Immigration and the supply of complex problem solvers in the Australian economy

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Abstract
In all advanced countries, the number of older workers is increasing while the number of younger workers is falling (or growing slowly). If labour shortages provide a stimulus to technological development and to higher productivity resulting from increases in capital per worker, this may not be a problem. However, this argument is contingent upon the assumption that older workers are substitutes for young workers. We argue that, in jobs that require the most sophisticated technological skills, older workers are not substitutes for young workers. We identify a segment of the labour force that we describe as complex problem solvers (CPS). Both the psychological literature and the economic literature show that complex problem solving skills deteriorate rapidly after age 40 and, consistent with this, in Australia, 80 per cent of CPS are aged less than 40. Using Australian data, we show that migration is a highly effective way of increasing the supply of CPS workers when the migration program is selective of those with high skills.

Background
Population ageing is a key policy issue of the 21st century, however, most of the focus of research on population ageing has been upon the health costs of older people and upon their income needs and the ways in which these costs can be met. As the key issue is the relative age of the population rather than the number of older people, policy has also addressed ways in which the labour supply can be increased so that the ratio of dependent older people to the working population can be kept as low as possible. In the longer term, this can be achieved though increases in fertility but in the shorter term, the two means available are increases in immigration and in labour force participation rates. McDonald and Kippen (2001) have shown that there is considerable scope in many countries to increase labour force participation. However, the main opportunities lie in increasing the participation rates of middle-aged women and older men. Family-friendly workplace policies and reversal of the trend towards early retirement can achieve these ends. Some countries, such as Australia, are now aggressively pursuing policies that will increase participation.

The efficacy of the approach of increasing participation is contingent upon the scope for increase, that is, upon how low participation rates are at present. However, it is also contingent upon the assumption that an older worker induced not to retire early is a substitute for a younger worker. Because the relative fall in labour supply stems from falls in fertility, falls in labour supply in the future are very heavily concentrated at the young end of the labour market (under 40 years). McDonald and Kippen (2001)

have estimated that, over the next 50 years, Japan's labour supply would fall by 20 million and Italy and Germany's by 11 million if their demography and labour force participation rates of the late 1990s were to continue unchanged. Almost all of the projected fall in labour supply is among younger workers. If younger workers and older workers are not substitutes for each other, then a labour supply problem may remain even though participation rates at older ages increase. At the very least, there will be an adjustment problem. Because fertility has been higher in the past, especially during the baby-boom period, most advanced economies are conditioned to an ever-growing supply of young workers. If there is a sudden fall in the availability of new young workers, as will be the case in the absence of large-scale immigration in most advanced countries in the immediate future, the economic adjustment required could be considerable.

Replacement of younger workers by older workers implies that employers are able to overcome their preferences for younger workers in many jobs. It also implies that older workers induced not to retire are or can be skilled to the level of the missing younger workers. Lifelong learning is promoted as a means of achieving this end but can it provide a substitute for young skilled workers?

Some argue that aging is not a problem because labour shortages will provide a stimulus to technological development and to higher productivity resulting from increases in capital per worker (Kosai et al. 1998; Dowrick 2002). The logic of this argument is compelling but it implies that there are sufficient adequately skilled workers to develop and implement the new technologies. If this is not the case, because technology is readily transportable, capital may flow to economies that have an ample supply of skilled workers. Emerging economies today have an abundant supply of highly skilled young workers available at lower wages than apply in the older advanced countries. The key to economic competitiveness in the future, as many writers have argued, will rest upon a country's capacity to produce and maintain highly skilled workers.

Carlsson (2003) has made the observation that 80 per cent of technology becomes obsolete within ten years while 80 per cent of the work force gained its qualifications more than 10 years ago. Young, recently trained workers have been the conventional means by which economies have met their demand for workers skilled in the latest high technology. If lifelong learning cannot raise older workers to the technological standard of recent young graduates, and we argue that this is indeed the case in highly specialised occupations, economies must look to ways to increase the numbers of young highly skilled workers. Relying on the market is inadequate because of response delays. If there is an absolute shortage of workers of this type, the price of these workers in the market will increase without generating additional supply for many years. If the price of domestic highly skilled workers is very high, capital may move offshore to places where the price of labour is lower. Persons with the required skills are long in the making. An increase in the supply of young highly skilled workers cannot be achieved by increasing the birth rate 25 years ago or by increasing the number of graduates in specialised fields five years ago. Long range planning is required including increased investment in the education of young people or increased population at the young ages. Immigration offers a shorter-term response but implies appropriate immigration policies.

Because the market for young, highly skilled workers is a global market, migration is highly relevant in the supply of such workers. Young Australians can command high wages in economies where workers of this type are in short supply. Indeed, the levels of emigration of Australian residents have increased substantially over the past decade and young people in professional or associate professional occupations have constituted a large component of these departures. Birrell et al. (2004) suggest that these trends have generated 'brain drain' hysteria in Australia. However, they conclude on the basis of a detailed analysis of movements into and out of Australia that, on balance, Australia gains more than it loses through the international movement of skilled people. A study by Osbourne (2004) has indicated that of those Australian residents who stated that they were leaving Australia permanently, 25 per cent had returned to Australia permanently within five years. Of course, more may return beyond five years. On the other hand, the return rate was lower for those in professional occupations (18 per cent). This implies that the loss of young professionals may indeed be an issue for Australia if those leaving Australia are the very best that Australia has to offer. There are no data to measure 'the very best' but it is possible to examine detailed occupation data of movers. Birrell et al. (2004) have estimated that about three-quarters of Australian professionals who leave Australia on a permanent or long-term basis return to Australia within a two-year period. Of those who went to the United Kingdom, about 85 per cent returned. Overall, Birrell et al take a sanguine approach to out-migration of Australian professionals. They see it mainly as a means by which young Australians can gain overseas experience and connections that will enhance their human capital when they return to Australia. The Senate Legal and Constitutional Committee's report on Australian expatriates (Commonwealth of Australia 2005) took a similar attitude and made recommendations about how Australians overseas might be encouraged to remain attached to Australia. Nevertheless, the question remains about the net flow of the 'the very best'. In this study, we examine the impacts of migration flows on the supply of high technology skills in Australia.

In summary, we argue in this paper that a sharp fall in the supply of young highly skilled workers puts a country's international competitiveness at considerable risk. Hatton and Williamson (1998) attributed successful economic growth in the New World countries in the 19th century to the dynamism and youthfulness of their labour forces. The Japanese economy has been described as having a 'demographic malaise' because of the projected fall in the supply of young workers. We argue that as economies become more heavily dependent upon new technology, the association between dynamism and the age of the labour force increases. The argument can be made that, in each wave of technology, it is young workers who assimilate new technology playing a role that is complementary to older workers.

Age and productivity

There is evidence for the significance of young skilled workers in the cognitive psychology literature (Hunt 1995, Douchemane and Fontaine 2003). This literature identifies two types of intelligence:

> Fluid intelligence: the ability to develop new techniques for the solution of problems that are complex and unusual.

> Crystallized intelligence: the ability to bring previously acquired problem-solving methods to bear on a current problem.

Testing has shown that fluid intelligence is highly associated with age with decline setting in rapidly from age 40 onwards. Complexity is said to be the underlying characteristic that determines the relationship with age. It is no accident that Nobel Prize winners in Physics, Chemistry, Medicine and Economics were almost all under the age of 40 when they did the work for which they received their prize (Jones 2005). Many were graduate students. On the other hand, crystallized intelligence falls only slowly with age.

In the economic-demographic literature, Skirbekk (2003) has recently shown a strong association of productivity with age. Rejecting the wage rate as a reliable measure of productivity, he uses supervisors' ratings, work-sample tests, analyses of employer-employee datasets and other approaches to estimate how individual productivity varies by age. He emphasises cognitive ability in his approach. He concludes:

> Productivity reductions at older ages are particularly strong for work tasks where problem solving, learning and speed are needed, while in jobs where experience and verbal abilities are important, older individuals maintain a relatively high productivity level (Skirbekk 2003: 2).

These findings correspond neatly with the findings of the cognitive psychology literature. Based on this literature, we postulate that productivity will be at its highest through the combination of young workers applying fluid intelligence with older workers applying crystallized intelligence. Both are important but one is much less efficient without the other. In today's demography, the deficit group is likely to be the former, that is, young people with high fluid intelligence

The arguments that we make in this paper have some similarity with grander conceptions of the skilled labour force devised by others. For example, Robert Reich (1992) identified the future dependency of economies on large numbers of 'symbolic analysts', who, in the main, are highly trained young people. The same argument has been popularised by Richard Florida (2002, 2005a, 2005b). Florida refers to the 'creative class' and the importance of their rise to prominence. The creative class makes up about 30 per cent of the US labour force and consists of two groups: the super-creative core (computer and mathematical occupations, architecture and engineering occupations, life, physical and social science occupations, education, training and library occupations, arts, design, entertainment, sports and media occupations) and creative professionals (management occupations, business and financial operations, legal occupations, healthcare practitioners and technical occupations and high-end sales and sale management). Florida's creative class bears a strong resemblance to Reich's symbolic analysts.

Complex problem solvers

In this paper, we focus attention upon skilled workers who are at the forefront of complex problem solving. Our emphasis deviates from that of Florida who is concerned with deriving indexes that can be applied to places. He attempts to identify dynamic cities and regions. This justifies the inclusion in his classification of high-paid, service workers (medical and legal workers) and those employed in

entertainment and the arts. Working at the national level, we are more concerned with those who directly contribute to substantial increases in a nation's economic productivity, the 'complex problem-solvers'. We do not wish to refer to this group as a 'class' because it is their integration into the rest of the labour force that is important, not their separateness. Also, although many may be relatively highly paid for their age, the continued association of wage with experience means that they will not necessarily be the highest paid workers in the labour force (Skirbekk 2003). However, we can postulate that they will be working with the highest paid workers in the economy, that is, in the same firms and industries. Thus, we refer to them simply as complex problem solvers (CPS). We define them using a demand variable based on the detailed occupation classification of employed workers. However, we examine their supply through the variables of age, sex, qualification and recency of qualification.

Data and Method

Our definition of complex problem solvers is based upon fine level data on occupations. In an earlier version of this paper (McDonald and Temple 2005), we used the six-digit Australian Standard Classification of Occupations (ASCO) to identify occupations that we considered required complex problem solving skills. In this paper, because only a four-digit ASCO code was available for statistics of movements into and out of Australia, we have revised our definition of CPS to a four-digit classification of occupations. The occupations defined as CPS are shown in Appendix Table 1. For the purposes of description, these occupations have been combined into five major divisions: medical scientists, scientists (other than medical scientists), engineers (construction and non-construction), information technology and business information technology, and selected marketing and business professionals.

The base population of complex problem solvers was obtained from a detailed cross tabulation showing age, sex, qualification, recency of qualification and ASCO code from the 2001 Australian Census of Population and Housing. The census population was adjusted on a pro rata basis so that the total population by age and sex agreed with the 2001 Estimated Resident Population published by the Australian Bureau of Statistics. The Department of Immigration and Multicultural Affairs (DIMA) provided another detailed table showing age, sex, ASCO code, citizenship and movement type for all permanent and long-term arrivals and departures to and from Australia in the financial year, 2004-05. The movement data do not include information on qualifications or recency of qualifications so it was not possible to obtain estimates of the number of CPS in the migration movements that were equivalent to those available for the base population. However, we are able to apply a procedure using parameters derived from the census to estimate the number of CPS in the migration movement.

Informed by our conceptual model and working with the 2001 Census, we define the following:

EQR_{ijk}	the employed with recent (<10 years) appropriate skills, of sex i, age j and qualification k;
a_{ijk}	the population with recent appropriate qualifications, employed;

b_{ijk} the population with recent appropriate qualifications;

c_{ijk} the population with appropriate qualifications;

P_{ij}^{C} the population estimate from the census.

P_{ij}^{E} the population estimate from the Estimated Resident Population data.

For the full labour force population, the total population of those employed with recent qualifications is given by:

$$\sum_{i=1}^{2}\sum_{j=20-24}^{70-75}\sum_{k=1}^{9} EQR_{ijk} \qquad [1]$$

Decomposing the terms we can write, for each i, j and k:

$$EQR_{ijk} = \left[\left(\alpha_{ijk}.\beta_{ijk}.\gamma_{ijk}\right)\right]\times \mathrm{P}_{ij}^{E} \qquad [2]$$

given:

$$\alpha_{ijk} = \frac{a_{ijk}}{b_{ijk}}$$

$$\beta_{ijk} = \frac{b_{ijk}}{c_{ijk}}$$

$$\gamma_{ijk} = \frac{c_{ijk}}{\mathrm{P}_{ijk}^{C}}$$

Equation [2] presents the supply of the qualified population, which is modelled as a function of α, β and γ. The supply of the qualified population is distributed into those employed in CPS occupations by:

$$\left[\left(\alpha_{ijk}.\beta_{ijk}.\gamma_{ijk}\right)\right]\times \mathrm{P}_{ij}^{E}\left|\mathrm{K}\right| \qquad [3]$$

Where K is a column vector of probabilities that measure the distribution of the employed and qualified population into the occupation categories. A summary measure of K, δ is included in the discussion section. This summary measure is the ratio of CPS to EQR for each age, sex and qualification category.

At this point, the projection that treats alpha, beta and gamma as exogenous is straight forward, as defined by Equation [4]

$$\left[\lambda_{ij}\left(\alpha_{ijk}.\beta_{ijk}.\gamma_{ijk}\right)\right]\times \mathrm{P}_{i,j+1}\times \mathrm{K} \qquad [4]$$

Given:

$P(i,j+1,y+1) = [P(i,j,y)][s(i,j,y)][1+m(i,j,y)]$, $j \geq 0$,

$$P(i,0,y+1)$$
$$= \frac{SR(i)}{2}\left\{\sum_{j=15}^{49}\left[b(j,y)P(f,j,y)\right]+\sum_{j=15}^{49}\left[b(j,y+1)A(f,j,y+1)\right]\right\}[s(i,birth,y)][m(i,birth,y)]$$

where:
$A(i,j,y)$ is the population of sex i aged j in year y,
$A(f,j,y)$ is the female population aged j in year y,
$b(j,y)$ is the fertility rate at age j in year y,
$m(i,j,y)$ is the migration ratio for sex i; that is, the factor by which a cohort changes through migration in its transition from age j in year y to age j+1 in year y+1,
$s(i,j,y)$ is the mortality survival ratio for sex g; that is, the probability that a person aged j in year y will survive to age j+1 in year y+1, and
$SR(i)$ is the proportion of births that are of sex i.

At this stage, the underlying demography b(j, y), m(i, j, y) and s(i, j, y) and other supply side variables, α, β and γ can be altered to simulate changes to those qualified and employed in each occupation. For the purposed of the current exercise, α, β and γ are estimated using DIMA departures and arrivals data and full count census data for immigrants and the Australian born respectively. The projected number of EQR and CPS are estimated given variations in migration, as well as variations in the underlying composition of the immigrant and Australian workers. As the purpose of this paper is to demonstrate the potential effects of different levels of net migration, we use just one fertility assumption, that is, that the total fertility rate remains constant throughout the period at 1.8 births per woman. Given the very low level of labour force participation in advanced old age (>75), we consider one mortality assumption.

Three demographic models are estimated to simulate the effect of the underlying demography on the numbers in the CPS and EQR categories. In Model 1, the zero migration scenario, Annual Net Migration (ANM) is held at zero throughout the projection period. Model 2, the continuation scenario, holds ANM constant throughout the projection period at 110,000 persons per annum. Finally, Model 3, the high migration scenario, increases ANM from 110,000 per annum to 190,000 per anum between 2001 and 2051. The level, 190,000, is roughly the level of migration to Canada today. Using this level, Australia's rate of migration in 2051 would be similar to that of Canada today.

Complex problem solvers in Australia in 2001; the base population

We begin the analysis with a description of the stages of the model that lead to the employment of complex problem solvers in Australia in 2001. The base data were obtained from detailed tabulations from the 2001 Census of Population and Housing. Table 1 shows the proportions holding various qualifications by sex and age (gamma in the model). The table shows little shift in the proportion holding any qualification as we shift from the oldest to the middle-aged cohort. The proportion with qualifications falls for the youngest age group but this reflects the fact that many at the youngest end of this age group are still in post-school training. Despite this, the proportion of males with information technology qualifications is twice as high for

those aged 20-39 as it is for those aged 40-54. Finally, there is a clear division in type of qualification by sex indicating a gendered orientation of qualifications in Australia. Women are very lowly represented in the engineering and building qualifications that include most of the skilled trades qualifications. On the other hand, they are much more highly represented in the health, management and commerce, society and culture and other qualifications.

TABLE 1 – Proportion of the Population Holding Specified Qualifications (the underlying gamma parameter) by Sex and Age, 2001.

	Males			Females		
Qualification	*20-39*	*40-54*	*55+*	*20-39*	*40-54*	*55+*
Natural and Physical Sciences	0.0196	0.0222	0.0154	0.0204	0.0143	0.0125
Information Technology	0.0320	0.0147	0.0023	0.0129	0.0076	0.0022
Engineering and Related	0.2015	0.2359	0.2231	0.0142	0.0125	0.1286
Architecture and Building	0.0700	0.0755	0.0728	0.0057	0.0032	0.0371
Agriculture, Environmental and Related Studies	0.0234	0.0185	0.0133	0.0095	0.0045	0.0081
Health	0.0205	0.0272	0.0234	0.0739	0.1022	0.0777
Management and Commerce	0.0812	0.0855	0.0604	0.1456	0.1009	0.0875
Society and Culture	0.0378	0.0453	0.0322	0.0766	0.0664	0.0418
Other	0.0662	0.0689	0.0493	0.1341	0.1396	0.1024
TOTAL	0.5522	0.5937	0.4922	0.4929	0.4512	0.4979

SOURCE: 2001 Full Count Census.

Given that the proportion of the population with post-school qualifications does not rise much from older to younger cohorts, there is clearly scope to increase the number of complex problem solvers by increasing the proportion of the population who have any qualifications. Furthermore, there would be scope to shift the distribution of qualifications more towards those qualifications that are more closely related to the employment of complex problem solvers.

Table 2 shows the proportion with qualifications that have recent qualifications (beta in the model), that is, qualifications that were obtained in the ten-year period prior to the census. Not unexpectedly, this parameter is highly associated with age with the 20-39 year-olds being much more likely to have recent qualifications. However, there are some interesting variations. For information technology, relatively high proportions with these qualifications in the older age groups have recent qualifications. This indicates the high demand for persons with these skills and the potential for retraining. Retraining is indicated by the percentage of those aged 40+ who have recent qualifications. Few people retrain as scientists or as skilled trades people (engineering and building). A very interesting result was that women aged 40+ with qualifications generally were more likely to have recent qualifications than men in the same age and qualification group. Ironically, this may be an advantage of being out of the labour force with children – the incentive or opportunity to retrain appears to be relatively high upon re-entry to the labour force or while children are young.

Because the proportions of those aged 40 years and over that have recent qualifications are low, there is considerable scope for re-training. Even if this does not sharply increase the proportion with fluid intelligence (because of the association with

age), it would increase the quality of crystallised intelligence. If we define policy strategies that increase the number of workers who are complex problem solvers, this direction will be all the more effective if we simultaneously increase the number of people that are able to work effectively with complex problem solvers. This again indicates that there is considerable scope to increase the levels of recent qualifications if suitable schemes can be devised for older persons. Income support to enable a year out of the labour force to undertake retraining may lead to a net gain of several years of subsequent employment.

TABLE 2 – Proportion of Those With Specified Qualifications Whose Qualifications Were Recent (less than 10 years old, the underlying beta parameter) By Sex and Age, 2001.

	Males			Females		
Qualification	*20-39*	*40-54*	*55+*	*20-39*	*40-54*	*55+*
Natural and Physical Sciences	0.6919	0.1187	0.0365	0.7040	0.1465	0.0442
Information Technology	0.8127	0.4253	0.4208	0.7471	0.5139	0.5351
Engineering and Related Technologies	0.5190	0.0898	0.0246	0.5798	0.1710	0.0224
Architecture and Building	0.5318	0.0849	0.0192	0.6977	0.2610	0.0761
Agriculture, Environmental and Related Studies	0.6419	0.2473	0.0842	0.7617	0.4169	0.1783
Health	0.7290	0.2641	0.0716	0.6347	0.2303	0.0399
Management and Commerce	0.7715	0.3429	0.1003	0.6703	0.2936	0.0548
Society and Culture	0.7684	0.2841	0.1295	0.7671	0.4345	0.2130
Other	0.6476	0.1877	0.0747	0.6234	0.2149	0.0575

SOURCE: 2001 Full Count Census.

TABLE 3 – Proportion Employed Among Those With Recent Qualifications (the underlying alpha parameter) By Sex, Age and Qualification, 2001.

	Males			Females		
Qualification	*20-39*	*40-54*	*55+*	*20-39*	*40-54*	*55+*
Natural and Physical Sciences	0.7865	0.8711	0.5985	0.7550	0.8096	0.5696
Information Technology	0.7803	0.8174	0.5763	0.7156	0.7652	0.5081
Engineering and Related Technologies	0.8748	0.8608	0.6158	0.7344	0.7493	0.3824
Architecture and Building	0.8716	0.8441	0.6546	0.7730	0.7711	0.5509
Agriculture, Environmental and Related Studies	0.8410	0.8480	0.7259	0.7463	0.7467	0.5467
Health	0.8955	0.9128	0.7368	0.8429	0.8921	0.6806
Management and Commerce	0.8651	0.9158	0.7464	0.7943	0.8296	0.6153
Society and Culture	0.8340	0.8410	0.5960	0.7661	0.8013	0.5148
Other	0.8220	0.8600	0.6256	0.7672	0.8379	0.5549

SOURCE: 2001 Full Count Census.

Table 3 shows the proportion of those with recent qualifications who were employed at the time of the census (alpha). These are much as we would expect, generally high in the peak ages but lower at the older ages. Once we restrict the analysis to those

with recent qualifications, the levels of employment are not very different for men and women. The main scope for improvement here is in the oldest age group, although 5-10 percentage point increases in employment of those aged less that 55 years also seem possible. Reversal of early retirement and welfare to work policies are being pursued at present by the Australian Government and these would seem to be the appropriate approaches for those aged under 55 who are out of the labour force or unemployed. However, the impact of such policies upon the high skilled segment of the labour force would be negligible.

TABLE 4 – Proportion of Employed Persons With Recent Qualifications Who Were Employed in CPS Occupations (the underlying delta parameter), by Sex, Age and Qualification, 2001.

	Males			Females		
	20-39	40-54	55+	20-39	40-54	55+
Natural and Physical Sciences	0.414	0.368	0.301	0.412	0.349	0.278
Information Technology	0.495	0.456	0.332	0.369	0.255	0.101
Engineering and Related	0.142	0.141	0.135	0.273	0.144	0.053
Architecture and Building	0.096	0.113	0.119	0.382	0.291	0.184
Agriculture, Environment and Related	0.113	0.134	0.111	0.209	0.127	0.058
Health	0.035	0.031	0.023	0.025	0.024	0.019
Management and Commerce	0.135	0.125	0.123	0.077	0.046	0.030
Society and Culture	0.105	0.078	0.068	0.061	0.042	0.032
Other	0.031	0.033	0.031	0.024	0.016	0.014

SOURCE: 2001 Full Count Census.

Finally, Table 4 shows the proportion of employed persons with recent qualifications who were employed in CPS occupations (the parameter, delta). This reflects the demand in the Australian economy for persons with CPS skills. In general, the CPS rates do not vary much by age, although the rates fall off as age increases. For example, among employed males with recent information technology qualifications, the percentages employed as CPS were 49 per cent for 20-39 year olds, 46 per cent for 40-55 year olds and 33 per cent for 55+ year olds. This suggests that the high concentration of CPS in the youngest age group (see Tables 5 and 6) is not related to a preference on the part of employers to employ younger workers when skills are equally recent for older workers. Some values of delta are much higher for women than for men indicating that women are more likely to be trained in the CPS end of the broad skill classifications that we have used. However, this is not the case with information technology and management and commerce skills; in these qualifications, men are more likely to be employed as CPS than women.

Tables 5 and 6 show the age and occupation distribution of employed CPS by sex in Australia in 2001. The tables also show the distribution by age of employed persons with recent qualifications who are not employed as complex problem solvers. CPS workers are overwhelming concentrated in the young ages as we had postulated in the discussion above, but this is also largely true of any employed worker with recent qualifications. There are very few CPS in the oldest age group indicating, as we have suggested above, that reversal of early retirement will not contribute in any significant

way to an increase in this segment of the labour force. Among female CPS workers, the relatively high proportions of middle-aged women in some occupations indicate that re-training provides some scope to increase the numbers of CPS. In further work, we shall examine scenarios in which the parameters, alpha, beta and gamma, are altered. In the current version, our emphasis is upon changing population structure, in particular, the importance of immigration to the production of complex problem solvers.

TABLE 5- Distribution of CPS by Age and Occupation, Males 2001.

	20-39	40-54	55+	Total
Scientists	82.3	15.9	1.8	100.0%
Engineers	84.1	14.1	1.8	100.0%
Information Technology and BIT	85.5	13.6	0.8	100.0%
Marketing and Business	75.2	21.7	3.2	100.0%
Medical Scientists	84.0	14.8	1.2	100.0%
Non Complex Problem Solvers	79.4	18.1	2.5	100.0%

SOURCE: 2001 Full Count Census

TABLE 6- Distribution of CPS by Age and Occupation, Females 2001.

	20-39	40-54	55+	Total
Scientists	88.8	10.2	1.0	100.00%
Engineers	88.1	11.0	0.9	100.00%
Information Technology and BIT	83.5	15.6	0.9	100.00%
Marketing and Business	84.5	14.0	1.5	100.00%
Medical Scientists	82.7	15.8	1.5	100.00%
Non Complex Problem Solvers	74.1	22.6	3.3	100.00%

SOURCE: 2001 Full Count Census

Complex problem solvers in the migration movements, 2004-05

DIMA movement data classify movers according to the stated intentions of movers as to whether their movement into or out of Australia is short term (less than 12 months), long term (more than 12 months but not permanent) or permanent. We use data only for the long term and permanent movements. For both Australian and New Zealand citizens, the distinction between long term and permanent is somewhat arbitrary. As described above, many Australians who said that they were leaving permanently returned permanently within five years. As New Zealand citizens can work in Australia freely, their stated intention (permanent or long-term) is necessarily somewhat arbitrary. Thus, we consider that greater accuracy on net movement is obtained by combining the long term and permanent movements for both Australians and New Zealand citizens. Accordingly, from the more detailed categories of permanent and long term movements provided by DIMA, we employ the following aggregated movement types:

Arrivals	Departures
Australian citizens	Australian citizens
New Zealand citizens	New Zealand citizens
Settler arrivals (other citizens)	Permanent departures (other citizens)
Long term visitor or resident arrivals (other citizens)	Departures of long term visitors or residents (other citizens)

The numbers in each category in 2004-05 for persons aged 20 years and over are shown in Table 7.

TABLE 7 – Permanents and Long-Term Arrivals and Departures to Australia, Persons Aged 20 Years and Over, 2004-05.

Category	Arrivals	Departures	Net
Australian citizens	66115	111702	-45587
New Zealand citizens	21513	10448	11065
Other citizens (permanent)	62233	5125	57108
Other citizens (long term)	155367	71303	84064
TOTAL	305228	198578	106650

Source: Authors' calculations from original data provided by DIMA

The total net gain for Australia in the 12-month period was 107,000 persons, but there was a net loss of Australian citizens of 46,000. It is notable that the number of permanent departures of 'other citizens' is very small. This suggests that persons who have migrated to Australia tend not to leave permanently[1]. There is a considerable gain among 'other citizens' in the long-term category. These are mainly overseas students studying in Australia, temporary long-term business workers, or spouses of Australians in the two-year waiting period before permanent residence is available to them. It should be noted that it is becoming common for persons in this category to change to permanent residence onshore in Australia, however, to avoid double counting, we do not include those who convert to permanent residence onshore among the permanent arrivals of other citizens. Note also that the long-term movements of 'other citizens' into Australia are rising across time producing a lag effect such that arrivals exceed departures in any year of observation. The same lag effect applies in the opposite direction for Australian citizens leaving long term – the numbers leaving exceed the numbers returning because the number of leavers is increasing across time.

The incidence of CPS occupations in the various movements is shown in Table 8. Note the numbers in Table 8 and subsequent tables in this section are simply the numbers in the CPS ASCO codes; they are not adjusted to include information on the recency of qualification. On the other hand, as we show in Table 10 below, most

[1] Some may do so after taking Australian citizenship in which case they would appear in the departures of Australian citizens.

migrants in CPS occupations are aged less than 40 meaning that qualifications would be recent for most of them[2].

In total, there was a net gain of 17,324 persons with CPS occupations in 2004-05. Those with CPS occupations leaving Australia are dominated numerically by Australian citizens. Furthermore, CPS occupations are much more heavily represented among Australian citizens departing Australia than they are among the general Australian population, that is, out-migration of Australian citizens is highly selective of CPS workers. On the other hand, there is evidence of substantial churning of CPS with Australian citizenship – large numbers also return each year with the net loss being only 39 per cent of total departures. Also, the percentage of CPS among those with a stated occupation is the same among Australian citizens who leave and those who return. This means that, among Australian citizens, the likelihood of return to Australia appears to be similar for CPS as it is for non-CPS occupations.

The proportion of CPS workers among employed New Zealanders arriving and departing from Australia is by far the lowest of any of the movements reflecting the fact that New Zealanders are not selected on the basis of skill. Presumably, like Australians, New Zealanders with CPS occupations leaving New Zealand go to countries like the United Kingdom and the United States.

Not unexpectedly given Australia's skills-based migration program, a high proportion of permanent settler arrivals state CPS occupations (27.6%). Also, very few permanent residents with 'other' citizenships leave. This applies both to those with CPS occupations and to all occupations. This means that the official migration program seems to be effective in recruiting new settlers who remain in Australia for some time. Of course, some former settlers may become Australian citizens and then leave under that category but this implies that they first make a longer-term commitment to Australia. The table shows that it is the permanent movement of other citizens that produces the largest net gain in CPS workers. Furthermore, many 'other' citizens who arrive on a long-term basis to Australia convert to permanent residence onshore. Currently about 40,000 persons of all ages convert to permanent residence onshore with probably around 20 per cent being in CPS occupations. This shows the importance of the opportunity to gain permanent residence as an attraction for CPS workers to move to Australia on a temporary basis.

There is also a large net gain in the long-term movement for other citizens, some of which, as discussed in the previous paragraph, may represent 'leakage' onshore into the permanent residence category. Among those with a stated occupation, a relatively high proportion of long-term arrivals of other citizens (25.1%) are in CPS occupations. This movement contains a very high proportion of people with no stated occupation (52.3% for arrivals). This is primarily related to the movement of overseas students, the largest component of long-term temporary migration to Australia. However, many spouses of Australians may also have no stated occupation upon entry. Among overseas students who convert to permanent residence onshore, there is likely to be a shift from the 'no occupation' category stated upon arrival to a CPS

[2] In the following section of the paper, the projections section, we estimate recency of qualification among migrants on the basis of Australian census data.

occupation onshore. Thus, the impact of immigration on CPS labour supply may be somewhat larger than our data show.

TABLE 8 – Numbers in CPS* and Non-CPS Occupations and Numbers with no Stated Occupation by Movement Type (Permanent and Long-Term), Persons aged 20 Years and Over, Australia, 2004-05.

Movement category	Occupation stated			No occupation stated	
	CPS	Non-CPS	% CPS	Number	% of total
Australian citizens					
• Arrivals	10066	45270	18.19	10779	16.30
• Departures	16616	78455	17.48	16631	14.89
• Net	-6550	-33185	16.48	-5852	12.84
New Zealand citizens					
• Arrivals	1989	16114	10.99	3410	15.85
• Departures	866	8028	9.74	1554	14.87
• Net	1123	8086	12.19	1856	16.77
Other citizen (Permanent)					
• Arrivals	12692	33294	27.60	16247	26.11
• Departures	779	2836	21.55	1510	29.46
• Net	11913	30458	28.12	14737	25.81
Other citizen (Long term)					
• Arrivals	17434	52023	25.10	85910	55.29
• Departures	6596	25517	20.54	39190	54.96
• Net	10838	26506	29.02	46720	55.58
TOTAL					
• Arrivals	42181	146701	22.33	116346	38.12
• Departures	24857	114836	17.79	58885	29.65
• Net	17324	31865	35.22	57461	53.88

* The table shows the numbers in CPS occupations without considering the recency of qualifications. The actual number of CPS (as defined in the paper) would be lower if recency of qualification could be assessed.

Source: Authors' calculations from original data provided by DIMA

Table 9 shows losses and gains of persons with CPS occupations for the sub-categories of CPS occupations. The net gain of CPS workers in 2004-05 was made up of around 1,000 scientists, 6,600 engineers, 7,100 IT and BIT workers and 4,100 specialist marketing and business professionals. Among scientists, it was the long-term movement of other citizens that kept the Australian side of the ledger in the black, that is, the net loss of Australian citizens was only balanced by the permanent net gain of other citizens. No doubt this is reflective of the general lack of employment opportunities for scientists in Australia and Australia's comparatively low level of investment in science and research and development. The immigration program reacts to perceived employment demand in Australia and little or no demand for scientists is perceived. This is an issue that is broader than immigration policy.

For engineers and IT and BIT professionals, net permanent migration of other citizens far exceeds the net loss of Australian citizens presumably because these occupations are given priority in the skills-based permanent migration category. Gains for these occupations are also strong in the other citizen (long-term) movement. Among

specialist marketing and business professionals, the net loss of Australian citizens exceeds the net gain from the permanent settler movement. Again, the net gain overall is equivalent to the net gain in the other citizen (long-term) movement. It probably can be argued that overseas experience is more relevant to this category of CPS workers than to other categories and so the high level of departures of Australian citizens might be seen in this light.

TABLE 9 – Sub Categories of CPS Occupations*, Losses and Gains by Movement Type, Persons Ages 20 Years and Over, 2005/05.

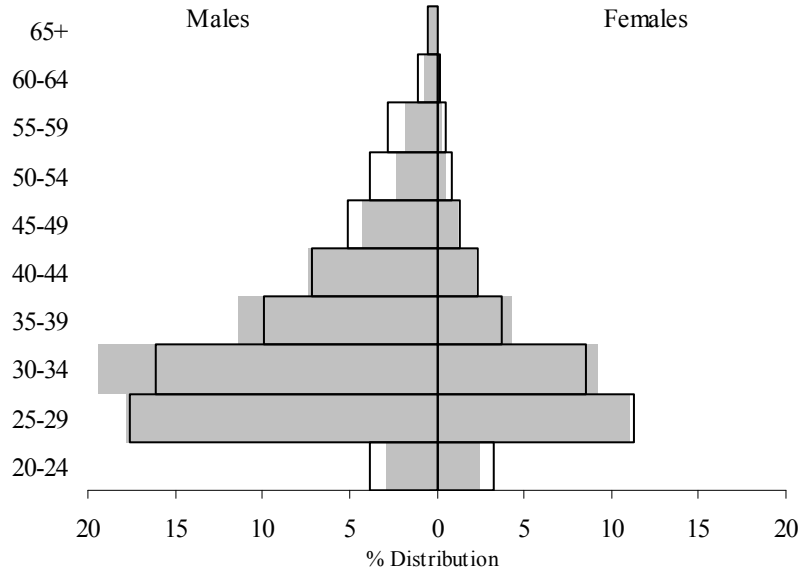
Movement category	CPS Occupation				
	Medical scientist	Other scientist	Engineer	IT and BIT	Marketing & business
Australian citizens					
• Arrivals	128	887	3516	1915	3620
• Departures	190	1548	5549	2830	6499
• Net	-62	-661	-2033	-915	-2879
New Zealand citizens					
• Arrivals	37	136	832	325	659
• Departures	15	66	289	174	322
• Net	22	70	543	151	337
Other citizen (Permanent)					
• Arrivals	270	542	3956	4979	2945
• Departures	14	38	161	140	426
• Net	256	504	3795	4839	2519
Other citizen (Long term)					
• Arrivals	225	1171	6377	3485	6176
• Departures	86	424	2120	424	2092
• Net	139	747	4257	3061	4083
TOTAL					
• Arrivals	660	2736	14681	10704	13400
• Departures	305	2076	8119	3568	9339
• Net	355	660	6562	7136	4061

* The table shows the numbers in CPS occupations without considering the recency of qualifications. The actual number of CPS (as defined in the paper) would be lower if recency of qualification could be assessed.

Source: Authors' calculations from original data provided by DIMA

The age and sex distributions of arrivals and departures of CPS are remarkably similar (Figure 1). There are proportionally more males in their thirties in the arrivals than in the departures with the opposite being the case for males aged 45 years and over. Given the importance that we place on recency of qualifications, this is a favourable outcome. It is clear that, as in the population itself, a much larger proportion of CPS international migrants are men.

FIGURE 1 – Age and Sex Distribution of CPS Migrants, Arrivals (Shaded) and Departures, 2004/05.



Source: Authors' calculations from original data provided by DIMA

In net terms, 83.9 per cent of the additions through migration to the Australian population in the CPS occupations were aged 40 years and under (Table 10) with the largest concentrations being in the ages 25-34 years (Figure 1). Thus, although we are not able to measure recency of qualifications directly, on the basis of age, the large majority of net migrants in CPS occupations are likely to have recent qualifications (less than 10 years since graduation). Perhaps the most striking number in Table 10, however, is the very small number of former permanent immigrants aged 20-39 in CPS occupations who leave Australia. In this movement category, the number of arrivals is 26 times the number of departures (10,646 arrivals compared to 408 departures). The permanent migration program is therefore not only an effective means of gaining new CPS workers; it is also an efficient means with very little churning.

TABLE 10 – Persons with CPS Occupations*, Arrivals and Departures by Movement Type and Age Group, Persons aged 20 Years and Over, 2004/05.

Movement category	20-39	40-54	55+
Australian citizens			
• Arrivals	7163	2289	614
• Departures	11630	3910	1076
• Net	-4467	-1621	-462
New Zealand citizens			
• Arrivals	1369	513	107
• Departures	613	212	41
• Net	756	301	66
Other citizen (Permanent)			
• Arrivals	10646	1831	215
• Departures	408	297	74
• Net	10238	1534	141
Other citizen (Long term)			
• Arrivals	13364	3357	713
• Departures	5361	1051	184
• Net	8003	2306	529
TOTAL			
• Arrivals	32542	7990	1649
• Departures	18012	5470	1375
• Net	14530	2520	274

* The table shows the numbers in CPS occupations without considering the recency of qualifications. The actual number of CPS (as defined in the paper) would be lower if recency of qualification could be assessed.

Source: Authors' calculations from original data provided by DIMA

As would be expected, among settler arrivals, CPS workers are heavily concentrated in the 'Points-tested' visa category type (Table 11). Indeed, in this category, 36.5 per cent of those with an occupation and 33.2 per cent of the total movement had CPS occupations. This means that the Points-tested migration scheme is very effective in targeting complex problem solvers. However, there is a reasonable number of CPS in the Family stream as well probably indicating that young Australians working overseas, themselves concentrated in high-level occupations, often meet and marry persons in similar level occupations. Only one per cent of the Humanitarian movement is CPS and, perhaps surprisingly, only eight per cent of the business, other skilled and special eligibility categories is CPS. It may be that the migration system channels those who would be successful under the point-based scheme into the point-based system meaning that other categories are selective of those who would not meet the points criteria. Another important finding from Table 11 is that CPS workers are not at all uncommon among 'other applicants'. Other applicants are persons (almost exclusively spouses and children) who enter Australia on the basis of a principal application by another person. Among those with a stated occupation, CPS workers constituted 23.5 per cent of all 'other applicants' compared with 28.9 per cent of principal applicants. This reflects 'assortative mating', that is, persons with high-level occupations are likely to have partners with high-level occupations.

TABLE 11 –CPS Occupations Among Settler Arrivals by Visa Type and Applicant Status, 2004/05.

Settler visa type and applicant status	Number	%CPS occupation stated	%CPS total movement
Family	2175	15.01	9.09
Points tested	10166	36.45	33.17
Business, other skilled and special eligibility	288	10.10	7.62
Humanitarian	63	8.43	1.62
Principal applicant	10171	28.86	22.27
Other applicant	2521	23.46	15.22
TOTAL	12692	27.60	20.39

Source: Authors' calculations from original data provided by DIMA

Complex problem solvers by period of residence in Australia, 2001 Census

Another way to look at the impact of immigration on the numbers of complex problem solvers in Australia is to examine the occupations of former immigrants present in the population at the time of the census.

Table 12 displays the percentages for each age group of persons working in a CPS occupation by period of residence – not considering recency of qualifications. Two periods of residence are shown, 1991-1995 and 1996-2001. These periods roughly divide migrants into those who arrived prior to the implementation of the points-based skills test and those who arrived after its implementation. Persons in these periods of residence categories are effectively are a net 'in-Australia' population. This means that no account is taken of out-migration of Australian citizens or any other persons absent from Australia at census date.

Even though migrants arriving from 1996 onwards might be expected to be more highly skilled than those arriving from 1991 to 1995 (because of the skills test), in fact by 2000, those arriving in the earlier period were more likely to be in a CPS occupation than those arriving in the later period. Of course, only a minority of total immigrants arrive in the points-tested skills category and, also, it is well known that there is an employment adjustment period for new immigrants such that their situation becomes more established between the 5th and the 10th year. Nevertheless, immigrants in both periods of residence had a higher participation in CPS occupations by 2001 than was the case for all Australians with those present for the longer duration being almost 50 per cent more likely to be in a CPS occupation. Because the CPS proportions in the net migration movement for 2004-05 are even higher, this may mean that, in recent years, the balance of the migration movement has shifted more heavily to higher skilled people.

TABLE 12 - % Working in a CPS Occupation by Period of Residence.

	20-39 (%)	40-54 (%)	55+ (%)
2001 Census, Arrived 1991-1995	18.1	18.1	4.5
2001 Census, Arrived 1996-2001	15.8	13.3	4.6
2001 Census, All Australians	12.3	11.3	4.0
Net migration, 2004-05 (DIMIA)	21.11	18.63	17.9

SOURCE: 2001 Full Count Census.

Model projections from 2001 to 2051

As described above, we model the future number of EQR (employed and recently qualified) and CPS (recently qualified persons employed in CPS occupations) in Australia using three assumptions relating to the level of annual net migration:

> Model 1: Annual Net Migration is zero throughout the period
> Model 2: Annual Net Migration is 110,000 throughout the period
> Model 3: Annual Net Migration increases linearly from 110,000 in 2001 to 190,000 in 2051.

For each of Models 2 and 3, three assumptions are made about the incidence of CPS workers in the migration movement:

1. The net migrants have the same propensity to be CPS as the overall Australian population at the time of the 2001 Census (labelled **Aus** in the charts).
2. The net migrants have the same propensity to be CPS as those persons in the 2001 Census who had arrived in Australia in the period, 1996-2001 (labelled **Census** in the charts).
3. The net migrants have the same propensity to be CPS as net migrants from the **DIMA** movement statistics for the year, 2004-05 (labelled DIMIA in the charts).

The **Census** and **DIMIA** assumptions are both more likely than the **Aus** assumption because both specifically relate to the characteristics of migrants. There are arguments in favour of both the **Census** and the **DIMIA** assumptions. The **Census** assumption has the advantage that it takes the experience of migrants in the Australian labour market into account, although we may be conservative in using arrivals for the period, 1996-2001 as more recent arrivals are more qualified. Furthermore, in the projections, migrants increase their duration of residence across time. This means that their level of employment is also likely to increase across time as indicated in Table 12. Finally, the recent movement data (**DIMIA** assumption) are more reflective of current migration policy and also include the effects of departures. In summary, the two assumptions (**Census** and **DIMIA**) provide a plausible range for the estimates. The difference between the **Aus** projections and the other two sets shows the impact of using specific migrant characteristics in the projections.

The projections are done separately for two groups: (i) the population as recorded at the 2001 Census and their descendants and (ii) the population (net) who arrive in Australia from 2001 onwards and their descendants. In each group, descendants have the same likelihood of becoming CPS (EQR) as the group that they are in – effectively children of Australians present in 2001 take on their parents' CPS (EQR) propensity and children born to net migrants from 2001 onwards take on the CPS (EQR) propensity of their parents. The effect of the higher skills of the second generation of immigrants is important in the longer term. As the recency or type of qualification is not available in the DIMIA data, we adjust the DIMIA occupation data for the propensity to hold various kinds of skills and their recency of attainment using parameters from the Census.

Results

Projections of EQR by age group and sex are shown in Figures 2-7 (Appendix 2 contains the underlying numbers). Figures 2 and 3 show that, with zero migration, the numbers of qualified young Australians would fall by about 15 per cent between 2001 and 2051. This would occur even though the fertility rate is set at the relatively high long-term level of 1.8 births per woman. In contrast, if migration is maintained at its present level, the numbers of young EQR would increase between 30 and 40 per cent over the next 50 years. The rise would be above 50 per cent if the high migration assumption were to apply. With other advanced countries facing substantial falls in the number of their young qualified people, these results would be very favourable for Australia.

Figures 3 and 4 show somewhat similar results to Figures 2 and 3. However, at the oldest ages the results are somewhat different as migration takes a long time to have an impact on this age group.

FIGURE 2 – Projected EQR, Males 20-39 (2001-2051)

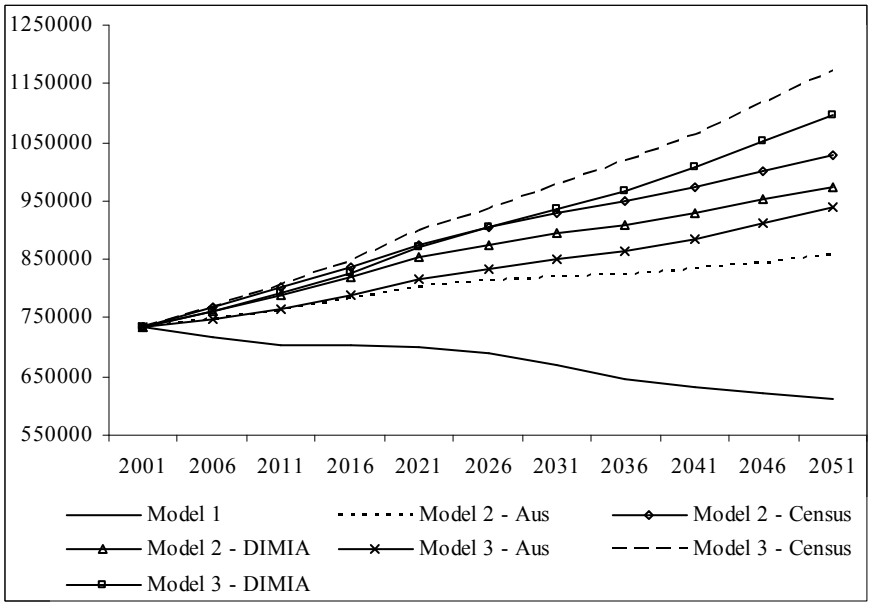


FIGURE 3 – Projected EQR, Females 20-39 (2001-2051)

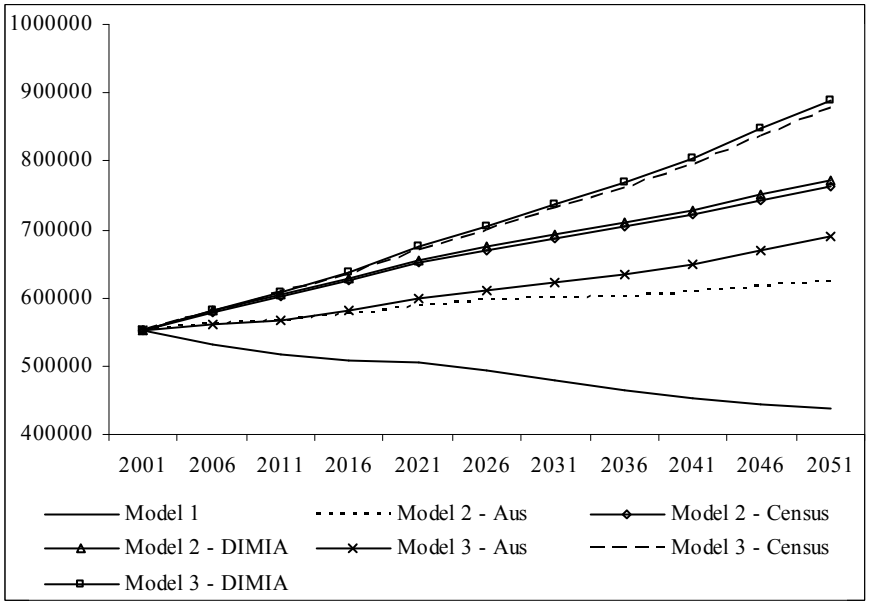


FIGURE 4 – Projected EQR, Males 40-54 (2001-2051)

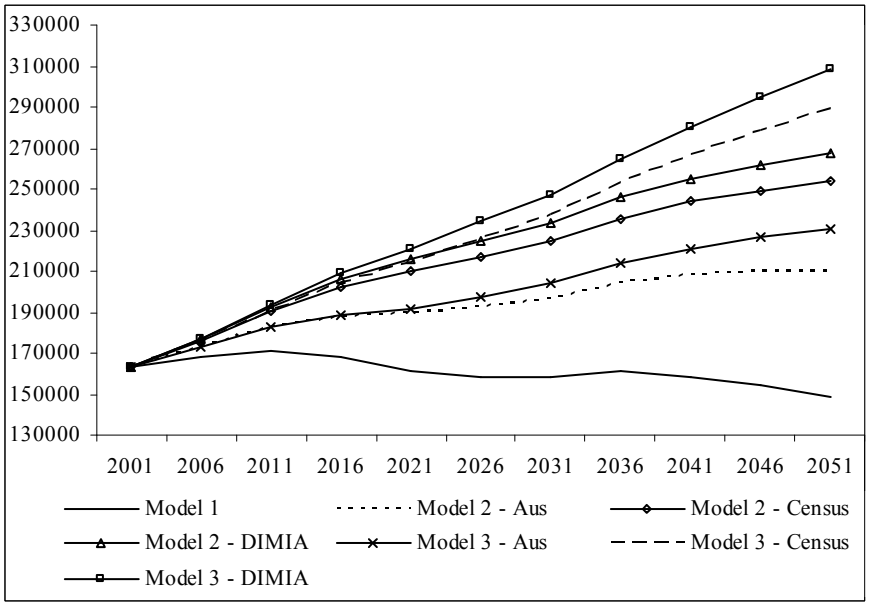


FIGURE 5 – Projected EQR, Females 40-54 (2001-2051)

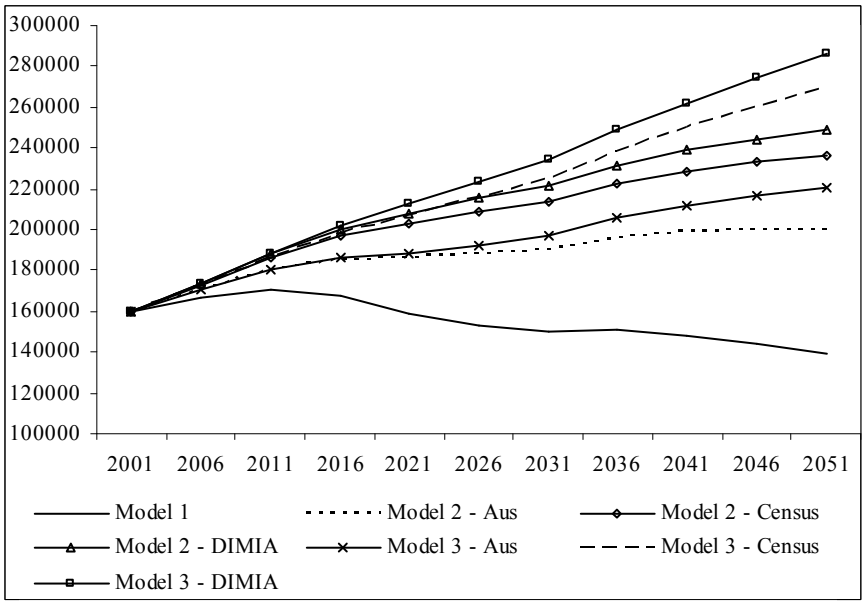


FIGURE 6 – Projected EQR, Males 55+ (2001-2051)

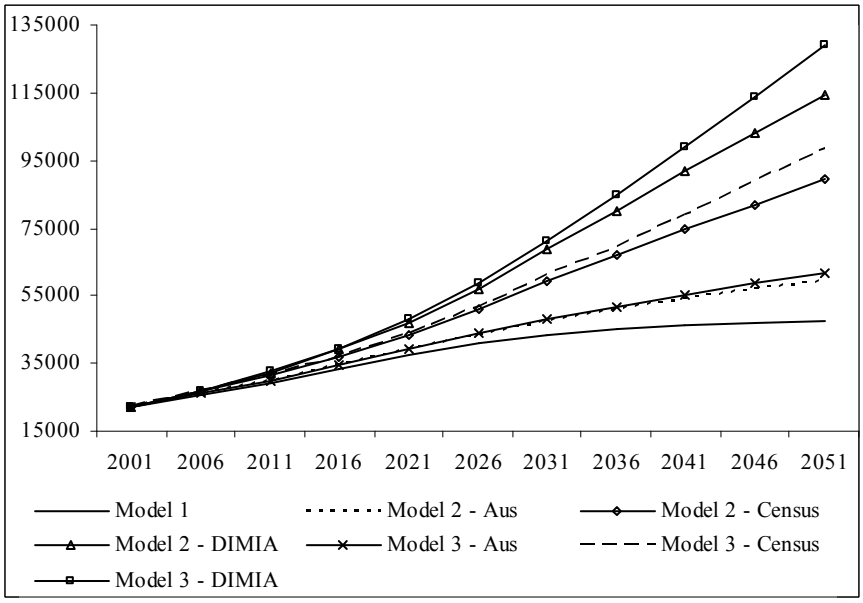
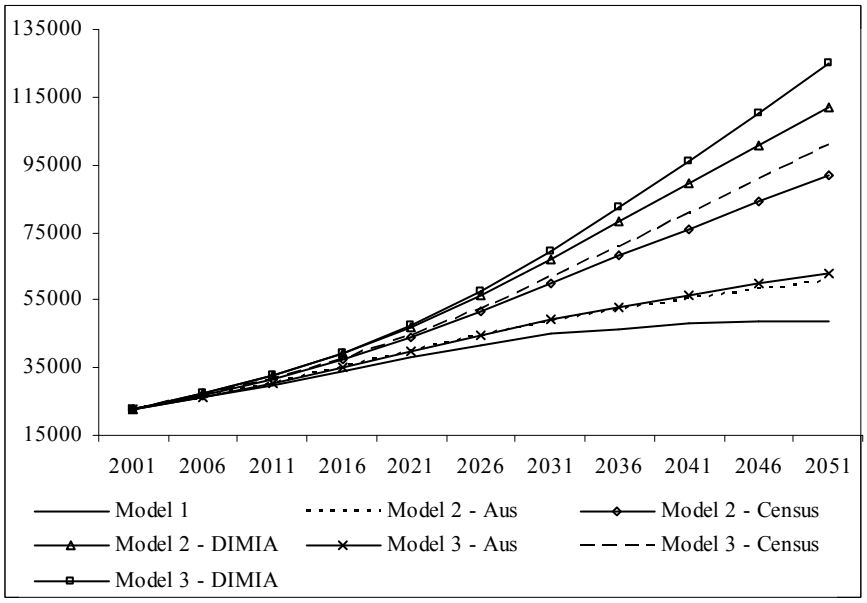


FIGURE 7 – Projected EQR, Females 55+ (2001-2051)



The results for CPS are shown in Figures 8-14 (Appendix 3 contains the underlying numbers). Compared to EQR, CPS takes into account whether the recently qualified employed person is employed in a CPS occupation. Here the changes due to immigration are more spectacular. The current level and composition of net migration extended over 50 years would increase the number of CPS in the 20-39 age group by around 100 per cent compared to the zero migration scenario. On the basis of our arguments, this would be an excellent result for Australia. The higher level of migration would add roughly another 50 per cent again to the number of complex problem solvers – an increase that is directly proportional to the increase in the migrant numbers. Again, the results are similar for the 40-54 age group but initially much more muted for the oldest age group.

For total CPS (Figure 14), the orders of magnitude are similar. With zero migration, the numbers of CPS would fall by 2051 by around 15 per cent. While this decline could be offset relatively easily by increased emphasis on training of young Australians or retraining, it is still a worrying result in what will be an increasingly competitive world where, as we argue above, competition will revolve around the ability of economies to produce and maintain CPS workers. On our modelling, the current level of net migration would yield a doubling in the number of CPS by 2051 and migration at the level of Canada would increase CPS by 150 per cent by 2051. Combined with an increased emphasis upon the training of young Australians, this would be an extremely competitive result for Australia.

FIGURE 8 – Projected CPS, Males 20-39 (2001-2051)

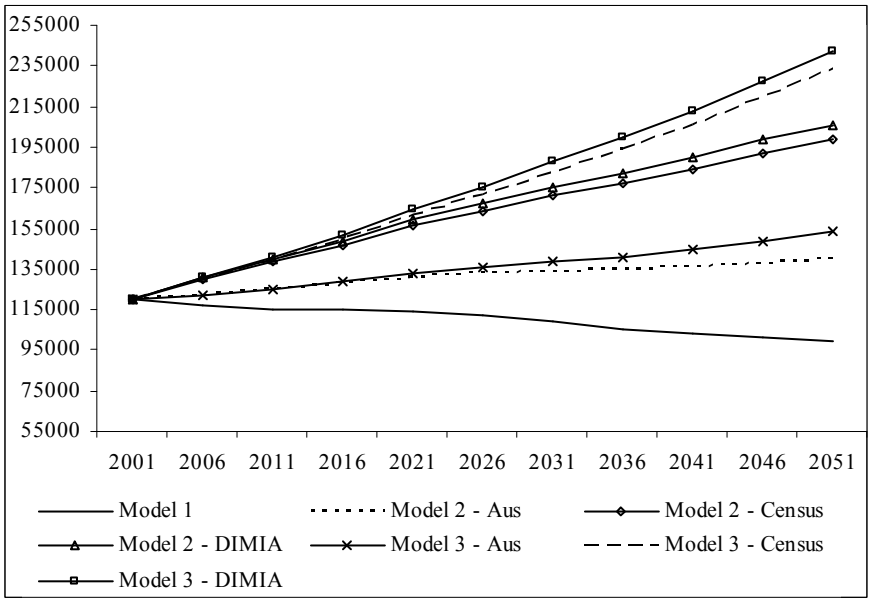


FIGURE 9 – Projected CPS, Females 20-39 (2001-2051)

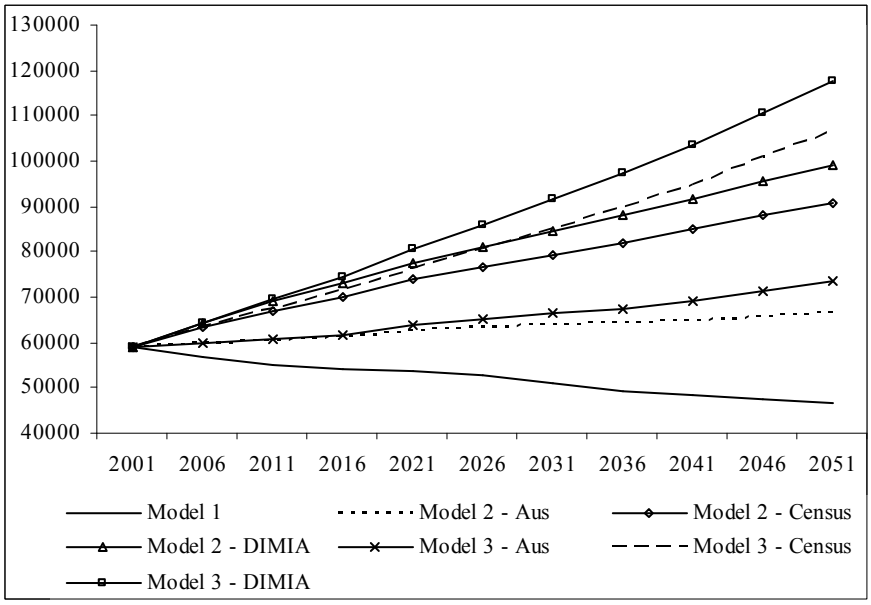


FIGURE 10 – Projected CPS, Males 40-54 (2001-2051)

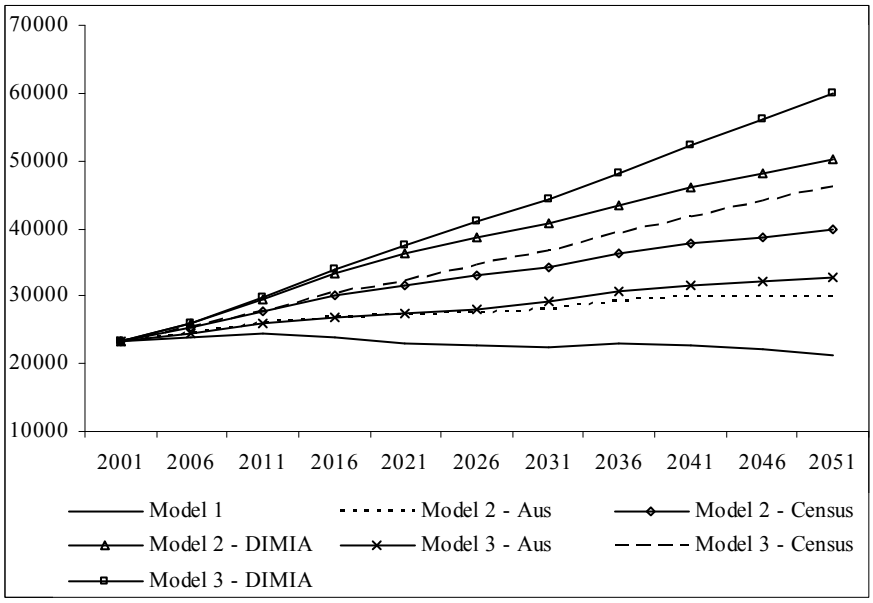


FIGURE 11 – Projected CPS, Females 40-54 (2001-2051)

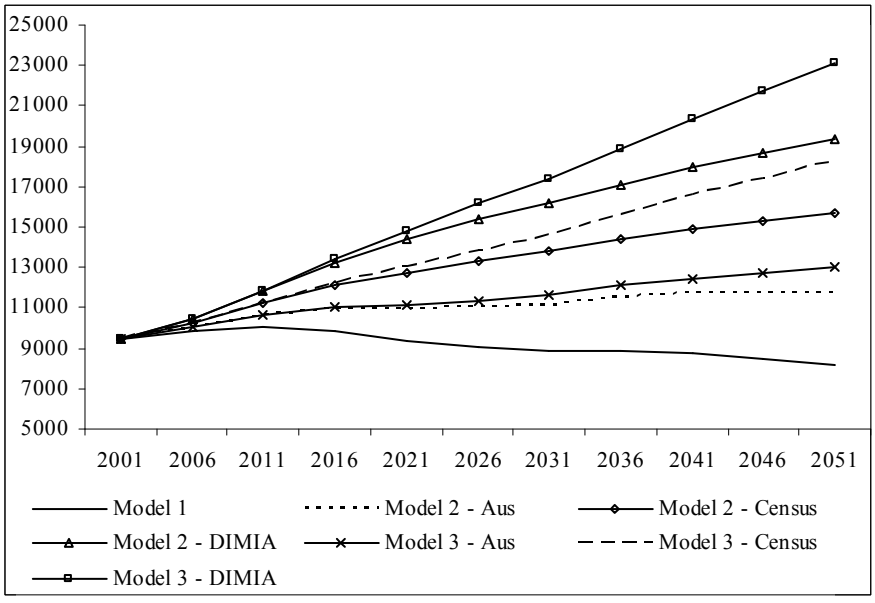


FIGURE 12 – Projected CPS, Males 55+ (2001-2051)

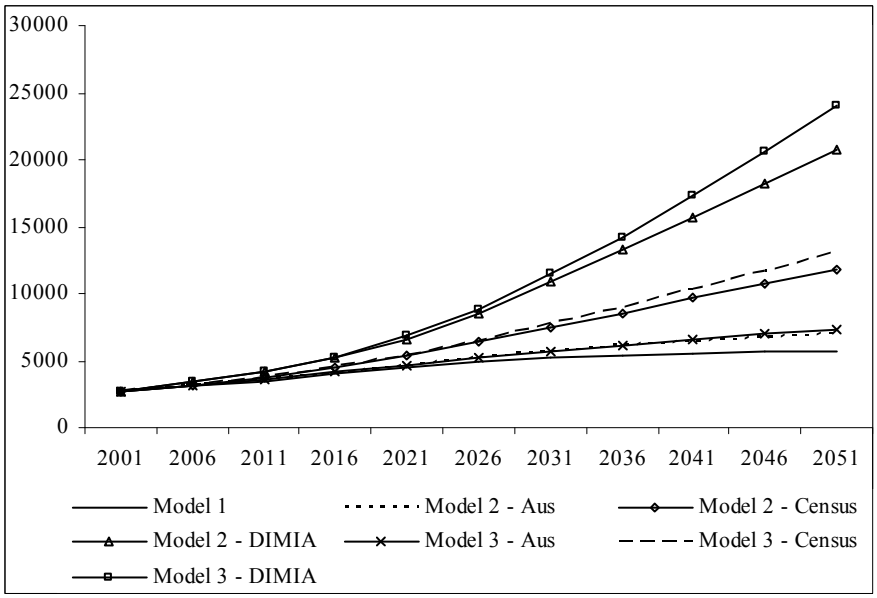


FIGURE 13 – Projected CPS, Females 55+ (2001-2051)

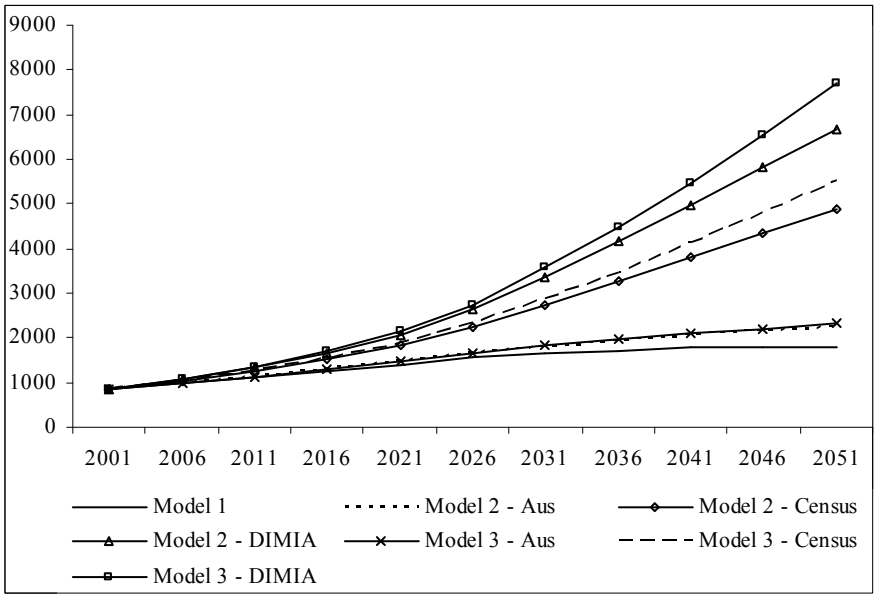
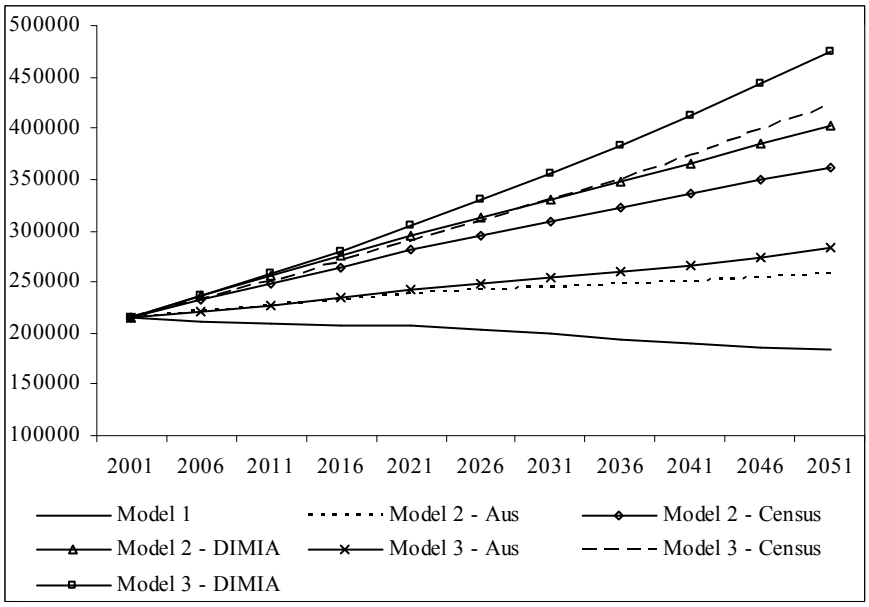


FIGURE 14 – Projected CPS, Total (2001-2051)



Concluding remarks

In the paper, we argue that the group we describe as complex problem solvers will play a fundamental role in the competitiveness of economies in the future. Accordingly, countries that allow the numbers of these workers to fall are putting themselves at risk. We have demonstrated the very strong association of employed complex problem solvers to the age distribution of the population, specifically its concentration in ages less than 40 years. In the absence of changes in the input parameters, alpha, beta, gamma and delta, only the age distribution of the future population affects the number of complex problem solvers. We demonstrate that Australia can improve its competitive position through positive net migration that is skill-based.

This is work in progress. In a subsequent version of the paper, we shall examine the effects of:

1. shifting the skill distribution in the population (the distribution of alpha across the set of qualifications),
2. retraining (increasing beta for those aged 40 and over),
3. employing higher proportions of recently trained skilled people (increasing gamma), and
4. increasing the extent to which employed recently trained skilled workers are working in CPS jobs (the vector K as summarised in the delta parameter).
5. separately modelling the skill and occupation characteristics of migrant offspring.
6. modelling the effects of migration on a cohort basis rather than a propensity basis.

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APPENDIX 1 – CPS Definitions.

CPS Category	ASCO
Scientists	2100
	2110
	2111
	2112
	2113
	2114
	2119
	2293
	3112
Engineers	2121
	2122
	2123
	2124
	3121
	3122
	3123
	2125
	2126
	2127
	2128
	2129
	3124
	3125
	3129
	2120
	3120
	3100
I.T	2231
Marketing & Business	2221
	2294
	2299
	3212
	3213
	2522
	2523
	1200
	1210
	2200
	3200
	3210
Medical Scientists	2115
	3111
	3110

APPENDIX 2 – EQR Projections, 2001, 2016 and 2051.

Projections of EQR, 20-39 Year Olds, 2001-2051.

	Males			Females		
	2001	2021	2051	2001	2021	2051
Model 1	733775	701525	610475	551632	504170	437558
Model 2 - Aus	733775	803800	855897	551632	588486	623637
Model 2 - Census	733775	876075	1029328	551632	651562	762844
Model 2 - DIMIA	733775	852763	973389	551632	655441	771403
Model 3 - Aus	733775	815961	939450	551632	598886	689725
Model 3 - Census	733775	896830	1171925	551632	669744	878372
Model 3 - DIMIA	733775	870746	1096942	551632	674100	889971

Projections of EQR, 40-54 Year Olds, 2001-2051.

	Males			Females		
	2001	2021	2051	2001	2021	2051
Model 1	163182	161496	148797	159977	159046	139238
Model 2 - Aus	163182	189386	209761	159977	186386	199964
Model 2 - Census	163182	209532	253797	159977	202828	236483
Model 2 - DIMIA	163182	215894	267705	159977	208297	248630
Model 3 - Aus	163182	191932	230477	159977	188683	220658
Model 3 - Census	163182	213917	289477	159977	206506	269623
Model 3 - DIMIA	163182	220860	308110	159977	212434	285910

Projections of EQR, 55+ Year Olds, 2001-2051.

	Males			Females		
	2001	2021	2051	2001	2021	2051
Model 1	22305	37458	47742	22960	38069	48977
Model 2 - Aus	22305	39107	59113	22960	39657	60392
Model 2 - Census	22305	43504	89429	22960	44012	91688
Model 2 - DIMIA	22305	47142	114513	22960	46797	111703
Model 3 - Aus	22305	39230	61604	22960	39784	62802
Model 3 - Census	22305	43953	98560	22960	44485	100705
Model 3 - DIMIA	22305	47861	129137	22960	47492	124945

Projections of EQR, Total, 2001-2051.

	Males			Females		
	2001	2021	2051	2001	2021	2051
Model 1	919262	900479	807015	734569	701285	625772
Model 2 - Aus	919262	1032294	1124771	734569	814529	883993
Model 2 - Census	919262	1129111	1372554	734569	898402	1091016
Model 2 - DIMIA	919262	1115800	1355606	734569	910535	1131736
Model 3 - Aus	919262	1047123	1231531	734569	827353	973185
Model 3 - Census	919262	1154700	1559963	734569	920735	1248700
Model 3 - DIMIA	919262	1139467	1534190	734569	934027	1300826

APPENDIX 3 – CPS Projections, 2001, 2016 and 2051.

Projections of CPS, 20-39 Year Olds, 2001-2051.

	Males			Females		
	2001	2021	2051	2001	2021	2051
Model 1	119817	114551	99684	58783	53725	46627
Model 2 - Aus	119817	131251	139758	58783	62710	66456
Model 2 - Census	119817	156041	199244	58783	73760	90842
Model 2 - DIMIA	119817	158949	206223	58783	77510	99120
Model 3 - Aus	119817	133237	153401	58783	63818	73498
Model 3 - Census	119817	160975	233140	58783	76231	106546
Model 3 - DIMIA	119817	164229	242494	58783	80444	117763

Projections of CPS, 40-54 Year Olds, 2001-2051.

	Males			Females		
	2001	2021	2051	2001	2021	2051
Model 1	23286	23046	21234	9424	9369	8202
Model 2 - Aus	23286	27026	29933	9424	10979	11779
Model 2 - Census	23286	31521	39760	9424	12743	15697
Model 2 - DIMIA	23286	36233	50058	9424	14379	19329
Model 3 - Aus	23286	27389	32889	9424	11115	12998
Model 3 - Census	23286	32295	46055	9424	13027	18251
Model 3 - DIMIA	23286	37436	59853	9424	14800	23121

Projections of CPS, 55+ Year Olds, 2001-2051.

	Males			Females		
	2001	2021	2051	2001	2021	2051
Model 1	2655	4459	5684	848	1406	1809
Model 2 - Aus	2655	4656	7037	848	1464	2230
Model 2 - Census	2655	5345	11790	848	1832	4874
Model 2 - DIMIA	2655	6639	20710	848	2082	6667
Model 3 - Aus	2655	4670	7334	848	1469	2319
Model 3 - Census	2655	5411	13127	848	1866	5521
Model 3 - DIMIA	2655	6800	24001	848	2136	7693