female	40_44	4-7	-0.537 (2)***		0.750 (5)*	-0.840 (6)***	0.729	0.666	11.652	1.8%	2.8%
22	Female	40_44	sch	-0.313 (2)*	0.670 (4)**		0.884 (3)***	0.514	0.410	4.945	1.6%	0.3%
23	Female	40_44	no q	-1.113 (5)***	2.107 (2)**		1.000 (5)***	0.750	0.692	12.979	2.4%	2.6%
24	Female	45_49	deg	-0.608 (2)***		-0.934 (5)*	0.353 (2)***	0.644	0.562	7.838	2.5%	1.8%
25	Female	45_49	4-7	-0.367 (4)**		-0.430(4)**	-1.000 (1)***	0.601	0.516	7.038	1.3%	1.2%
26	Female	45_49	sch	-0.563 (1)**	-1.088 (5)**		-0.669 (3)***	0.719	0.654	11.063	1.3%	2.0%
27	Female	45_49	no q	0.443 (4)**	-1.391 (2)**		0.895 (7)***	0.735	0.678	12.942	1.3%	2.0%
28	Female	50_54	deg	-0.438 (4)***		-0.453 (4)**	-1.000 (1)***	0.844	0.810	25.178	1.8%	0.8%
29	Female	50_54	4-7	-0.507 (1)***		-0.382 (4)**	-0.859 (5)***	0.623	0.542	7.715	1.4%	0.4%
30	Female	50_54	sch	-0.888 (6)***		0.555 (6)*	-0.955 (1)***	0.643	0.553	7.194	1.6%	2.0%
31	Female	50_54	no q	-0.482 (1)**	1.161 (1)**		0.402 (4)***	0.440	0.342	4.459	2.5%	1.5%
32	Female	55_59	deg	0.250 (7)**	-1.153 (1)*		-0.956 (3)***	0.913	0.890	38.610	3.5%	3.2%
33	Female	55_59	4-7	-0.360 (1)*		0.467 (5)*	-0.908 (4)***	0.553	0.450	5.371	2.9%	2.5%
34	Female	55_59	sch	-0.427 (3)*		-0.850 (5)**	0.663 (5)**	0.666	0.589	8.634	2.9%	5.7%
35	Female	55_59	no q	0.544 (3)**		0.511 (4)**	-0.662 (4)**	0.542	0.444	5.532	2.9%	3.3%
36	Female	60_64	deg	-0.774 (1)***	2.668 (1)***		0.640 (1)***	0.685	0.629	12.304	13.4%	11.3%
37	Female	60_64	4-7	-0.202 (6)**		0.256 (5)*		0.490	0.411	6.234	4.6%	1.2%
38	Female	60_64	sch	-0.544 (3)*	2.062 (3)**		0.867 (6)***	0.716	0.659	12.608	6.2%	2.7%
39	Female	60_64	no q	-0.368 (6)*		0.436 (4)*	0.827 (6)***	0.722	0.652	10.381	4.2%	7.0%
40	Female	65+	deg	-0.359 (4)**		0.875 (5)***	-0.999 (1)*	0.538	0.431	5.040	16.2%	6.2%
41	Female	65+	4-7	-0.338 (6)**	-0.771 (6)*		-1.000 (1)***	0.642	0.553	7.182	13.3%	3.9%
42	Female	65+	sch	-0.412 (6)**	0.768 (6)**		-0.890 (4)***	0.642	0.553	7.186	6.9%	3.7%
43	Female	65+	no q	0.520 (3)***	-1.114 (1)**		-0.095 (2)***	0.527	0.432	5.569	10.7%	2.7%

Working Age Population (WAP) Male

Model Type: **A_WAP = A_WAP (Gen, Age, Qual)**

Model Specification:

$$A\_WAP_t = \alpha_{t-i} * A\_WAP_{t-i} + \beta_{t-j} * A\_PLTAA_{t-j} + \gamma_{t-k} * A\_PLTAO_{t-k} + \theta_{t-l} * A\_PLTDA_{t-l} + \rho_{t-m} * A\_PLTDO_{t-m} + \delta_n * MA\ (n) + \varepsilon_t$$

Significance : * 10% ; ** 5%; *** 1%

Model Type				Estimated Coefficients						Diagnostic Criteria				
	Gen	Age	Qual	α(i)	β(j)	γ(k)	θ(l)	ρ(m)	δ(n)	RSQ	Adj RSQ	F	S.E. of Regression	MAPE
1	Male	15_19	4-7	-0.479 (1) **		0.764 (4)**			-0.835 (7)***	0.705	0.632	9.578	10.6%	29.3%
2	Male	15_19	sch	-0.369 (2)*			0.056 (4)**		0.798 (2)***	0.474	0.343	3.607	1.6%	1.4%
3	Male	15_19	no q	-1.169 (7)**		-0.128 (7)***			0.815 (3)***	0.800	0.733	11.970	1.6%	8.6%
4	Male	20_24	deg	-0.951 (1)***		0.457 (6)**			-0.928 (4)***	0.655	0.552	6.329	6.5%	1.9%
5	Male	20_24	4-7	0.412 (3)**	0.533 (6)**			1.035 (7)***		0.713	0.617	7.457	3.8%	6.3%
6	Male	20_24	sch	0.452 (1)*		-0.237 (5)**			0.878 (5)***	0.667	0.576	7.338	3.3%	12.6%
7	Male	20_24	no q	-0.715 (6)**				-0.981 (4)**	0.775 (5)**	0.602	0.483	5.046	6.0%	22.1%
8	Male	25_29	deg	-0.761 (1)***	0.447 (6)*				1.000 (1)***	0.479	0.323	3.068	5.1%	2.5%
9	Male	25_29	4-7	0.304 (1)*				-0.553 (2)***	-1.000 (1)***	0.580	0.489	6.432	5.2%	2.4%
10	Male	25_29	sch	0.482 (1)* & 0.695 (2)**	0.496 (7)**				-1.000 (1)*	0.678	0.517	4.215	5.3%	18.1%
11	Male	25_29	no q	0.596 (1)***	0.572 (3)***				-1.000 (1)***	0.434	0.303	3.320	9.2%	12.1%
12	Male	30_34	deg	0.455 (4)**		0.433(2)**			-0.985 (4)***	0.552	0.440	4.928	6.1%	1.0%
13	Male	30_34	4-7	-1.075 (1)***				-0.447 (4)**	1.000 (1)***	0.409	0.262	2.773	3.8%	1.8%
14	Male	30_34	sch	-0.516 (1)*			0.222 (7)***		0.813 (3)***	0.528	0.370	3.350	5.2%	4.5%
15	Male	30_34	no q	-0.677 (4) ***				0.614 (2)***	-0.881 (7)***	0.675	0.594	8.324	4.1%	14.9%
16	Male	35_39	deg	-0.367 (5)*				0.391 (6)**	-1.000 (3)***	0.745	0.668	9.725	3.3%	9.4%
17	Male	35_39	4-7	0.680 (3)***	-0.786 (7)***	-0.243 (4)**			0.960 (1)***	0.868	0.801	13.095	2.6%	2.4%
18	Male	35_39	sch	-0.343 (4)***	0.270 (6)***				0.930 (1)***	0.520	0.376	3.608	4.5%	6.9%
19	Male	35_39	no q	-0.502 (2)** & 0.598 (3) ***		0.295 (6)***			0.947 (1)***	0.799	0.710	8.963	3.3%	2.6%
20	Male	40_44	deg	0.404 (3)*		0.418 (2)***			-0.831 (3)***	0.638	0.554	7.627	4.5%	19.8%
21	Male	40_44	4-7	0.477 (2)**	-0.338 (6)**				-1.000 (1)***	0.623	0.509	5.499	3.8%	2.0%
22	Male	40_44	sch	-0.641 (7)**	-0.629 (3)**				-1.000 (1)***	0.581	0.441	4.160	5.4%	8.0%
23	Male	40_44	no q	-0.599 (6)***			-0.189 (3)***		-0.969 (1)***	0.578	0.452	4.569	3.4%	6.6%
24	Male	45_49	deg	0.553 (5)**			-0.300 (3)**			0.417	0.320	4.289	6.8%	9.4%
25	Male	45_49	4-7	0.678 (2)**	-0.406 (6)***				-0.923 (1)***	0.486	0.332	3.151	4.2%	5.8%
26	Male	45_49	sch	-0.693 (4)***				0.842 (3)***	0.581 (2)***	0.600	0.500	6.003	5.5%	6.9%
27	Male	45_49	no q	-0.890 (7)***	-0.336 (2)*				0.782 (3)***	0.823	0.765	13.996	2.7%	5.8%
28	Male	50_54	deg	0.757 (3)***		0.212 (2)** & 0.375 (7)***			-0.963 (1)***	0.861	0.791	12.381	4.2%	3.2%
29	Male	50_54	4-7	0.412 (4)*		-0.267 (7)***			-0.974 (1)***	0.822	0.763	13.901	2.8%	1.1%
30	Male	50_54	sch	0.310 (3)*				0.923 (3)***	0.447 (2)***	0.534	0.426	4.959	6.5%	8.3%
31	Male	50_54	no q	-0.785 (5)***	0.264 (3)**				-0.940 (1)***	0.689	0.604	8.107	3.6%	4.1%
32	Male	55_59	deg	-0.290 (6)***				0.591 (2)*	0.900 (1)***	0.632	0.522	5.725	5.7%	2.4%
33	Male	55_59	4-7	-0.539 (7)*	0.555 (2)**				0.436 (4)***	0.560	0.413	3.814	5.8%	9.8%
34	Male	55_59	sch	-0.362 (6)**	0.385 (7)***				-1.000 (1)***	0.721	0.629	7.771	6.0%	7.2%
35	Male	55_59	no q	-0.415 (2)***	-0.711 (7)***				-1.000 (1)***	0.790	0.720	11.310	4.0%	4.7%
36	Male	60_64	deg	0.572 (7)**		0.540 (6)*		1.019 (7)*		0.551	0.401	3.683	9.7%	10.7%
37	Male	60_64	4-7	0.844 (5)***			-0.381 (2)***		-0.926 (3)***	0.739	0.668	10.375	4.0%	7.3%
38	Male	60_64	sch	0.527 (1)**		-0.287 (2)**			-1.000 (1)***	0.542	0.444	5.525	7.0%	11.0%
39	Male	60_64	no q	-0.783 (5)***		0.161 (4)***			0.897 (3)***	0.739	0.668	10.381	3.7%	3.3%
40	Male	65+	deg	-0.344 (6)***		0.514 (4)**			-1.000 (1)***	0.647	0.541	6.107	8.0%	1.2%
41	Male	65+	4-7	-0.448 (7)***	1.080 (2)***		-0.319 (4)***		-1.000 (1)***	0.859	0.789	12.235	4.3%	24.1%
42	Male	65+	sch	-0.915 (7)***			0.334 (4)**		-0.806 (4)***	0.819	0.759	13.615	4.3%	26.7%
43	Male	65+	no q	-0.387 (7)***			0.156 (2)***		0.885 (3)***	0.871	0.828	20.215	1.8%	7.7%

Working Age Population (WAP) Female

Model Type: **A_WAP = A_WAP (Gen, Age, Qual)**

Model Specification:

$$A\_WAP_t = \alpha_{t-i}*A\_WAP_{t-i} + \beta_{t-j}*A\_PLTAA_{t-j} + \gamma_{t-k}*A\_PLTAO_{t-k} + \theta_{t-l}*A\_PLTDA_{t-l} + \rho_{t-m}*A\_PLTDO_{t-m} + \delta_n*MA\ (n) + \varepsilon_t$$

Significance : * 10% ; ** 5%; *** 1%

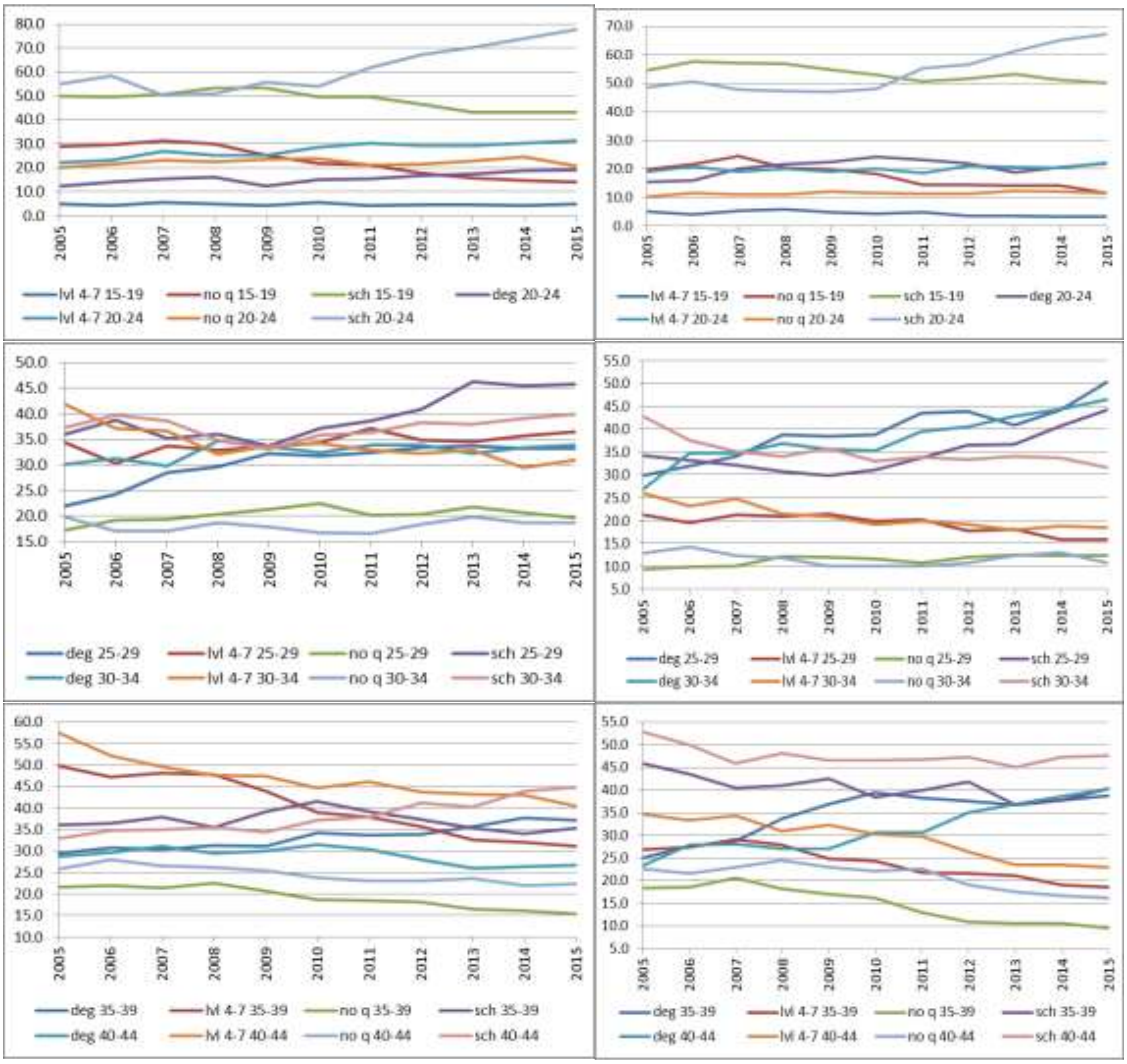
	Model Type			Estimated Coefficients						Diagnostic Criteria				
											Adj		S.E. of	
	Gen	Age	Qual	α(i)	β(j)	γ(k)	θ(l)	ρ(m)	δ(n)	RSQ	RSQ	F	Regression	MAPE
1	Female	15_19	4-7	-0.510 (5) ***		-0.838 (4)*			0.921 (1)***	0.536	0.409	4.234	14.1%	12.1%
2	Female	15_19	sch	0.514 (3)*	-0.130 (5)*				-0.896(1)***	0.573	0.456	4.911	1.7%	2.6%
3	Female	15_19	no q	-0.503 (1)**				0.430 (2)**	0.890(1)***	0.392	0.262	3.009	4.2%	12.1%
4	Female	20_24	deg	-0.497 (1)***		0.585 (2)**			-0.553 (4)***	0.441	0.322	3.688	9.0%	6.2%
5	Female	20_24	4-7	-0.359 (5)**	0.729 (3)***				-0.928 (1)***	0.544	0.420	4.375	7.4%	9.1%
6	Female	20_24	sch	0.586 (2)**				0.529 (6)**	0.865 (3)***	0.601	0.482	5.025	4.2%	9.7%
7	Female	20_24	no q	0.439 (2)***		0.268 (4)***			-0.927 (1)***	0.712	0.640	9.875	5.1%	6.6%
8	Female	25_29	deg	0.675 (2)***		0.288 (2)*			0.768 (3)***	0.619	0.538	7.589	5.1%	5.1%
9	Female	25_29	4-7	-0.425 (4)**	0.648 (4)***				-0.928 (1)***	0.702	0.628	9.425	6.4%	3.1%
10	Female	25_29	sch	-0.845 (7)***				0.494 (6)*		0.527	0.433	5.580	4.8%	3.3%
11	Female	25_29	no q	0.683 (3)**	0.862 (4)***				0.631 (4)***	0.609	0.512	6.242	6.6%	27.8%
12	Female	30_34	deg	0.677 (1)***		0.315(2)***	0.196 (6)**		-0.999 (1)***	0.667	0.518	4.497	6.5%	4.4%
13	Female	30_34	4-7	0.667 (2)***				-0.510 (3)*	0.936 (3)***	0.410	0.274	3.011	6.4%	3.2%
14	Female	30_34	sch	0.682 (1)**			-0.164 (6)*		0.211 (2)***	0.543	0.405	3.954	4.1%	1.2%
15	Female	30_34	no q	-0.898 (1) ***			-0.334 (4)***		1.000 (1)**	0.467	0.334	3.505	6.4%	17.5%
16	Female	35_39	deg	0.622 (2)*		0.611 (3)***			-0.920 (1)***	0.517	0.405	4.637	7.8%	16.9%
17	Female	35_39	4-7	-0.608 (7)*	0.473 (3)**					0.434	0.321	3.831	5.1%	8.7%
18	Female	35_39	sch	0.425 (3)*			0.195 (4)**		0.254 (2)***	0.532	0.415	4.551	3.9%	2.0%
19	Female	35_39	no q	-0.787 (6) **			-0.240 (4)**		0.469 (2)***	0.647	0.541	6.097	4.8%	14.3%
20	Female	40_44	deg	0.349 (4)**	0.766 (3)**				-1.000 (3)***	0.525	0.406	4.423	6.0%	12.5%
21	Female	40_44	4-7	0.383 (5)**			0.113 (4)**		0.671 (2)***	0.589	0.477	5.264	3.9%	2.3%
22	Female	40_44	sch	0.653 (2)**		-0.154 (4)**	0.150 (4)**			0.713	0.641	9.947	2.6%	1.2%
23	Female	40_44	no q	0.359 (3)*		0.156 (4)**			-0.918 (1)***	0.531	0.414	4.536	3.9%	7.6%
24	Female	45_49	deg	-0.613 (2)***	-0.940 (2)***				0.180 (2)***	0.429	0.307	3.506	9.1%	4.6%
25	Female	45_49	4-7	-1.029 (7)***	-0.389 (5)**			0.519 (4)*	1.000 (1)***	0.791	0.687	7.589	4.7%	2.7%
26	Female	45_49	sch	0.660 (1)***		-0.205 (3)***			-0.954 (1)***	0.584	0.488	6.078	3.6%	5.3%
27	Female	45_49	no q	0.609 (1)***		-0.221 (5)***	-0.225 (3)***			0.783	0.724	13.265	3.5%	13.3%
28	Female	50_54	deg	-0.605 (1)***	-0.984 (6)**				0.518 (6)***	0.711	0.625	8.214	6.1%	7.7%
29	Female	50_54	4-7	0.466 (4)*				-0.415 (3)*	0.643 (2)***	0.484	0.355	3.757	5.6%	0.2%
30	Female	50_54	sch	-0.346 (6)**	-0.407 (4)**				-0.903 (2)***	0.644	0.537	6.035	3.8%	7.4%
31	Female	50_54	no q	-0.515 (3)**				0.371 (2)**	-0.385 (2)***	0.501	0.386	4.347	3.1%	4.3%
32	Female	55_59	deg	-0.589 (5)***	1.985 (6)***			2.966 (7)***	-0.968 (1)***	0.932	0.898	27.403	5.2%	4.6%
33	Female	55_59	4-7	0.394 (2)*	0.741 (2)***					0.427	0.351	5.588	6.3%	15.5%
34	Female	55_59	sch	-0.646 (1)**			0.281 (5)*		-0.808 (6)**	0.700	0.618	8.554	5.5%	0.3%
35	Female	55_59	no q	-0.550 (6)**			-0.222 (4)**		0.267 (2)***	0.597	0.476	4.931	4.3%	1.2%
36	Female	60_64	deg	-0.515 (1)**		-1.528 (2)*			-0.421 (2)***	0.424	0.301	3.440	18.6%	2.7%
37	Female	60_64	4-7	-1.008 (1)***			-0.255 (3)**		0.891 (3)**	0.633	0.549	7.482	6.5%	1.0%
38	Female	60_64	sch	-0.679 (4)**	-0.551 (5)*				-0.823 (2)***	0.572	0.456	4.906	7.1%	14.3%
39	Female	60_64	no q	-0.798 (6)**				0.458 (2)*	0.410 (4)***	0.497	0.346	3.290	5.2%	15.8%
40	Female	65+	deg	0.414 (4)*				1.162 (3)**		0.439	0.353	5.096	13.0%	5.3%
41	Female	65+	4-7	0.689 (1)***				0.722 (7)**	-1.000 (1)**	0.645	0.527	5.455	6.3%	9.8%
42	Female	65+	sch	0.424 (1)**	-0.309 (3)**				0.510 (4)***	0.510	0.397	4.515	4.4%	10.7%
43	Female	65+	no q	-0.749 (6)***	0.117 (2)*				-0.996 (1)**	0.835	0.786	16.884	1.3%	1.2%

APPENDIX B: LABOUR SUPPLY

Labour supply (thousands) by age, gender and qualification

HLFS data, MBIE forecasts from 2013
Abbreviations: deg (degree), lvl 4-7 (level 4 to level 7), sch (school & level 1-3), no q (no qualification), age groups as shown (15-19 to 40-44)

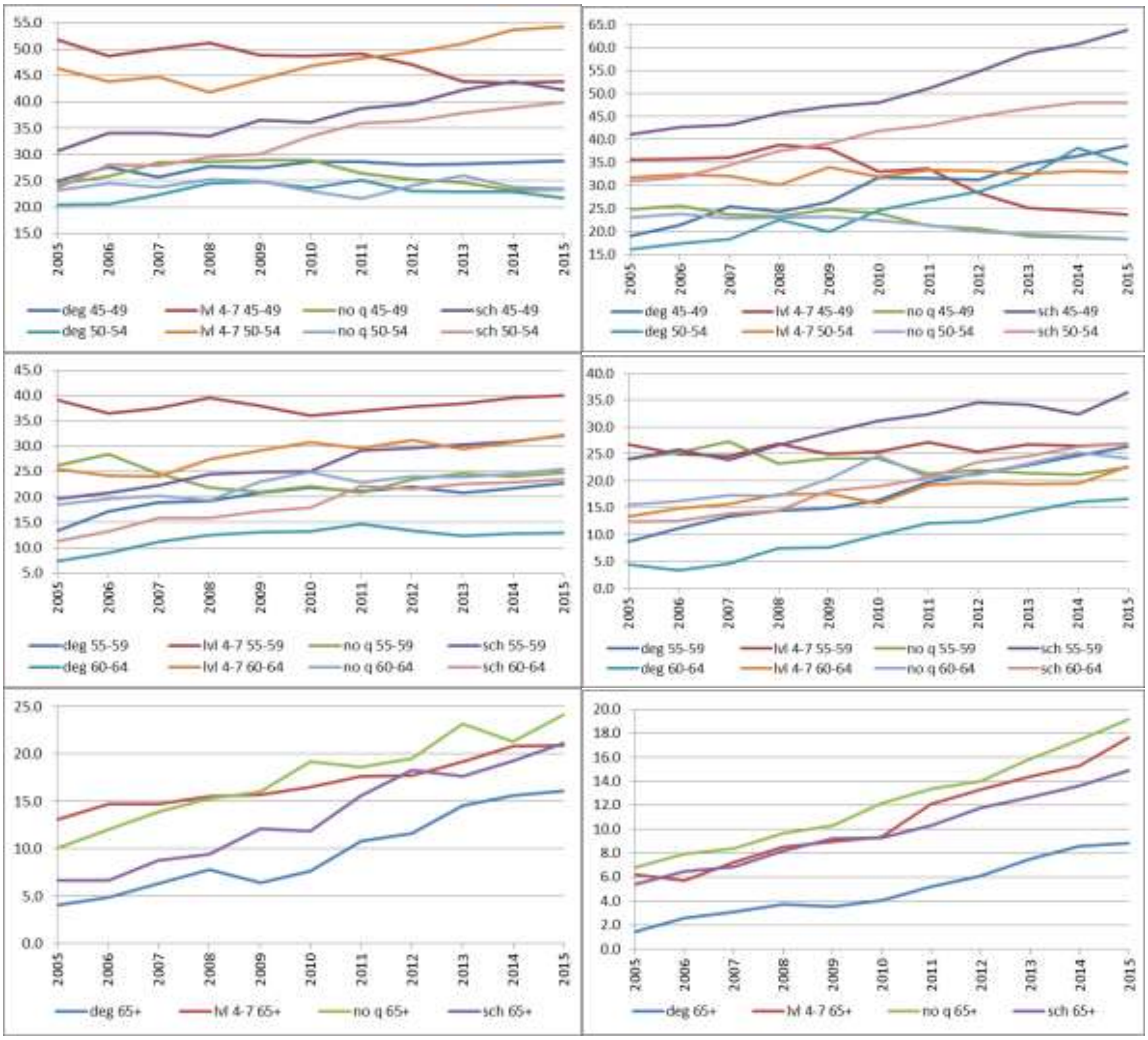
Male Female



Labour supply (thousands) by age, gender and qualification

HLFS data, MBIE forecasts from 2013
Abbreviations: deg (degree), lvl 4-7 (level 4 to level 7), sch (school & level 1-3), no q (no qualification), age groups as shown (45-49 to 65+)

Male | Female

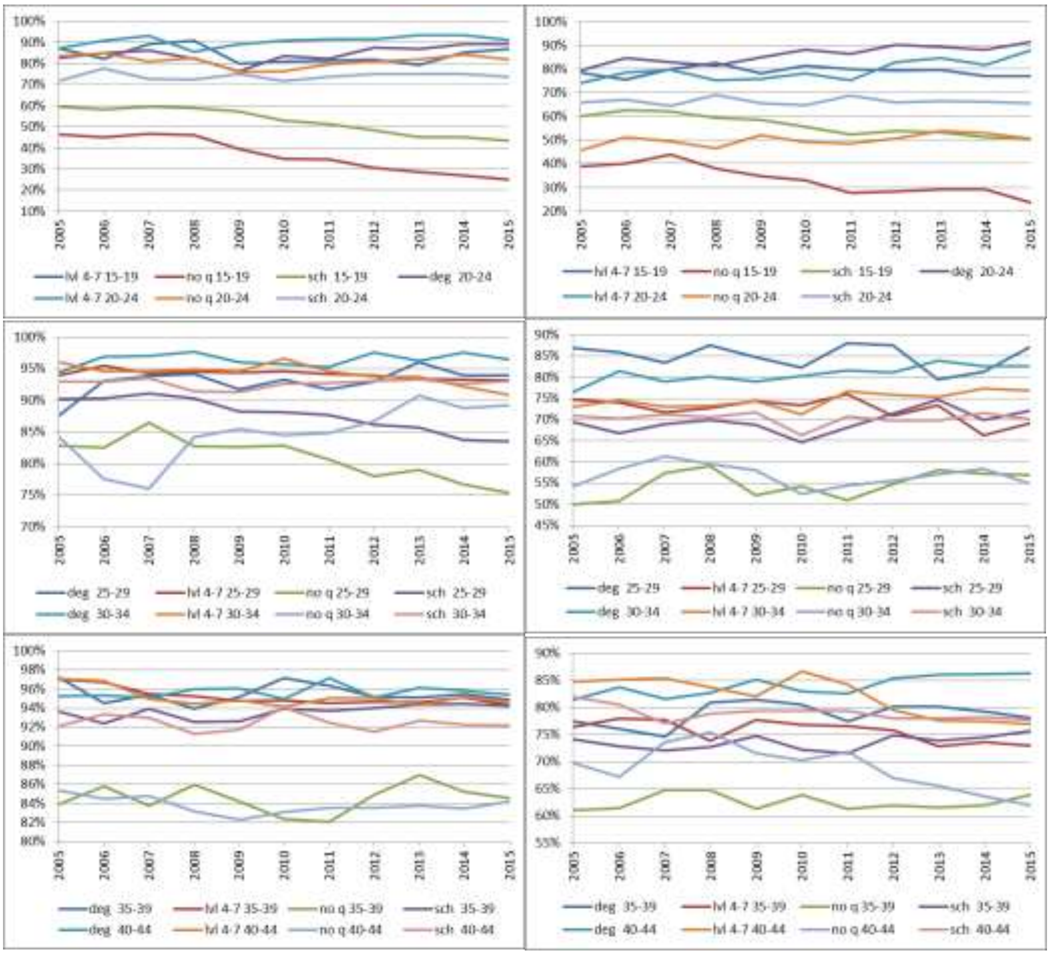


APPENDIX C: LABOUR FORCE PARTICIPATION RATES

Labour force participation rate by age, gender and qualification

HLFS data, MBIE forecasts from 2013
Abbreviations: deg (degree), lvl 4-7 (level 4 to level 7), sch (school & level 1-3), no q (no qualification), age groups as shown (15-19 to 40-44)

Male Female

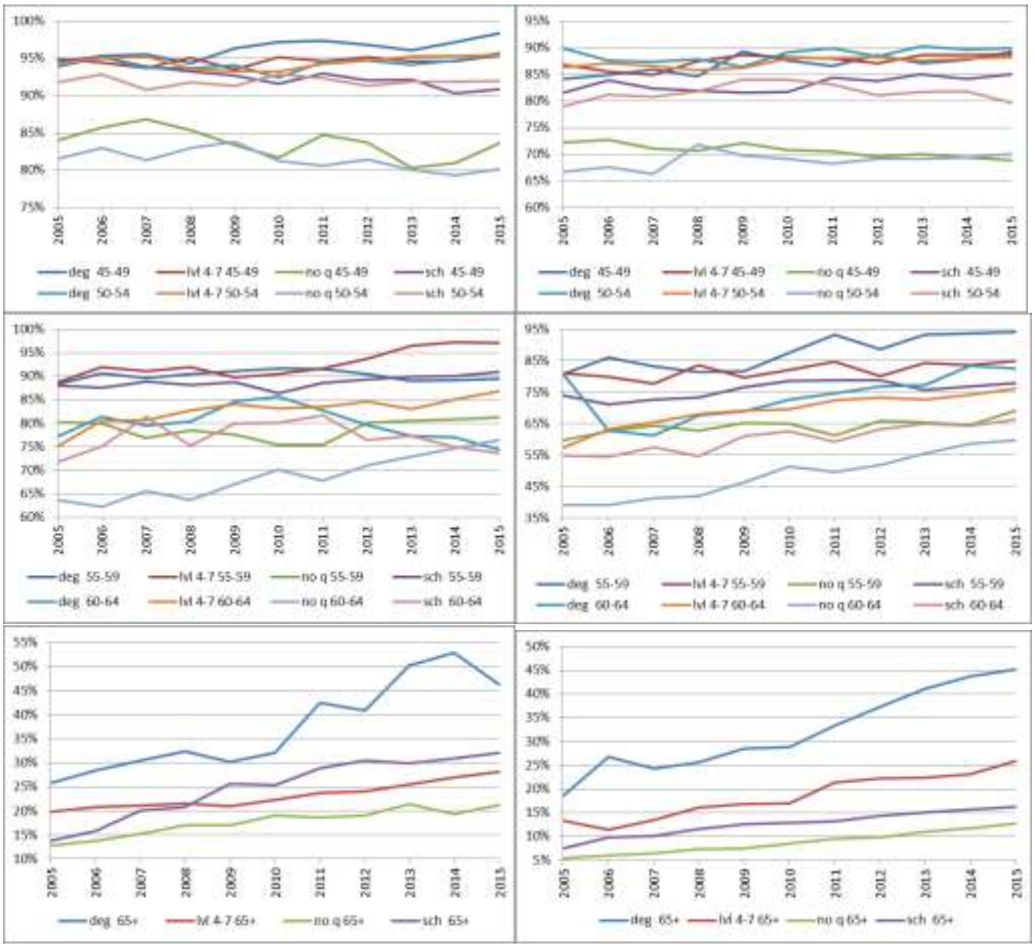


Labour force participation rate by age, gender and qualification

HLFS data, MBIE forecasts from 2013
Abbreviations: deg (degree), lvl 4-7 (level 4 to level 7), sch (school & level 1-3); no q (no qualification), age groups as shown (45-49 to 65+)

Male

Female

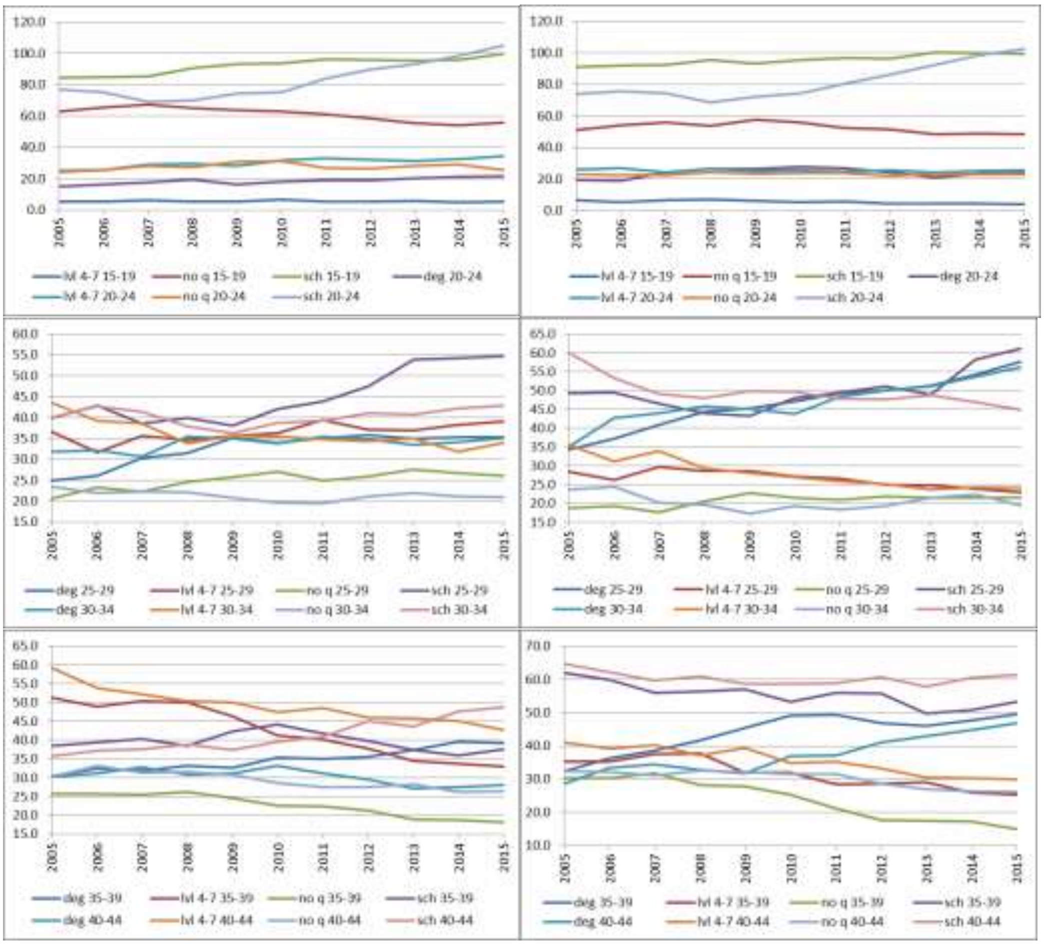


APPENDIX D: WORKING AGE POPULATION

Working age population (thousands) by age, gender and qualification

HLFS data, MBIE forecasts from 2013
Abbreviations: deg (degree); lvl 4-7 (level 4 to level 7); sch (school & level 1-3); no q (no qualification); age groups as shown (15-19 to 40-44)

Male Female



Working age population (thousands) by age, gender and qualification

HLFS data, MBIE forecasts from 2013
Abbreviations: deg (degree), lvl 4-7 (level 4 to level 7), sch (school & level 1-3), no q (no qualification), age groups as shown (45-49 to 65+)

Male | Female