Australian Government
Department of Immigration and Citizenship

About the research

Immigration, Labour Supply and Per Capita Gross Domestic Product: Australia 2010-2050

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Growth in the size and productivity of Australia's work force is the key determinant of Australia's economic growth, even though overall demand will continue to be cyclical and mean a continuing role for macroeconomic management. The report examines whether some (approximate) level of immigration stands out as having a superior balance of outcomes or whether no such conclusion can be drawn. The report's assumptions are aligned to the 2010 Intergenerational Report.

The research presents a partial analysis of the impact of migration on Australia. It was commissioned to complement research on the impact of migration on the built and natural environments ('Long-term physical implications of net overseas migration: Australia in 2050', Dr Jonathan Sobels, Professor Sue Richardson, Dr Graham Turner, Associate Professor Alaric Maude, Dr Yan Tan, Professor Andrew Beer, Dr Zhang Wei, July 2010).

Key messages

The impact of immigration on population ageing and, hence, upon the rate of growth of per capita GDP, is subject to diminishing returns: the effects get smaller as the migration level increases. An ageing workforce can have adverse consequences for Australia's prosperity. The report deals with a highly simplified mathematical modelling of relationships between the dynamics of population, NOM and Australia's prosperity. In this simplified representation of the issues, the report argues that carefully managed net overseas migration (NOM) can mitigate these. There is a range of NOM levels (160,000 to 210,000) which the modelling suggests would have the 'best' impact by 2050 on ageing of the population and the rate of growth of GDP per capita.

These findings are based on a demographic model MoDEM 2.0. The value of research that is based on models depends crucially on their quality. Experts consider that this modelling makes a useful contribution to the understanding of the issues. As the model is demographic rather than economic, it could benefit from further development and testing to increase its utility. Reviews of this report, including consideration of modelling issues, are available on the Department of Immigration and Citizenship's website.

In addition, further research should have regard to the variable hours worked across occupational categories; the role of positive or negative feedback processes in the Australian economy; the dynamics of the demand for labour and the impact of macroeconomic shocks.

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Immigration, Labour Supply and Per Capita Gross Domestic Product; Australia 2010-2050

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FINAL REPORT

EXECUTIVE SUMMARY

Australia is facing the challenges of population ageing whereby the size of the aged population relative to the working age population increases. This is a challenge because the public costs of aged persons are higher than the costs of persons at other ages.

Ageing can be ameliorated through strategies related to the three Ps: productivity, participation and population. The *2010 Intergenerational Report* emphasizes the importance of enhancing productivity through in vestment in social and economic infrastructure. The *Australian Work Force Futures* report by Skills Australia emphasizes increased labour force participation along with skills enhancement.

In this report, the efficacy of population strategies or, more specifically, migration strategies is investigated. How effective can migration be in ameliorating population ageing in Australia and what would be the ensuing impact on the rate of growth of per capita gross domestic product?

If migration fell to zero by 2012 and then remained at that level, 27.3% of the 2050 Australian population would be aged 65 years and over. This percentage falls to 24.5% with migration of 100,000 per annum, to 22.7% with migration of 180,000 per annum and to 20.7% with migration of 300,000. The number of workers for each older person would be two with zero migration and three with migration of 300,000. Thus, migration can significantly slow population ageing.

The modeling in this report assumes the same labour force participation rates and the same level of annual productivity growth as are assumed in the 2010 Intergenerational Report. With zero migration, the annual rate of growth of real GDP per capita would fall almost immediately to 1.3% and it would remain roughly at that level to 2050. This would be about 20% below the level that would result if age structure had no impact on GDP per capita (1.6%, the assumed level of productivity).

Migration has a meaningful impact on the rate of growth of per capita GDP. From 2013 to 2020, the rate of growth of GDP per capita would be about 0.15 percentage points higher with migration of 180,000 than with zero migration. This is equivalent to an upward shift in productivity of 0.15 percentage points which, if it were to be achieved through productivity improvement, would be considered to be a very desirable result. In 2040, the rate of growth of GDP per capita would be about 0.20 percentage points higher with migration of 180,000 than with zero migration. In the 2040s, however, this effect becomes smaller falling to about 0.10 percentage points by 2050.

The impact of immigration on population ageing and, hence, upon the rate of growth of per capita gross domestic product is subject to diminishing returns, the effects get smaller as the migration level increases. This is inherent in mathematical demography. A population with a constant level of below replacement fertility and a constant level of immigration will eventually reach zero population growth and an unchanging age structure. This process takes about 80-100 years. The ultimate unchanging size of the population will be determined by the constant level of immigration. If a particular level of population were considered to be the desirable 'carrying capacity' for Australia, in theory, this mathematical approach indicates what level of immigration would be necessary to move to and stay at that population level (assuming constant fertility).

Because of these diminishing returns, the question arises as to whether there is a range of migration levels where the advantages gained by a higher rate of growth of GDP per capita are no longer large in comparison with the ensuing demands incurred by increased population size. The answer to this question is not immediately obvious because the changes occur monotonically. In respect of the ageing of the population, it can be concluded that at least 100,000 immigrants would have a desirable effect but, beyond that level, it is difficult to specify a desirable level. However, there are indications that migration in the range of 160,000 to 210,000 provides the most beneficial impact on the rate of growth of GDP per capita. This 'best' outcome is not evident in the short term; it becomes more evident in the long-term, especially by 2050. Again, this is the result of the mathematics of stable populations.

The report also examines the demand for labour relative to its supply. Many studies indicate very strong demand for labour in the next decade as a result of the resources boom and the programme of renewal of Australia's social and economic infrastructure. The wealth generated by the resources boom will spread across the economy creating further demand for labour. Throughout Australian history, immigration has been driven by the demand for labour. In the mid 1970s and mid 1990s, immigration fell to very low levels because of lack of labour demand. Today, it is very high because of strong labour demand and this can be expected to continue for at least the next decade, and probably beyond. By 2020, the labour force would be growing at the rate of 1.3% if immigration is set at 180,000 in the coming decade but would be only growing at 0.3% with zero migration, a growth rate that would continue to fall after 2020. Given the resources boom and its impacts on the broader economy, as reviewed in the report, it seems very unlikely that a 0.3% growth rate of the labour force would meet the strong demand for labour in Australia. This would only be the case if there were to be severe downturn in the economy. While there is a chance that this may occur and that the resources boom may come to an abrupt halt, on the balance of probabilities it is prudent to plan for strong labour demand.

The strong demand for labour cannot be 'switched off' because many of the resources boom contracts are already signed and there is no present indication that the signing of new contracts is about to be truncated. There are numerous development applications awaiting the investment decision. Capacity constraints will necessarily slow down these investments but this will have the effect of spreading them over a longer period of time. Then, simultaneously, governments also wish to develop new social and economic infrastructure which will also be demanding of labour. If the demand for labour far outstrips its supply, there is a risk of inflation and rising interest rates. This means that high levels of immigration can be expected to continue for the next decade and probably beyond.

BACKGROUND

Like other industrialized countries, Australia is facing the challenges of population ageing. Population ageing is the result of sustained low fertility rates in combination with increasing levels of life expectation. In this situation, the size of the aged population relative to the working age population increases. Ageing is a challenge because the public costs of aged persons are higher than the costs of persons at other ages. Rapid ageing is threatening the viability of social security systems in some European countries (European Commission 2005). Australia's fertility rate, now around 2.0 births per woman, is one of the highest in the OECD countries and, if it remains around this level, ageing in Australia will be substantially less of a challenge than it will be in some countries of Europe and East Asia where fertility rates have been below 1.5 births per woman for many years. While the Australian challenge of ageing is moderate compared to most other OECD countries, it remains an important consideration in planning for Australia's longer-term future:

> Population ageing reduces the proportion of working age people supporting people aged over 65 years. The rate of improvement in average living standards is projected to fall, placing pressure on Australia's capacity to fund the spending pressures associated with an ageing population, particularly in terms of health spending (Department of the Treasury 2010: vii).

The Intergenerational Report (Department of the Treasury 2010) discusses the potential for the effects of population ageing to be modified by changes in labour productivity, labour force participation and the population of working age. There is no question, as the report concludes, that, among these three possibilities, economic growth is dominated by the rate of labour productivity. Small changes in labour productivity can have a larger effect on the level of per capita gross domestic product than relatively large changes in participation and population. The Intergenerational Report considers that the best opportunities for improved labour productivity lie in improvements to social and economic infrastructure and these should be vigourously pursued. Nevertheless, for any given level of labour productivity, increases in labour force participation and increases in the relative size of the population in the working age groups have an additional beneficial

effect upon reduction of the ageing challenge and, from that perspective, are worthy of policy consideration.

While having positive macro-economic effects, increases in labour force participation may have detrimental effects as well. For example, if participation in the work force draws young people away from education, it may reduce future levels of labour productivity and social integration. Increased participation at old ages may mean the diminution of the opportunity for a 'well-earned retirement'. Parents of young children may also wish to combine part-time work with parenting and pressure to work full-time would reduce their capacity to do so. This, in turn, could reduce fertility. Increases in paid parental leave could potentially reduce labour force participation but still be regarded as socially desirable. Thus, it is relevant to ask what forms and levels of increased labour force participation are desirable.

Likewise, increases in the population of working age through immigration can have detrimental effects deriving from rapid population increase. If planning and provision lag behind population growth, rapid increases in population will lead to increased housing shortages, urban congestion, strains on the provision of water and energy and environmental degradation. Even if planning for future population growth is well done, there may come a point at which the improvements to age structure brought about by immigration are no longer worth the effort that is involved in managing the consequent population growth.

In this report, we examine the marginal impacts of immigration upon the age structure of the population and upon the per capita rate of growth of gross domestic product (GDP). It is well known that there are diminishing returns to scale in relation to the impact of immigration upon population ageing (McDonald and Kippen 2001). In a previous report, McDonald and Temple (2009) suggested that the marginal increases in GDP per capita tended to level off more markedly when annual net overseas migration rose above about 180,000. This report re-examines these issues in contemporary circumstances using assumptions that are aligned to the assumptions used in the 2010 Intergenerational Report.

The main purpose is to examine whether some (approximate) level of immigration stands out as having a superior balance of outcomes or whether no such conclusion can be drawn? The report is undertaken in the context of the development of the Australian Government's longer-term planning framework for skilled migration (Evans 2010).

The criteria examined in this report are not the only criteria that might be used in determining the size and nature of an immigration program. The paper does not consider the specific skill demands of particular industries and what ensues if these skilled demands are not met. We do not consider what the impacts are upon the economy if there is a gross excess of labour demand over labour supply? Wage inflation and rising interest rates are the theoretical consequences (McKissack et al. 2008) but how large and how significant would these be? The paper does not consider the possibility that immigrants may have different employment patterns to non-immigrants or that immigrants may have different labour productivity levels. Given that immigrants are chosen on the basis that their skills match the skills in short supply in the economy, this should imply an impact on productivity, but how large are the effects?

The paper does not consider the impacts of immigration upon wages nor the fiscal impacts of immigration. In regard to wages, a recent paper by Bond and Gaston (2009) concluded that immigration has a positive impact upon the wages of the domestic labour force, not a negative impact as is usually assumed. The authors postulate that this may indicate that there is complementarity rather than competition between migrant workers and existing workers in the economy. This would occur if immigrants filled skill gaps that were in short supply among existing workers in the economy, the central aim of the Australian immigration program. Immigration also has a generally positive impact on public fiscal balances (Access Economics 2008). While the report examines the impact of immigration upon the ageing of the labour force, it does not address the possibility that there is complementarity rather than substitutability between workers of different ages as has been argued (McDonald and Temple 2006). There is a potential argument that the skills introduced through young migrant workers are a necessary complement to an improvement in productivity among the larger numbers of older workers that would

result from increased participation rates at older ages. This is an example of how all three Ps, productivity, participation and population, can be inter-related but these inter-relationships are not considered in this report.

THE LABOUR DEMAND CONTEXT

The resources boom in Australia has necessitated reconsideration of Australia's labour needs. Announcements of potential huge mining developments are being made on a very frequent basis as are new agreements for the long-term supply of mineral resources to countries such as China, India and Japan. Each new venture would require large numbers of construction workers in the initial phase and then a somewhat smaller number of workers to run the operation once constructed. The Western Australian Chamber of Commerce & Industry has estimated that an additional 400,000 workers will be required in that state over the next seven years (Pearson 2010). The Western Australian Technology and Industry Advisory Council estimated that, in addition to current trajectories for natural increase and migration, Western Australia will require an additional 224,000 new workers by 2016 (TIAC 2009).

News reports talk of competition for workers between Queensland and Western Australia and attempts by employers in those states to draw workers from the southern states (Gaynor 2010, McCarthy 2010). However, past history in Australia suggests that labour shortages are not met through interstate migration and this is confirmed by the fall in net interstate migration to Queensland over the past five years from 36,000 in 2003-04 to 18,000 in 2008-09 despite the strong demand for labour in Queensland. Internal migration to Queensland comes very largely from New South Wales and it seems to be driven mainly by the state of the New South Wales economy. In recent years, absolute employment growth in New South Wales has been the highest of all of the States. In the same five-year period, net overseas migration to Queensland rose from 25,000 to 58,000 indicating that Queensland is now sourcing its excess labour needs mainly from overseas. It has been estimated that the mining workforce in South Australia will grow at an annual average growth of 7.6 per cent out between 2006 and 2014 (O'Neil and Huntley 2006). Most of these new mining ventures are relatively long-term in nature extending for 20

years or so and, because of capacity constraints, potential financing difficulties and construction timetables, many will not come on line for several years. Thus, what appears now to be a short-term demand for labour will inevitably extend into longer-term demand.

Much of the demand arising from the resources boom relates to the construction of related infrastructure including ports, railway lines, pipelines, power stations, water supplies and roads. The use of fly in – fly out workers necessitates upgrades of many airports. All these workers have to be fed and housed.

A recent Treasury Working Paper (McKissack et al. 2008) has concluded that labour demand in the resource-rich States of Queensland and Western Australia over the next three years could only be met through increased population growth as participation is already at a long-term high and unemployment at a long term low. These authors estimated that the increase in population from migration required to meet labour demand assuming constant employment to population ratios would be 35,000 per annum for Western Australia and 91,000 per annum for Queensland. In 2003/04, population increase from international and internal migration was 15,700 for Western Australia and 60,500 for Queensland. By 2008-09, the estimated net migration numbers were 50,000 for Western Australia and 76,000 for Queensland, exceeding the numbers projected by McKissack et al. for Western Australia but not yet for Queensland. However, much of this growth in net migrant numbers was among overseas students, a movement that can be expected to fall in the immediate term..

While continuation of the resources boom is not guaranteed, it has largely continued during the present global financial crisis. However, a further severe downturn in the world economy could lead to a considerable slowing of the boom. As migration reacts relatively rapidly to changes in labour demand in Australia, as indicated by the downturn in 457 visa applications during the GFC, the end of the resources boom would be accompanied by a fall in migration levels. In other words, international migration presently operates in Australia as a flexible mechanism for dealing with skill shortages. Over-supply is an unlikely outcome except in the very short term.

Beyond the infrastructure directly related to the resources boom, Australia is embarking upon a concerted effort to provide updated infrastructure in order to improve productivity across the economy. The broad priority areas identified by Infrastructure Australia (2009) are:

1. A national broadband network
2. Creation of a true national energy market (national grid)
3. Competitive national gateways (ports)
4. A national rail freight network
5. Transformation of cities (public transport)
6. Essential indigenous infrastructure (improved services)
7. Adaptable and secure water supplies

The National Housing Supply Council (2009) reports that an additional 3,060,000 dwellings or over 150,000 new dwellings per annum will be required in Australia by 2028. There is also considerable attention at present upon Australia's health infrastructure and its improvement. The labour demands of these housing, health and infrastructure projects will be considerable and often will be in direct competition with labour demands from the resources sector. However, financial and organizational constraints could slow the development of these objectives and these constraints also need to be considered in estimating future labour demand.

More broadly, the resources boom will produce wealth and that wealth will spread across the economy both through market and taxation mechanisms. The 2010 Intergenerational Report projects that real GDP per capita will almost double by 2050. The ensuing increase in living standards will create increased demand for labour in the service occupations where some 85 per cent of all workers are employed. In addition, if the labour demands described above are met to a large extent by immigration, Australia's population will grow. Population growth has a multiplier effect upon the demand for labour. The additional population must be fed, clothed, housed and generally serviced. Richardson and Teese (2008) have estimated that the Australian economy would require a net addition of 500,000 vocationally educated (VET) workers by 2020 over a period

where exits from the labour force of persons with these skills will be well in excess of entrants. Again, the likelihood of continued high demand for labour is confirmed over a long period of time. The Western Australian Technology and Industry Advisory Council states that demand for training, housing, utilities, infrastructure and social services will grow dramatically in that State (TIAC 2009).

In 2009, Skills Australia contracted Access Economics to consider future labour demand in the context of three scenarios (Access Economics 2009). In its report, Skills Australia opted for one of these scenarios as its preferred option, the so-called 'open doors' scenario (Skills Australia 2010). Under this scenario, the labour force participation rate (ages 15 and over) increases from 65 per cent in 2009 to 69 per cent in 2025. This is an outcome that is strongly counter to the downward movement in participation projected in the Treasury's 2010 Intergenerational Report, a result driven largely by population ageing. Under the Skills Australia scenario, population ageing is clearly not an issue; under the Treasury scenario, it is. That two important national agencies should differ to this extent on an issue of fundamental importance to Australia's future is clearly a matter of interest. There are two main differences between the two agencies that lead to this result. First, the Skills Australia scenario assumes considerably higher future levels of age and sex specific labour force participation rates than does the Treasury scenario. Second, the Skills Australia scenario assumes a much higher level of net overseas migration than does the Treasury scenario (250,000 per annum versus 180,000 per annum). Despite this heavy reliance upon international migration in the 'open doors' scenario, the Skills Australia report states that the outcomes of the scenario can be achieved 'without continued reliance on migration rather than locally grown skills' (Skills Australia 2010: 14). It then calls for considerable new investment in training within Australia. The Access Economics report upon which the Skills Australia report is based took a more sanguine view of migration by saying that with its 'open doors' scenario, there is a risk of a significant skills deficit remaining overtime, however, net migration might close that gap (Access Economics 2009). These varying opinions about future labour force participation are discussed in the following section. In total, the 'open doors' scenario of Skills

Australia projects that the Australian labour force would need to increase by 4.36 million workers between 2010 and 2025, a 37 per cent increase in just 15 years.

When the Australian Bureau of Statistics publishes its final estimate of Net Overseas Migration to Australia for the year 2008-09, it will be about 340,000. This is a massive number by historical standards but it is not comparable with history because, in 2006, the ABS changed its definition of a migrant. Since 2006, people who enter Australia on a long-term **temporary** basis have been counted as migrants. Prior to 2006, the vast majority were not counted as migrants. And, in the years since the definition was changed, temporary entry to Australia has increased dramatically. In 2009, there were 1,440,000 people living in Australia on a long-term temporary basis. Five years earlier this number was just 790,000. About 580,000 of these temporary residents are current overseas students or former overseas students permitted to remain in Australia temporarily for another 18 months. A further 550,000 are New Zealand citizens.

In the next five years, the overseas student population is much more likely to fall than to rise. Australian universities will face massive competition in the immediate future from UK and US universities desperate for cash and the relative shift in currency values will make Australia less competitive. In the Vocational Education and Training sector, the migration rules have been changed both for entry and for conversion to permanent residence. The vast majority of overseas students in Australia take up employment in combination with their studies. A fall-off in the number of overseas students will affect labour demand in certain sectors of the economy.

A high proportion of new permanent residents in Australia are already resident in Australia on a temporary basis when they are granted their permanent residence. A further high proportion of these temporary residents are already in the Australian labour force. Thus, roughly half the new permanent residents of working age in any year do not add to the Australian labour force because they are already working in Australia. Considering this situation and the likely fall in the number of overseas students in Australia, if labour demand remains very strong, a rapid increase could be expected in the

number of temporary Long Stay Business visa holders in Australia. The numbers entering Australia on this visa fell off in the early part of the global financial crisis but are now rising again.

Downturns in the business cycle like the recent severe international downturn can modify upbeat views of Australia's future labour demand, but, if a long-term perspective is taken, chronic long-term under-supply of labour is a larger threat than a possibility of moderate, short-term over-supply. The large pool of temporary residents of Australia also provides something of a buffer against over-supply of labour as indicated by the immediate fall in applications for Long Stay Business visas at the onset of the global financial crisis. Furthermore, during the global financial crisis, the demand for labour has been largely sustained in Australia despite record levels of overseas migration. In previous recessions, immigration to Australia has fallen to low levels. In the current recession, migration has risen sharply.

CHANGES IN LABOUR FORCE PARTICIPATION

In this report, labour force participation is assumed to be the same as that modeled in the main scenario of the 2010 Intergenerational Report. The IGR projections of future labour force participation are very much in keeping with the discussion of labour force participation in our previous report (McDonald and Temple 2009), nevertheless some further evaluation of labour force participation trends is warranted given the different future scenarios assumed by Skills Australia. By OECD standards, the Australian participation rate (ages 15-64) is not especially low as is sometimes inferred; it is ranked 10th out of 30 OECD countries (Department of the Treasury 2010: 27).

Changes in Australia's labour force participation rates by sex and age group between 2000 and 2009 are shown in Tables 1 and 2. For men in age groups from 15-19 to 45-54, there has been little change in participation over this period. For prime age males (those aged 25-54), this is significant because considerable effort and funding has been put into welfare to work programs during this period with apparently very little impact on participation. This is even more surprising given the fact that labour demand was very

strong during these years. The conclusion to be drawn from this experience is that increases in participation for this group are very difficult to achieve despite the social and economic value of doing so.

The Intergenerational Report points out that the participation rates of prime age males have been largely constant for a decade across comparable OECD countries as well. The IGR is not positive about the potential to increase participation among prime age males although it does point out that Australia's rate is a little lower than rates in Canada, New Zealand and the United Kingdom while being higher than the United States. The Access Economics 'open doors' scenario assumes in contrast that participation for prime age males will rise substantially and that, for those aged 30-45, it will rise to 96 per cent in the next 15 years. This would be achieved through post-school training and adult education. This higher level of participation is said by Skills Australia to be achievable because 'international evidence shows that comparable countries to Australia do achieve higher rates of participation' (Skills Australia 2010: 3). However, none of the other English-speaking countries have rates of participation for men in this age range that approach 96 per cent (Table 3). Access Economics points out that this high level of participation would result if all prime age Australian males had post-school qualifications on the assumption that those gaining these qualifications achieved the same participation as those that already have these qualifications. While for reasons of social inclusion it would be desirable that all prime age males gained post-school qualifications in the next 15 years, this seems to be an unlikely eventuality, particularly for those who have been many years out of education. Nevertheless, there is scope to increase the participation rates of prime age males and there are very good reasons that this is a priority of government.

Table 1. Labour Force Participation Rates, Males by Age Group, Australia 2000-2009 (July)

	15-19	20-24	25-34	35-44	45-54	55-59	60-64	65+
2000	59.3	87.5	93.2	91.7	87.0	71.6	46.5	10.1
2001	59.9	87.1	91.0	91.5	87.6	70.2	47.0	10.2
2002	56.9	85.0	91.6	90.8	87.8	71.4	48.4	10.5
2003	54.9	85.1	91.2	90.3	87.4	72.3	50.5	10.5
2004	58.1	83.6	91.3	90.5	87.0	75.4	51.9	10.4
2005	57.4	85.1	90.8	91.2	87.9	76.2	54.8	12.2
2006	57.1	85.4	91.9	91.1	88.7	77.5	56.1	12.4
2007	57.1	84.8	92.3	91.3	89.0	77.1	56.6	13.4
2008	57.8	84.0	92.4	91.6	88.3	76.5	57.7	14.7
2009	53.4	84.4	90.6	91.4	88.7	79.2	58.4	15.8

Source: Australian Bureau of Statistics.

Table 2. Labour Force Participation Rates, Females by Age Group, Australia 2000-2009 (July)

	15-19	20-24	25-34	35-44	45-54	55-59	60-64	65+
2000	58.9	77.9	70.8	71.5	71.3	48.0	21.7	2.9
2001	59.2	78.5	71.3	72.3	70.1	49.2	21.8	3.4
2002	56.8	76.5	70.5	71.2	73.3	49.4	23.8	3.3
2003	58.5	76.9	70.2	72.2	73.2	51.7	27.8	3.2
2004	59.6	75.9	71.1	70.3	73.6	53.7	30.8	3.5
2005	61.6	76.6	72.7	73.2	75.7	55.8	30.6	4.4
2006	60.2	78.5	72.7	74.2	76.3	58.7	32.9	4.2
2007	58.8	77.2	72.5	74.0	77.4	59.1	36.7	5.2
2008	59.6	79.0	73.5	75.1	77.3	61.1	37.6	5.6
2009	55.5	75.9	72.7	75.6	78.2	63.0	41.5	5.9

Source: Australian Bureau of Statistics.

Table 3. Age specific labour force participation rates, males aged 25-54, various countries, 2008

Country	25-34	35-44	45-54
Australia	92.4	91.7	88.7
New Zealand	92.1	93.1	89.8
Canada	91.7	92.2	91.8
United Kingdom	93.1	92.5	89.3
United States	91.5	92.2	88.0

Source: OECD Stat Extracts, accessed 28 March 2010.

For women in the prime working ages, participation has increased in the last decade by about two percentage points for those aged 25-34, four percentage points for those aged 35-44 and six percentage points for those aged 45-54 or an average of about 4 percentage points for the age range, 25-54 years. The Access Economics 'open doors' scenario assumes that female participation in the age range 25-54 will increase by about 10 percentage points in the next 15 years. Comparison with other English-speaking countries

indicates that the participation rates of women in these ages tend to be higher in the other countries than in Australia, especially in Canada (Table 4). Canada's participation for women in this age range is currently 82 per cent, about seven percentage points above the Australian level. The Skills Australia target might be met if Australian women behaved in the future like Canadian women do today. It should also be noted that Australian women in these ages are much more likely than Canadian women to work part-time. The IGR is not specific about its assumptions about future participation for women in this age group but an increase has been assumed.

Table 4. Age specific labour force participation rates, females aged 25-54, various countries, 2008

Country	25-34	35-44	45-54
Australia	74.1	74.8	77.3
New Zealand	73.8	77.0	81.7
Canada	81.3	82.9	81.7
United Kingdom	76.6	78.2	80.1
United States	75.2	76.1	76.1

Source: OECD Stat Extracts, accessed 28 March 2010.

In the two younger age groups, 15-19 and 20-24, participation has fallen a little since 2000 for both men and women and this was especially so between 2008 and 2009 probably as a result of the global financial crisis. With increasing emphasis upon post-school training and the extension of schooling, it is unlikely that participation rates will rise in the future above their standard levels over the past decade. The Skills Australia 'open doors' scenario projects increases in participation at these ages for both men and women despite the fact that participation at these ages is already a lot higher in Australia than in the other English-speaking countries. There is a strong tendency for Australian full-time students to work part-time explaining the higher participation at these ages than in other countries.

At older ages (55 years and over), participation has been rising strongly for men over the past decade and even more strongly for women. Both the IGR and Skills Australia reports project that increases in participation at these ages will continue. Several policy directions as described in the IGR are supportive of this trend including an increase in the pension age for women, the introduction of the Work Bonus that treats earned income more generously under the pension income tests and superannuation taxation incentives

to continue working to at least age 60. More policy initiatives in this direction are presaged in the IGR. Higher participation at older ages can be expected for women because of the 'cohort' effect, that is, because participation rates have increased at younger ages in the past, there is a flow on effect as women age to the older ages.

Furthermore, there are a range of reasons not related to policy that older males will increase their participation. Future jobs will be less likely to be physically demanding. The next generation of 55 year-olds started work later than their older peers, so, if they work the same years, they will also end later. More people will be self-employed or have a higher degree of autonomy in their work. The next generation will be healthier and more aware of the long years that remain in their lives. The coming 55-64 year age group will have had their children at later ages and their children will stay financially dependent for more years. Simultaneously, they may have financial responsibilities for their own parents. Being the baby-boom generation, they have expectations of higher living standards in retirement than their parents had. The Aged Pension alone will not be enough. And their years living on retirement income will be longer. Because of cohort changes in women's participation, the wives of 55-64 year-old men will be more likely to be working in the future: wives will be less likely to be encouraging their husbands out of the labour force. And, maybe, the next generations of 55-64 year olds will have lives that are more 'work-defined' and they may like their jobs more than previous generations did.

In comparison with other English-speaking countries, participation rates for older Australian males are a little lower but similar to those in all of the other countries except for New Zealand at all ages above 55 and for the USA for men aged 65-69. The very high rates of participation in New Zealand are probably related to a relative absence of work disincentives because of the availability of a generous age pension (New Zealand Superannuation) that is not income-tested. For women, Australian participation rates are noticeably lower than in all of the other English-speaking countries except the United Kingdom. Again, New Zealand has very high participation rates. The rates projected by Skills Australia for participation above age 60 in 2025 are lower than the current rates in

New Zealand. At these ages, there is relative consistency between the IGR and the Skills Australia projections.

Table 5. Age specific labour force participation rates, males aged 55-69, various countries, 2008

Country	55-59	60-64	65-69
Australia	76.3	58.0	28.6
New Zealand	87.9	75.0	40.2
Canada	77.1	55.4	27.0
United Kingdom	80.0	60.0	22.5
United States	78.8	59.9	36.6

Source: OECD Stat Extracts, accessed 28 March 2010.

Table 6. Age specific labour force participation rates, females aged 55-69, various countries, 2008

Country	55-59	60-64	65-69
Australia	60.8	37.8	14.2
New Zealand	74.1	54.3	25.6
Canada	66.0	41.1	16.0
United Kingdom	65.5	34.5	12.4
United States	67.7	48.7	26.4

Source: OECD Stat Extracts, accessed 28 March 2010.

In summary, the capacity to meet Australia's future increased labour demand through increases in participation rates is limited. While there will be increases in participation at older ages, older workers will not have many of the skills that will be required. If those in the prime working ages now out of the labour force can be brought into the labour force, they also will not have the skills that will be required. These participation strategies are essentially 'low-skills' strategies. They provide employment to those that need it and reduce the government's social security bill, but do not meet the skills needs of the broader economy. Beyond the issue of skills, in absolute terms, McDonald and Temple (2009) have shown that even 'maximum' levels of future labour force participation would have only a small impact on the size of the Australian labour force, well below the likely level of demand for labour. Unless labour demand is curtailed in Australia through slowing the pace of the resources boom, substantial recourse to migration seems to be inevitable.

OBJECTIVES OF THE REPORT

McDonald and Temple (2009) have shown that, in Australia's present situation, increased levels of migration would:

1. Increase the size of the population
2. Lower the average age of the population
3. Increase the size of the labour force
4. Lower the age of the labour force
5. Increase GDP
6. Increase the growth rate of GDP per capita.

However, the marginal benefits of increased migration levels to age structure and growth in GDP per capita tend to decline as the level of migration increases; there are diminishing returns to scale (McDonald and Kippen 2001, McDonald and Temple 2009). At the same time, increases to migration add constantly to the population and this increases the burdens associated with the provisioning and servicing of a growing population. This gives rise to the question of balance. At what point do the disadvantages of increased population outweigh the advantages to the economy of increases in immigration? This is a very large question and is beyond the scope of this report. Instead, this report examines one component of this question. Is there a point where further increases in immigration lead to substantially lower marginal increases in the growth of GDP per capita?

The objectives of the report are:

1. To model the effects of varying levels of net overseas migration on future population size, the age structure of the population, the size and age structure of the labour force and the growth of GDP and GDP per capita.
2. By examining changes in the marginal effects of increasing levels of net overseas migration on the growth rate of GDP per capita, to determine whether any particular migration level or range of levels marks a turning point where the

advantage of further migration is likely to be outweighed by the disadvantages of increased population.

With the exception of the use of varying levels of net overseas migration, the modeling in the report aligns its input assumptions to those used in the 2010 Intergenerational Report.

The modeling in this report makes use of the Productivity Commission's MoDEM model (Cuxson et al. 2007). The detailed description of the modeling procedure is provided in Appendix 1. The appendix also describes the limitations of the results.

Model inputs

The model has the following 10 inputs:

1. A base population by sex and age in single years. The 30 June 2009 Estimated Resident Population of Australia is used in all scenarios.
2. The Total Fertility Rate (TFR) and associated age specific probabilities of birth (single years of age). TFR is assumed to fall to 1.9 births per woman by 2013 and then remain constant to 2050 in all scenarios.
3. Expectations of Life at Birth for men and women and the associated age and sex specific probabilities of death (single years of age). For men, expectation of life is assumed to increase to 87.7 by 2052. For women, the assumed increase is to 90.5 years by 2050.
4. The numbers of permanent and long-term arrivals and departures to Australia and their associated age and sex distributions (single years of age). Scenarios make use of varying assumptions about net overseas migration (NOM), the excess of arrivals over departures. The scenarios are described in the following section.
5. Age and sex specific labour force participation rates in five-year age groups from 15-19 to 65-69 and age group 70 and over. In line with the 2010 Intergenerational Report, the labour force participation rate of persons age 15 and over falls from 65 per cent in 2009 to 62 per cent in 2050.

6. Age and sex specific rates of unemployment (same age groups as 5). Overall unemployment remains at 4.9 per cent throughout the period of study.
7. Part-time work shares for each age and sex category (same age groups as 5). A single assumption is used.
8. Average weekly hours worked by full-time workers by age and sex (same age groups as 5). A single assumption is used.
9. Average weekly hours worked by part-time workers by age and sex (same age groups as 5). Average hours of work fall from 33 hours per week in 2009 to 32 in 2050.
10. Aggregate annual productivity growth. Set at 1.6 per cent per annum throughout the projection period. The age and sex productivity profile is assumed to be flat, that is, all age and sex groups of workers are assumed to be equally productive. Importantly also, migrants and the domestic population are assumed to have the same productivity.

Model Outputs

The outputs from the models that are discussed in this report are divided into three types:

1. Population outcomes including population size, the rate of population growth and the percentages of the population aged less than 15, 15-64 and 65 years and over.
2. Labour force outcomes including the future size of the labour force, the growth rate of the labour force, the labour market entry-exit ratio (defined as the number of persons aged 15-24 divided by the number of persons aged 55-64), and the percentages of the labour force aged less than 25, 25-54, 55-64 and 65 years and over.
3. GDP per capita and growth of GDP per capita.

RESULTS: OBJECTIVE 1

The effects of different levels of migration upon the outcome measures is described using four scenarios of future net overseas migration as shown in Table 7. All four scenarios phase in a new level of net overseas migration over a three-year period from 2009.

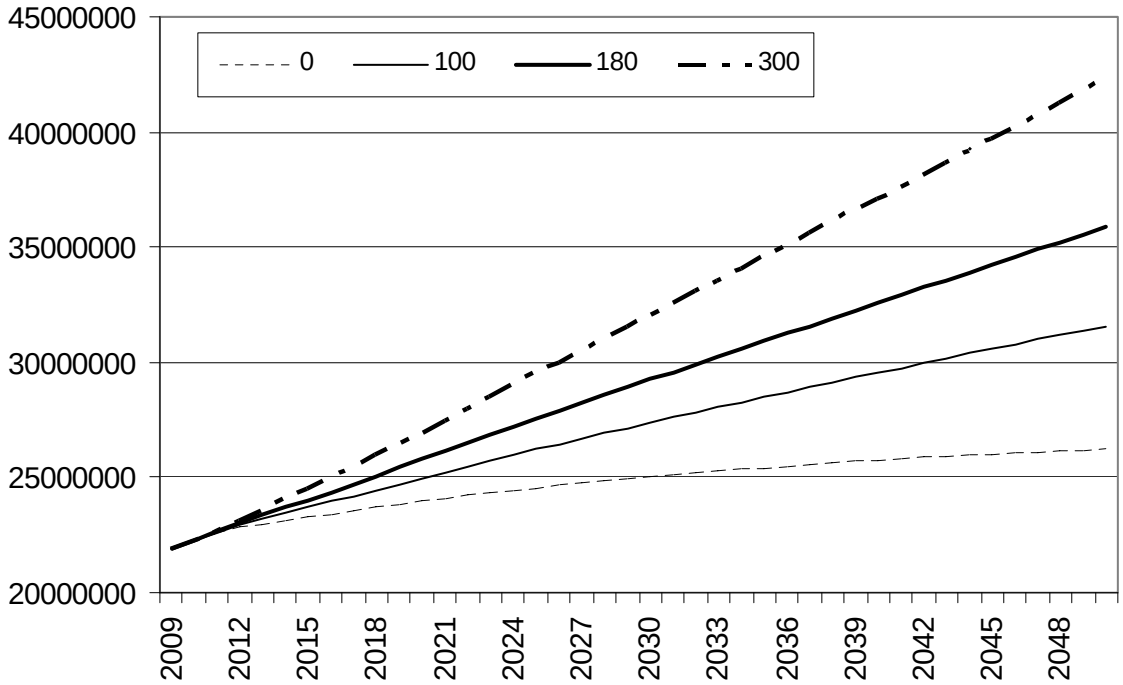
Table 7. Assumed NOM scenarios (000's per annum)

Year	NOM Scenario			
	0	**100**	**180**	**300**
2009	244	244	244	244
2010	163	196	223	263
2011	81	148	201	281
2012-2050	0	100	180	300

Population Outcomes

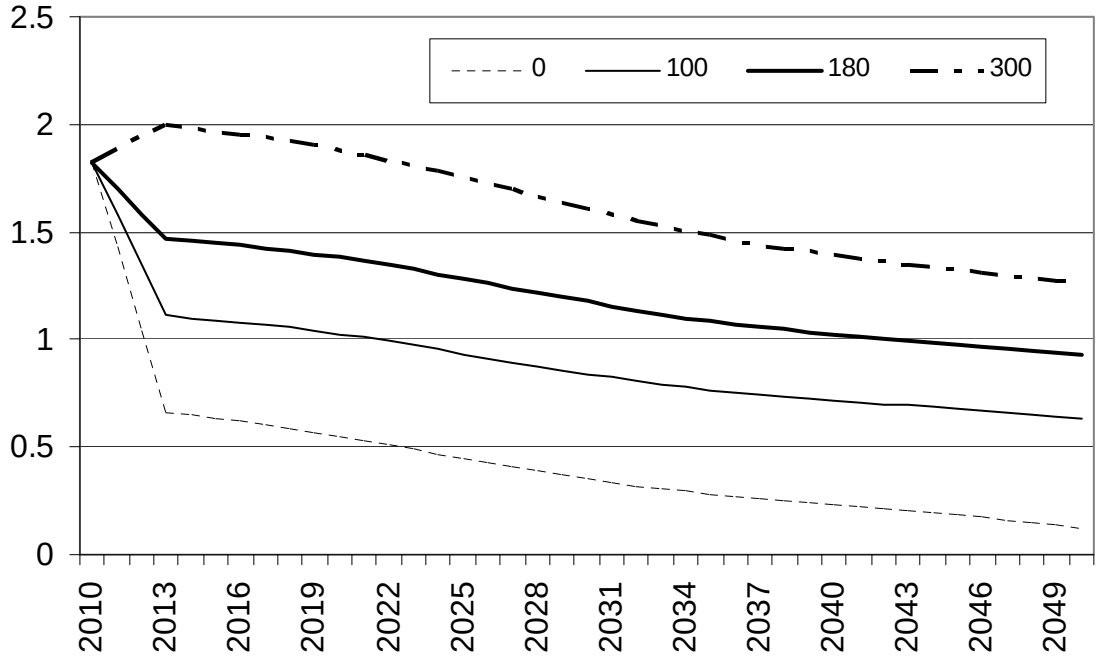
Under the zero migration scenario, Australia's population would rise slowly to about 26.2 million in 2050 (FIGURE 1). Half of its increase would be in the first decade, 2010-2020. By 2050, the population would reach 31.6 million with migration set at 100,000, 35.9 million with migration set at 180,000 and 42.3 million with migration set at 300,000. Migration has a direct and strong impact on the growth of Australia's population.

Figure 1. Population Size, by Scenario, 2009-2049



With zero migration, the rate of population growth would fall rapidly to a much lower 0.66% from the initial level of 1.82% (FIGURE 2). It would then gradually fall and be close to zero by 2050. Once net migration becomes zero, population growth is determined by the balance of births over deaths. This remains positive until 2050 because the birth rate is assumed to remain close to the replacement level throughout the period. By 2050, the population growth rate falls to 0.63% with NOM of 100,000, to 0.93% with NOM of 180,000 and to 1.26% with NOM of 300,000. Thus, even with extremely high migration, the increase of deaths compared to births will bring the population growth rate down to a level well below its present level.

Figure 2. Population Growth, by Scenario, year 20 2010, 2050



Figures 3-5 show the impacts on the future age distribution of the population under varying levels of NOM. The effects of all scenarios are small in the first decade to 2020. The limited capacity of immigration to influence the age structure is indicated by the fact that the proportion of the population aged 65 and over rises under all scenarios and the proportion in the working ages (25-64) falls. Despite this, immigration leads to a significant slowing down of the extent of ageing and in the fall in the percentage of the population that are of working age. With zero migration, the proportion of the population aged 65 and over would rise to 27.3% by 2050 and would continue to rise rapidly beyond 2050. With 300,000 NOM, those aged 65 and over would represent only 20.7% of the population in 2050 and the percentage would be rising much more slowly. By 2050, there would be two workers for every aged person with zero migration compared with three workers per aged person with 300,000 net migration. Migration does not have much impact on the proportion of the population aged 15 years and younger. Under zero migration, this proportion would fall by 2050 from 19% to 16.4%. The same proportion would fall to 17.6% with NOM of 300,000.

Figure 3. Population Aged <15, by Scenario 2009-2049

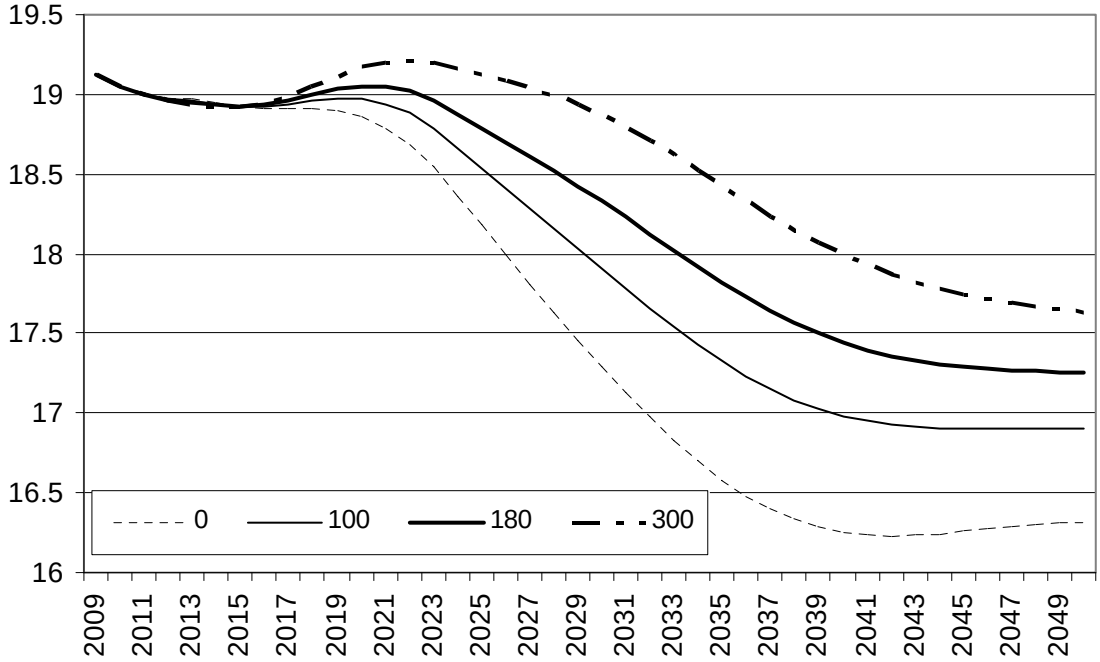


Figure 4. Working Age Population, by Scenario 2009-2049

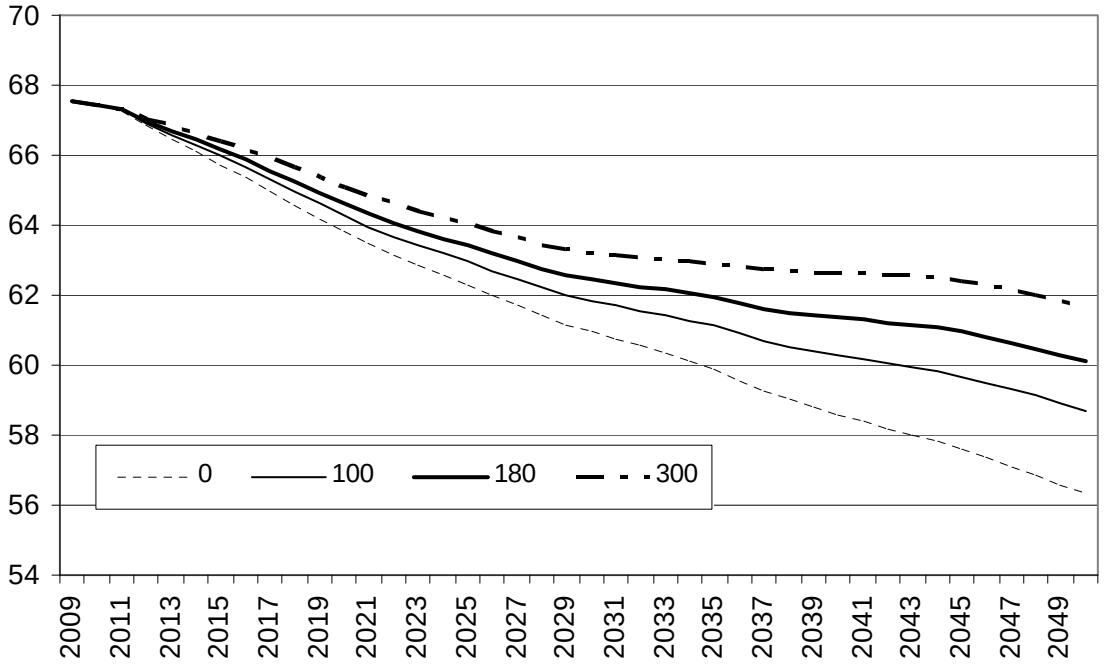
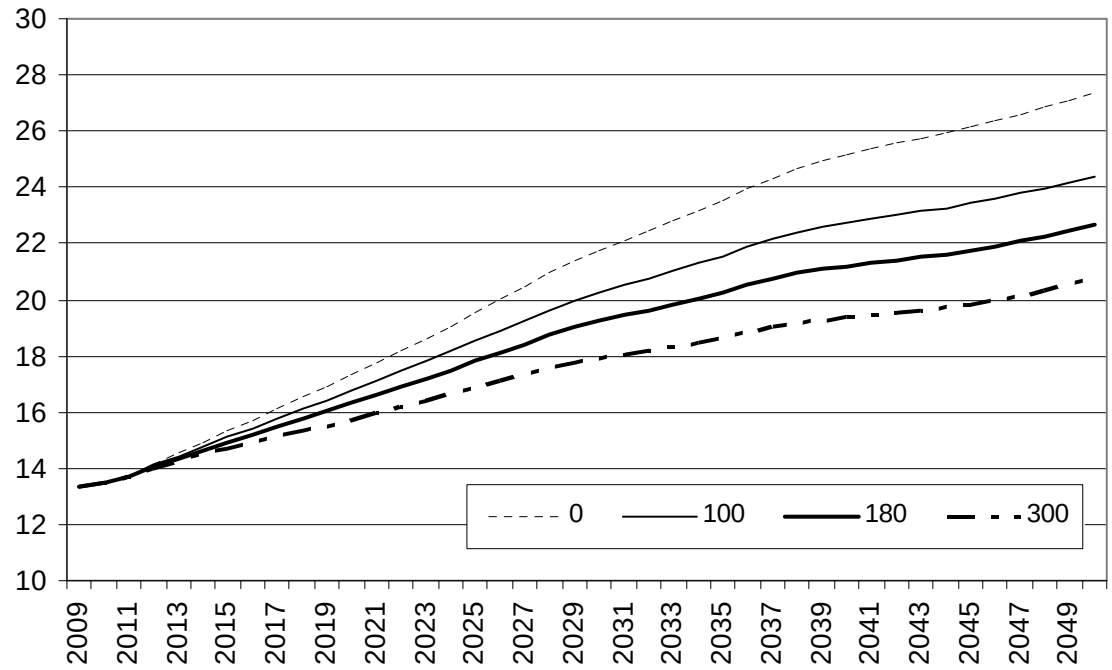


Figure 5. Population Aged 65+, by Scenario 2009-2049

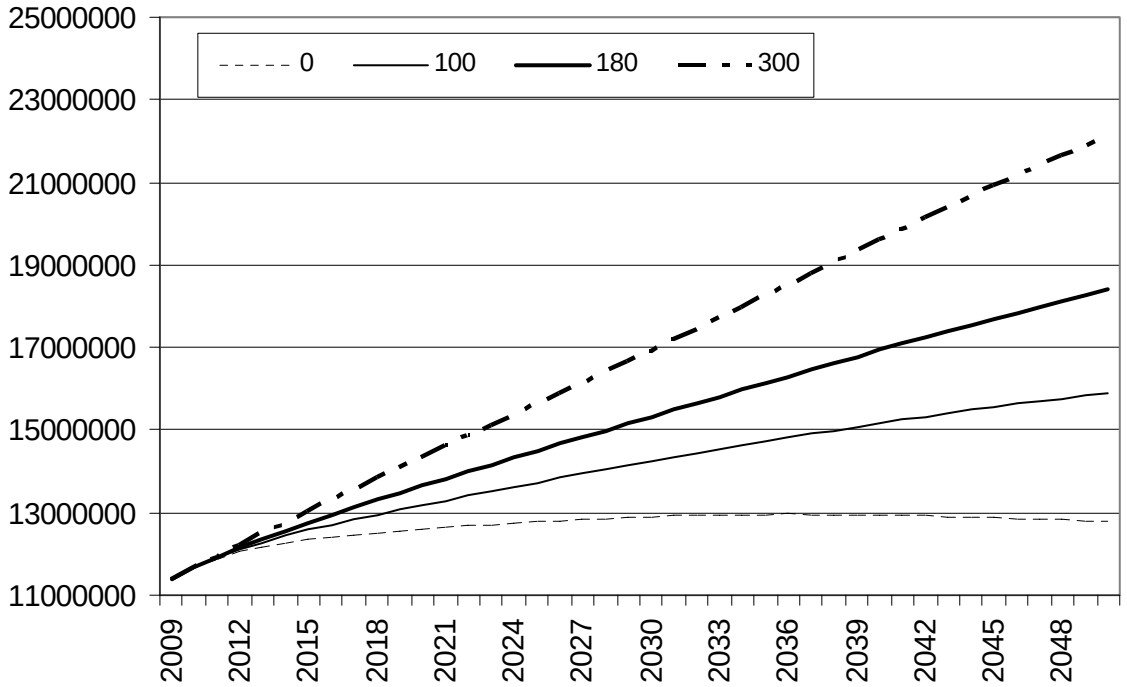


Labour Force Outcomes

Figure 6 displays the impact of varying levels of migration upon the size of the labour force. Because the zero migration assumption is assumed to phase in over a few years and because the large-scale retirement of the baby boom is yet to come, under the zero migration scenario, the labour force grows by about one million workers between 2009 and 2015. In the two decades after 2015, the Australian labour force would grow by only 600,000 workers after which it would begin to fall. Thus, leaving aside the growth that will occur in the next five years, the zero migration assumption is essentially an assumption about near-zero growth of the labour force. Under the 100,000 migration scenario, the labour force would grow from 11.4 million in 2009 to 15.9 million in 2050. With 180,000 migrants, the labour force in 2050 would reach 18.4 million and 22.1 million with 300,000 migrants. Thus, like population, migration has a direct and large impact on the size of the labour force. The Skills Australia 'open doors' scenario projects Australia's labour force to reach 16.0 million by 2025. This is a higher level than would be reached by even the 300,000 migration scenario. The 'open doors' scenario obtains

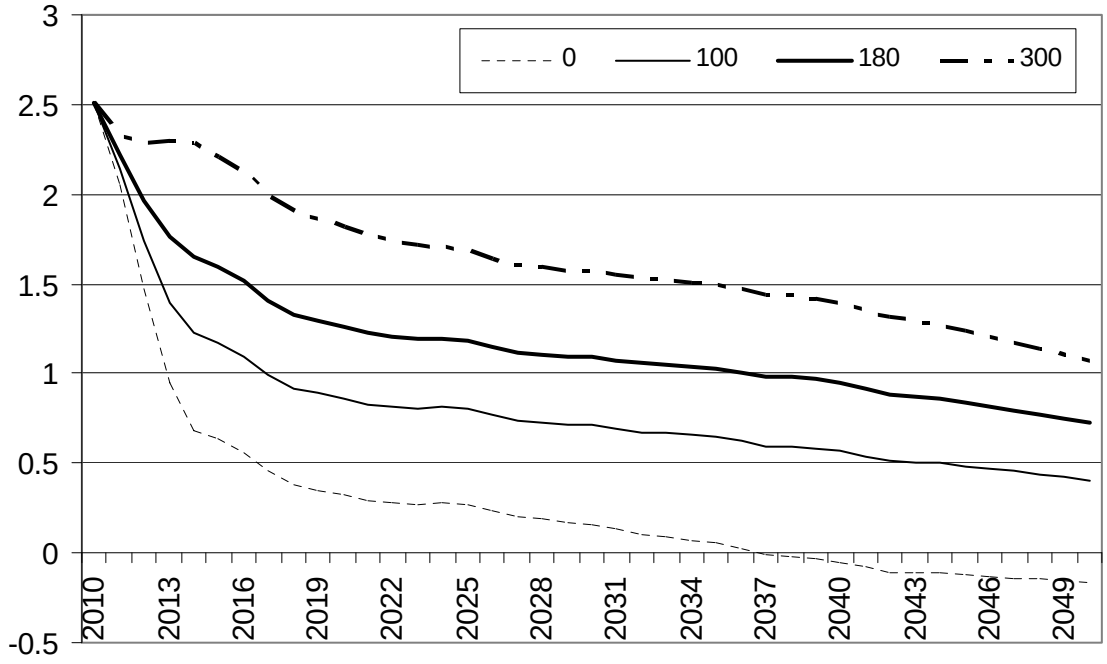
this result despite a lower migration assumption because of its very much higher assumptions about future labour force participation.

Figure 6. Labour Supply, by Scenario 2009-2049



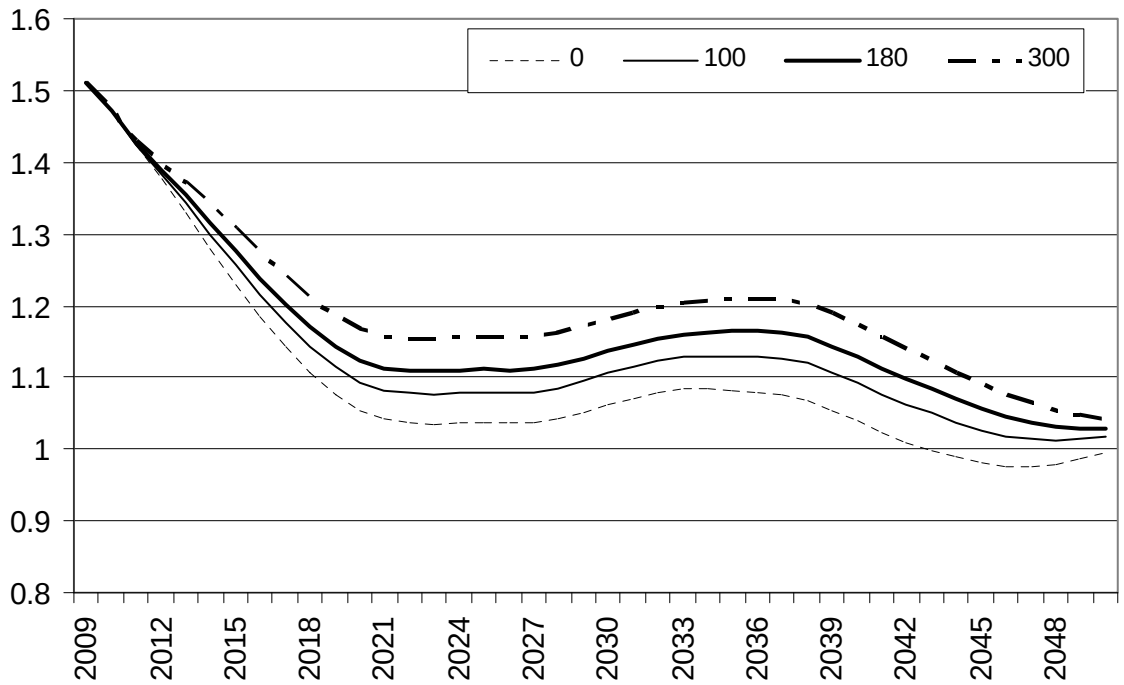
The growth rate of the labour force falls away sharply from its present abnormally high level for all levels of migration between zero and 300,000 (Figure 7). Before the very large levels of migration in 2008 and 2009, the labour force was growing at an annual rate of about 1.2% per annum. While no specific estimates have been made of the labour force growth that will be required to meet the strong labour demand in the future (see above), it is very likely to require growth as high as 1.2% per annum for the next two decades. With zero migration, the growth of the labour force falls to 0.6% by 2014 and then falls to zero by 2036. With 180,000 immigrants, the growth rate of the labour force remains above one per cent until 2036 and with 300,000 immigrants, the growth rate will be above 1.5% in the next two decades and above one per cent until 2050.

Figure 7. Labour Supply Growth, by Scenario year to 2010 - 2049



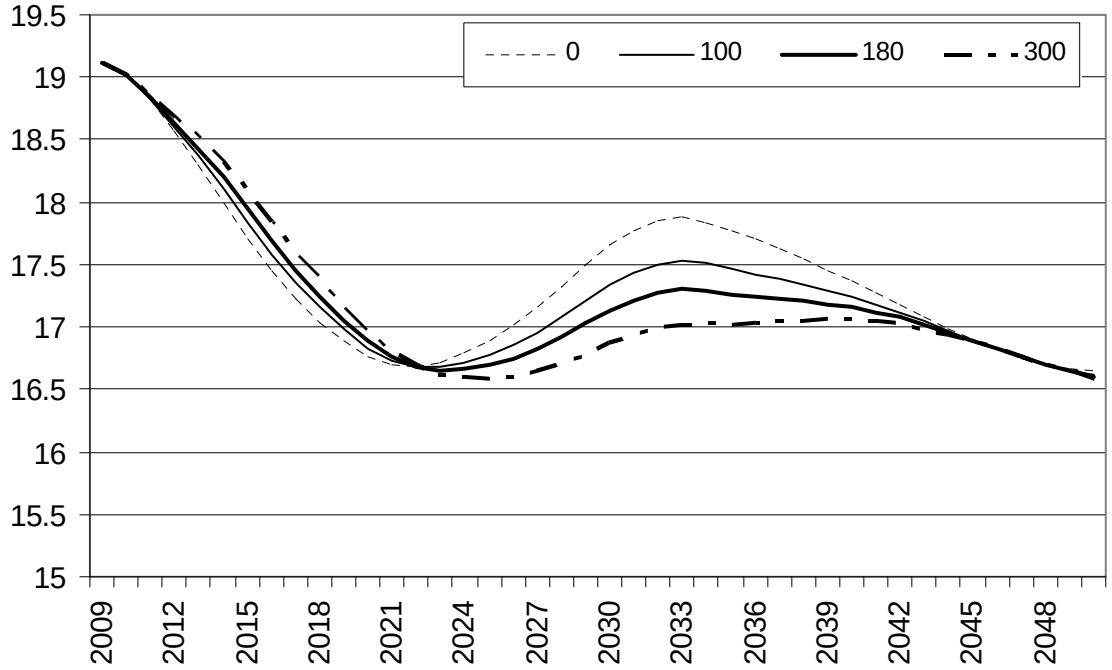
The entry/exit ratio (Figure 8) is less affected by migration because most migrants are aged between the two age groups used for this measure (15-24 and 55-64). Accordingly the measure is driven mainly by the changing age structure of the population. It initially falls sharply irrespective of the level of migration reflecting the movement into the retirement ages of the baby-boom generation. In the 2030s, the measure rises as the current and impending high numbers of births feed into the 15-24 age group.

Figure 8. Labour Supply Entry Exit Ratio, by Scenario 2009-2049



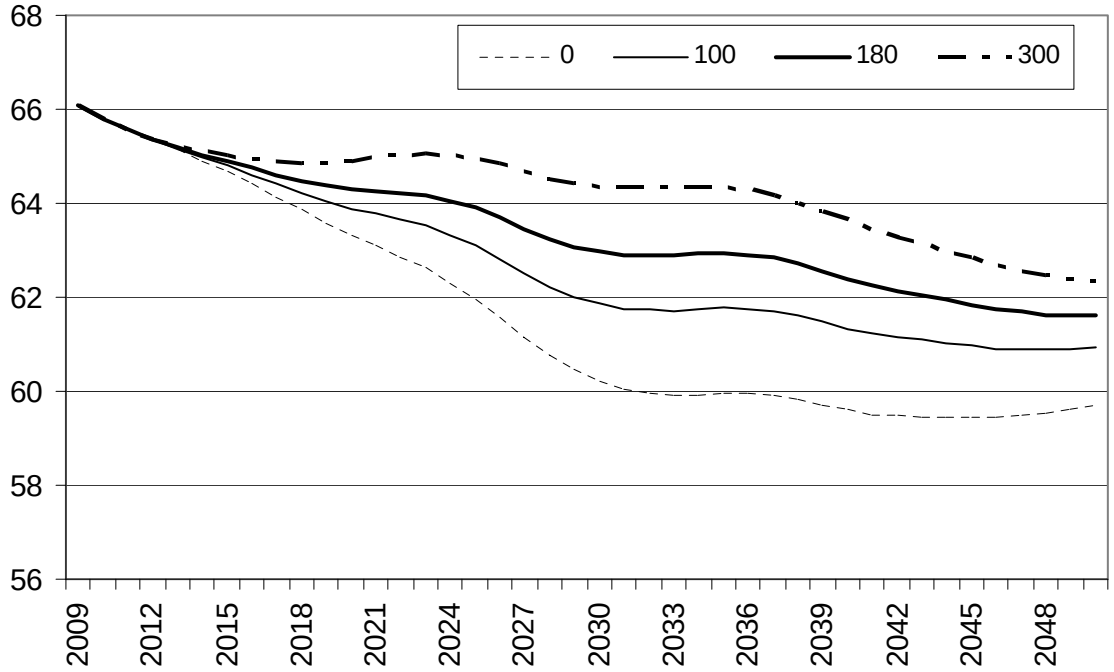
The proportion of the labour force aged 15-24 does not change much over the 40 years and does not vary much between the differing levels of migration (FIGURE 9). It will constitute around 17% of the total labour force. The rises in the 2030s once more reflect the current and prospective higher numbers of births. The inevitable ageing of the labour force is evident from the declining proportion of the labour force in the prime working ages from 66% currently to between 60% and 62% by 2050 (FIGURE 9).

Figure 9. Labour Supply Aged 15-24, by Scenario 2009-2049



Higher levels of migration lead to higher percentages of the labour force being in the prime working ages but the differences are not large (FIGURE 10).

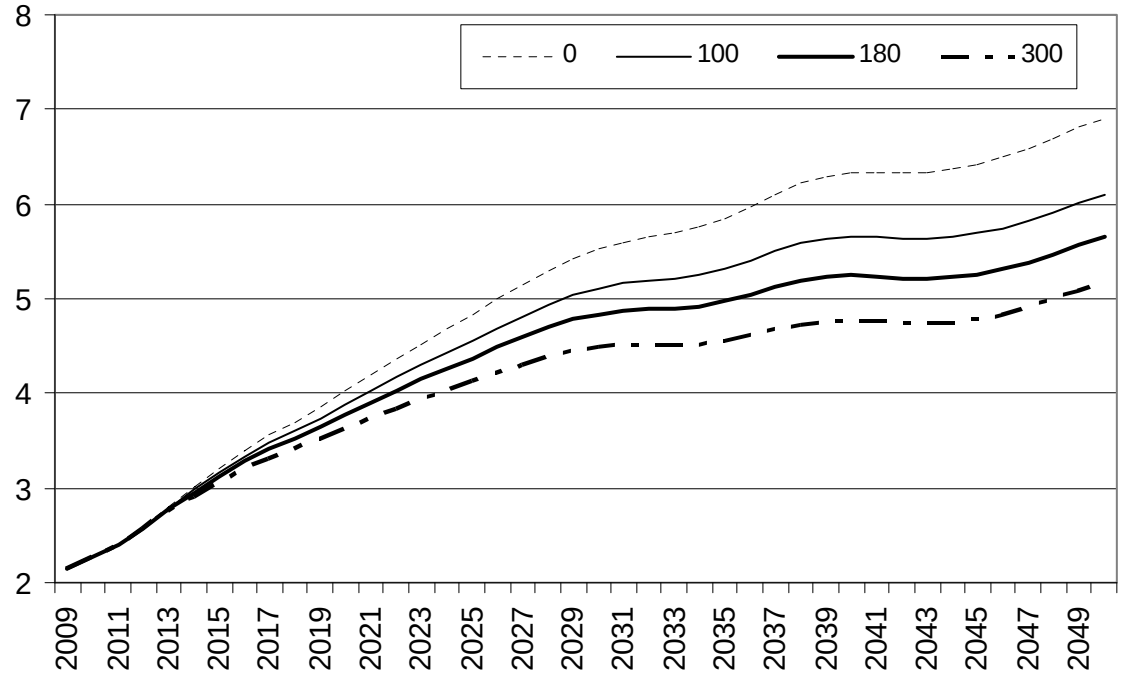
Figure 10. Labour Supply Aged 25-54, by Scenario 2009-2049



The proportions of the labour force aged 55-64 and 65 and over increase strongly in the next decade due mainly to the assumed increases in participation at these ages (FIGURES 11-12). For age group 55-64, these increases tend to flatten out after 2020 but the proportion for those aged 65 and over continues to rise throughout the projection period. While it is sometimes suggested that migration will make the labour force older when the migrants reach old age, these graphs show that the labour force ages more the lower is the level of migration.

Figure 11. Labour Supply Aged 55-64, by Scenario 2009-2049

Figure 12. Labour Supply Aged 65+, by Scenario 2009-2049

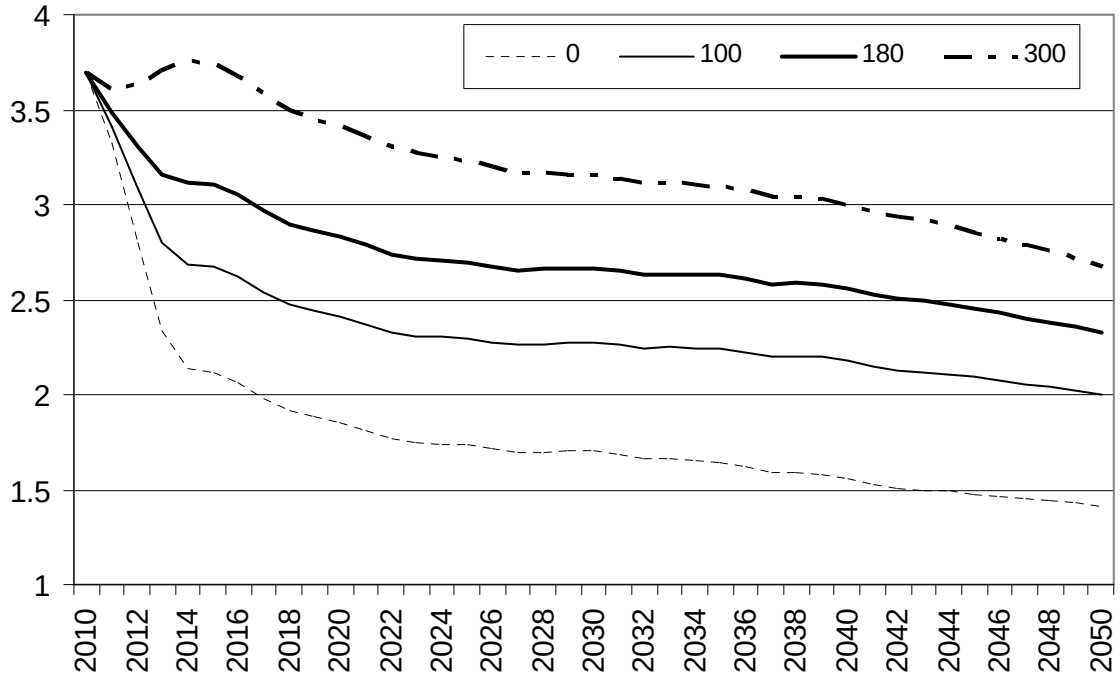


The summary from this sub-section is that migration has a large impact on the size and growth of the labour force but a relatively small impact on the age structure of the labour force.

Outcomes for Gross Domestic Product

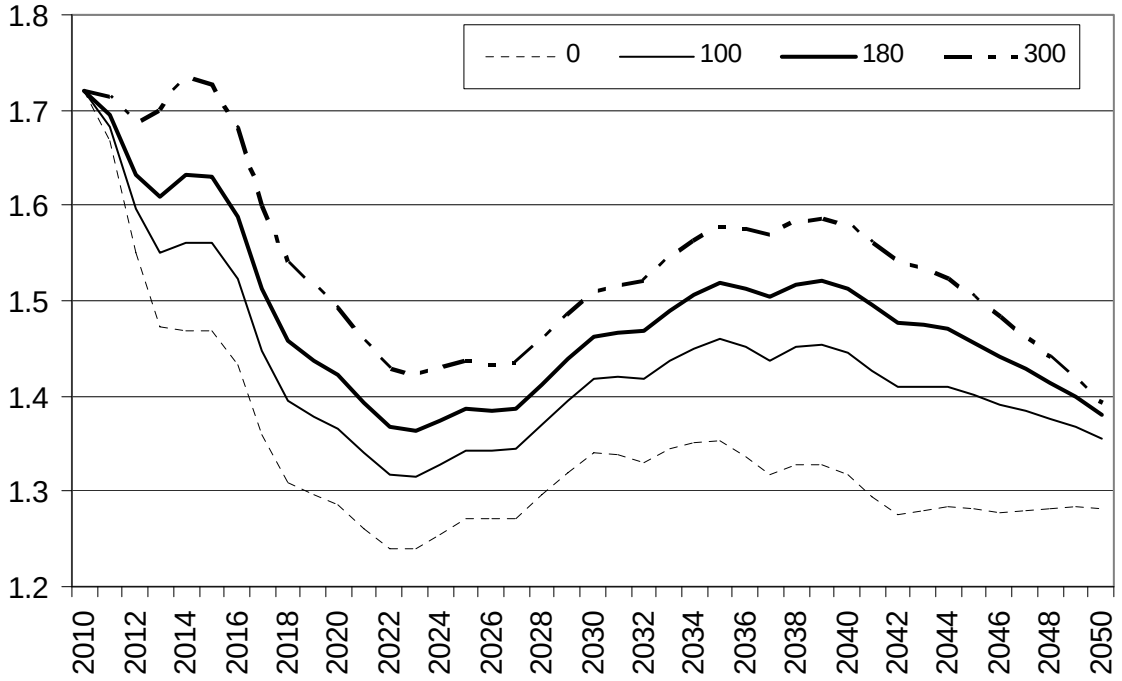
The annual rate of growth of GDP increases sharply with higher levels of immigration (FIGURE 13). A larger population means a larger GDP. By 2050, the size of the Australian economy would be 108% larger than in 2009 with zero migration, 160% with 100,000 migrants per annum, 202% with 180,000 migrants and 263% with 300,000 migrants. Size of an economy is not a measure of wellbeing of the residents of a country but it does influence the international forums to which the country is invited.

Figure 13. GDP Growth, by Scenario, year to 2010-2049



GDP per capita is an internationally accepted measure of wellbeing. For example, it is a key component of the Human Development Index. Despite assumed increases in participation, ageing of the population will lead to a substantial lowering of the rate of growth of GDP per capita in the next decade irrespective of the level of migration (FIGURE 14). However, the fall increases greatly (relative to the underlying 1.6% productivity growth) as the level of migration falls. With zero migration, the growth rate of GDP per capita essentially never rises again hovering around 1.3% for the 30-year period from 2020 to 2050, that is, age structure would be reducing the underlying outcome due to productivity by almost 20% for this entire period. The level of recovery of the growth of GDP per capita in the 2030s and 2040s is much sharper when annual migration is 100,000, 180,000 or 300,000. Migration would lead to higher growth rates of GDP per capita throughout the entire period to 2050. By 2050, GDP per capita would be 72.6% higher than in 2009 with zero migration, 79% higher with 100,000 migrants per annum, 83% higher with 180,000 migrants and 87% higher with 300,000 migrants.

Figure 14. GDP Per Capita Growth, by Scenario, year to 2010-2049



Summary

Because of the imminent movement out of the labour force of the baby-boom generation, without migration in the next decade, Australia faces a major fall in the rate of growth of the labour force and a substantial fall in the rate of growth of GDP per capita. The age of the labour force will also increase; a higher proportion will be aged 55 years and over and a lower proportion will be aged less than 25. Migration, not unexpectedly, has its most significant impact on the growth rate of the labour force. By 2020, the labour force would be growing at the rate of 1.3% if immigration is set at 180,000 in the coming decade but would be only growing at 0.3% with zero migration. Given the resources boom and its impacts on the broader economy, as reviewed above, it seems very unlikely that a 0.3% growth rate of the labour force would meet the strong demand for labour in Australia.

Migration also has a meaningful impact on the rate of growth of per capita GDP. From 2013 to 2020, the rate of growth of GDP per capita would be about 0.15 percentage

points higher with migration of 180,000 than with zero migration. This is equivalent to an upward shift in productivity of 0.15 percentage points which, if it were to be achieved through productivity improvement, would be considered to be a very desirable result.[1] The impact of immigration on the ageing of the labour force is positive but relatively small.

After 2020, the growth rate of the labour force would continue to fall through to 2050 and beyond under all migration scenarios (FIGURE 7) but the additions to labour force growth made by varying levels of migration would remain roughly constant. By 2040, under the zero migration scenario, the growth rate of the labour force would be negative under the zero migration scenario but about 0.9% under the 180,000 migration scenario. The positive impact of migration upon the growth rate of GDP per capita remains at about the 2013-2020 level throughout the 2020s but begins to grow in the 2030s to a maximum around 2040. In 2040, the rate of growth of GDP per capita would be about 0.20 percentage points higher with migration of 180,000 than with zero migration. In the 2040s, however, this effect becomes smaller falling to about 0.10 percentage points by 2050.

RESULTS: OBJECTIVE 2

The second objective of this report is to determine whether any particular migration level marks a turning point where the advantages of migration begin to fall off quickly. This is done by examining the marginal impacts on ageing of the population and the rate of growth of GDP per capita of an additional 10,000 migrants as migration increases from zero to 340,000. The full set of graphs detailing 10k increment effects on labour supply growth, labour supply entry/exit ratios, labour supply age, GDP, GDP Per Capita, population growth, population aged 65+, working age population and population aged under 15 are shown in appendix 2.

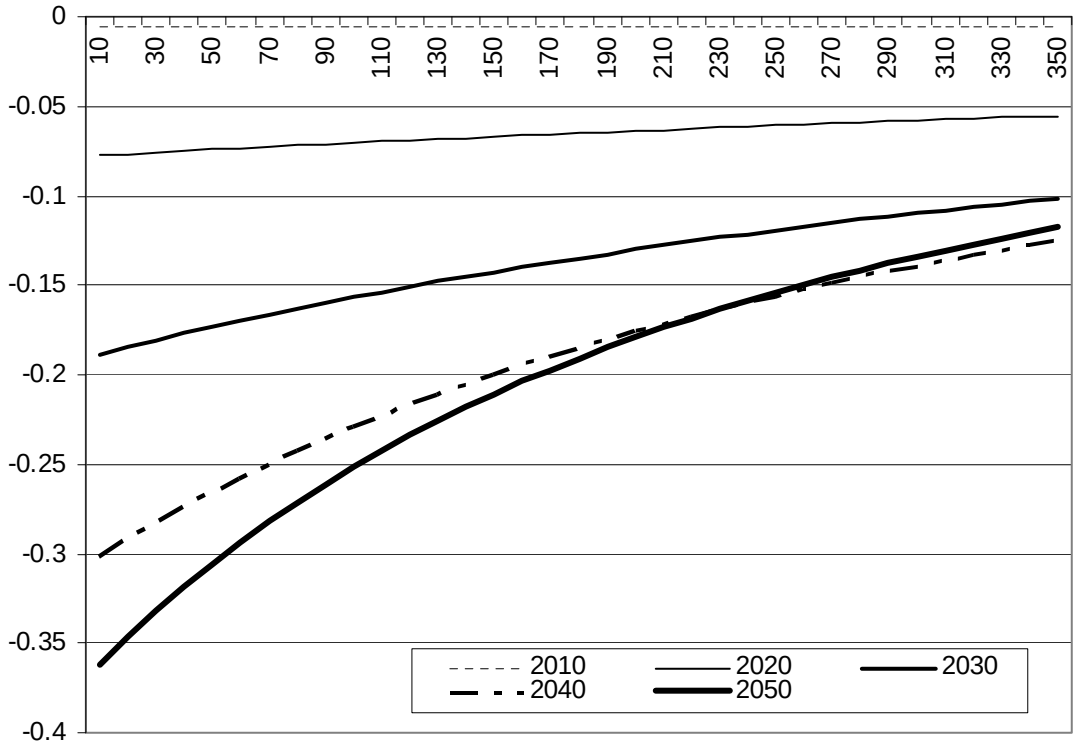
[1] This is a 'ceterus paribus' conclusion. The larger population resulting from higher migration may reduce productivity through increased congestion or demands on scarce resources. On the other`hand, if the migrants were filling skill gaps in the economy, the increased immigration could lead to higher productivity.

The impact on ageing

Figure 15 graphs the marginal impact on the percentage of the population aged 65 years and over for each additional 10,000 migrants. It shows the result at four points in time, 2020, 2030, 2040 and 2050. The graph shows that, at every time point, the marginal impact of 10,000 additional migrants gets smaller as migration increases. The first 10,000 immigrants have the largest impact in reducing ageing and the last 10,000, the least effect though still positive. In this analysis, however, we are looking for a distinct slowing down of the marginal effect of immigration upon ageing. This would be evidenced by the lines in Figure 15 flattening out as the migration level increases.

To 2020 and 2030, there is essentially no evidence of the lines flattening; the lines for these two outcome years are essentially linear. In other words, to 2030, there is little reason to choose between one level of migration and another in relation to its impact on ageing. However, a distinct slowing down of the marginal impact of migration on ageing is evident by 2040 and more so again by 2050. This means that a choice about a level of migration that would have the 'best' impact upon ageing is a choice about the long-term. The choice is best made on the 2050 outcomes rather than the outcomes of any earlier year. It is difficult to make any particular choice about a preferred level of migration based on the data shown in Figure 15 but certainly a level above 100,000 and below 250,000 is desirable.

Figure 15. Marginal Effect (additional 10k), Population Aged 65+



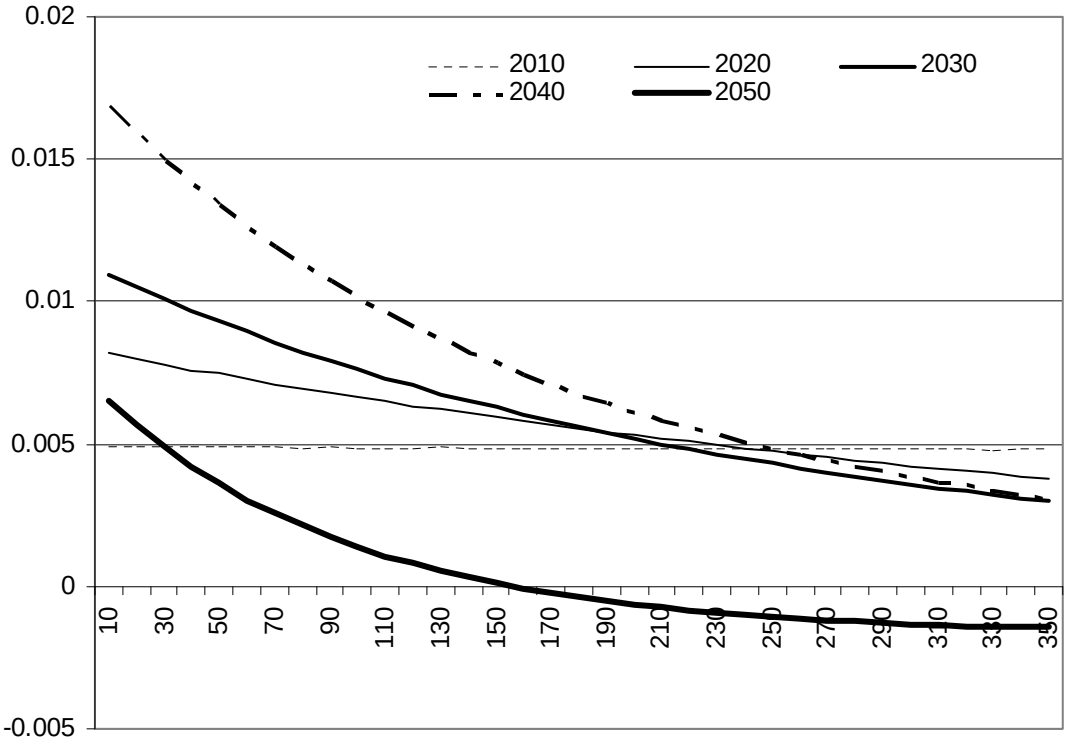
It is known from mathematical demography that a population that experiences a combination of below replacement fertility with a constant number of immigrants eventually produces a stationary population with an unchanging age structure (Espenshade et al. 1982). It is for this reason that the vertical gaps between the lines in Figure 15 become smaller across the time lines. For example, the gaps between the 2040 and 2050 lines are narrower than the gaps between the 2030 and 2040 lines. The empirical modeling in Figure 15 suggests that the stable age structure emerges more rapidly the higher is the level of migration (the gaps narrow more rapidly at higher levels of migration). Thus, a higher level of migration not only leads to a lower proportion of the population aged 65 years and over, it also achieves the transition to a long-term stable age structure more rapidly than a lower level of migration. Again, however, it is difficult to say that any particular level of migration is preferable other than that any level below 100,000 substantially delays the emergence of the stable age structure.

The impact on the rate of growth of GDP per capita

In this methodology, the impacts of migration upon the rate of growth of GDP per capita derive from the impact of migration upon the proportion of the population that are in the labour force which, in turn, is determined largely by the extent of population ageing. Figure 16 mirrors Figure 15 but this time showing the marginal effects of an additional 10,000 migrants upon the rate of growth of GDP per capita. Once more, the marginal impacts decline as the level of migration increases whether this be by 2020, 2030, 2040 or 2050. Each additional 10,000 migrants produce a smaller marginal impact on the rate of growth of GDP per capita.

In Figure 16, however, the lines are more curvilinear than they were in Figure 15 and there is a considerable downward shift in the marginal benefits between 2040 and 2050; the maximum marginal benefits are achieved around 2040. Using the 2050 line, there is a distinct flattening of the line between from about 170,000 migrants onwards. Also, again using the marginal benefit in 2050, the marginal benefit falls to zero when migration is at about 170,000 per annum. However, as in Figure 15, the flattening of the curve is not so evident at earlier points in time so, once more, any choice of a particular level of migration as being desirable is a choice based on the long-term.

Figure 16. Marginal Effect (additional 10k), GDP Per Capita Growth



Summary

The analysis in this sub-section is not conclusive but if any conclusion were to be drawn it would be that levels of migration between about 160,000 and 210,000 seem to have the 'best' impact by 2050 on ageing of the population and the rate of growth of GDP per capita. It is less easy to draw this conclusion for years earlier than 2050, thus, the choice is a choice for the long term and, because of this, may have less relevance because of the unpredictable changes that may occur in the next 40 years. It has meaning more from the perspective that, if migration at this level is consistent with labour demand over the next two decades, it clearly does not present problems for the long-term state of the economy. Rather it would be consistent with the long-term healthy state of the economy.

IMPROVING ANALYSIS FOR LONG TERM PROJECTIONS OF LABOUR DEMAND

As noted earlier, results from this analysis ignore two important factors: (1) the modeling ignores labour demand and (2) the modeling ignores feed-back effects between demography and the economy.

Economic, planning and environmental models conventionally treat future demography as 'exogenous', that is, determined outside of or independent of the model. Future demography is the 'front-end' of these models and is estimated statistically from past demographic trends. It is then taken as a given to be fed into economic, planning or environmental models. Effectively, this approach assumes that there are no feedbacks, that future demography will not be affected by the state of the future economy, changes in the nature of social institutions or the future environment. Recent examples of the exogenous treatment of future demography include the models used in the 2002, 2007 and 2010 Treasury *Intergenerational Report*, the 2005 and 2006 Productivity Commission reports (*Economic Implications of an Ageing Australia*; *Economic Impacts of Migration and Population Growth*), all the conventional models of the Australian economy (eg. the Monash CoPS model, the Econtech model) and the CSIRO environment and resource modeling (*Future Dilemmas*). Furthermore, the official population projections made by the Australian Bureau of Statistics are made in isolation from modeling of future economic, social or environmental trends.

In reality, demographic behaviour is very much influenced by the state of the economy, social organization and the state of the environment. If the economy turns down or if there are environmental or social problems, the expected results are that fertility will tend to fall, immigration will tend to fall and mortality may slow its rate of decline. The evidence for these associations is strong across Australian history. The economic recessions of the 1890s, 1930s, early 1960s, mid 1970s, early 1980s and early 1990s all produced falls in fertility and migration. Thus, there should be no question that future demography is not independent of future economic, social or environmental conditions.

Despite this, the associations are almost never drawn in the context of population projections. Most importantly, as already discussed above and as observed frequently, migration is driven very largely by labour demand rather than being exogenously determined. This is now especially true of certain long-term temporary movements that are demand driven such as the Trans-Tasman movement and the Long Stay Business Visa movement.

Rather than future demography being predetermined inevitably and inexorably by past trends in demography as is conventionally assumed, it would be preferable if estimates of future demography could be made as an endogenous component of models that incorporate future economic, social and environmental trends. The aim should be to build new models that recognize this reality. We should consider what demographic futures are likely as an endogenous component of targeted or likely longer-term economic, social and environmental goals.

Long-term models of future labour demand (at least 20 years into the future) cannot incorporate major new directions in technology and ways of living and, from this perspective, they will be erroneous. On the other hand, long-term models can be updated on a continuous basis and potential bounds of error can be incorporated. Such long-term models would be a useful resource for future labour force planning. In particular, long-term labour force projections by occupation/industry sector would provide a better basis for both population and skills planning. There is a considerable lead time involved in training people with particular skills that will be in future demand and longer term models of labour demand can be useful in identifying these skill areas.

Some previous research has attempted to model industry specific labour forces. Key among them is the MONASH model maintained by the Centre of Policy Studies at Monash University. The MONASH model is a dynamic computable general equilibrium model (CGE) of the Australian economy. This model has the advantage of simultaneously modeling numerous aspects of the Australian economy and can thereby account for dynamic feedback effects into labour supply. However, the MONASH model

is limited considerably because of its focus upon the national level labour supply and its relatively short projection span. For example, MONASH has been used to project sectoral labour supply from 2004-05 to 2009-10 (DEWR, 2005). However, as detailed by McDonald and Kippen (2001), the speed of population ageing is projected to pick up considerably after 2020. The limited range of the MONASH model means that the long-term effects of population ageing are not captured.

The Access Economics AEM model is a similar model to the MONASH model. Access describes it as a relatively small, dynamic model of the Australian economy. It has 'a theoretically consistent long-term open-economy growth path, together with short-term dynamics derived from Australian economic experience over the past 30 years. The model ensures internally consistent forecasts for key economic variables – GDP and its components, employment, exchange rates, inflation, and interest rates' (Access Economics 2009). The essential requirement is for long-term projections of labour demand and supply by occupation and industry sector and the AEM model has provided this, at least to 2025, subject to scenario setting.

As discussed above, changes in Australia's population age structure and living standard over the next fifty years will have implications for labour demand in service sectors such as health, education, government and defence. For example, projections of the demand for specific occupations such as doctors and nurses based on current patterns of age-specific consumption of health services or alternate scenarios can be compared with projected supply and are helpful for long-term planning. With these two occupations being prominent in current temporary skilled migration arrivals, such projections are also of interest from a migration policy perspective. More generally, it is possible to examine the ways in which employment in the full range of service occupations has changed over the past 30 years and to model the associations of these changes with economic, social and demographic changes. Such an information base then provides a basis for projection of future employment in the service industries. Other methodologies can be applied to project demand in non-service sectors such as mining, manufacturing and construction.

Of course, long-term projections will be inaccurate because we fail to project that which we do not yet envisage. However, this is more an argument for regular revision than for abandonment of the endeavour. At present, Australian labour force policy tends to be more a matter of reaction than of long-term planning. Labour shortages emerge and attempts are made to plug them through training or immigration. This approach often leads to short cycles of under- and over-supply as has been evident in the IT industry in recent years. A longer-term planning agenda would enable the specification of immigration and local training targets to be better balanced. There has been a tendency to rely upon immigration because it is more immediate and this has been at the expense of better domestic training policy. A longer-term agenda would also enable better planning of future infrastructure and service needs at both the national and the regional levels.

POLICY ANALYSIS OF KEY OUTCOMES

Australia has come through an era when the labour force has grown substantially as a result of the natural growth of the population. This was the period in which the baby-boom generation had its full impact on labour supply. From now on, the baby-boom will begin to retire and move out of the labour force. In the future, natural decrease will be a feature of the Australian labour force. Without increases in participation rates and with zero net migration, the Australian labour force would begin to fall in number from about 2010 (McDonald and Temple 2010).

This comes at a time when labour demand is very strong in Australia driven by the mineral boom and its flow on effects to the broader economy. Besides the mineral boom, this report argues that future labour demand will be also be strong because of the need for Australia to invest heavily in infrastructure, new forms of energy and reversal of environmental degradation. Without this investment, Australia's capacity to take full advantage of present and future productivity opportunities is threatened. Labour demand will also flow from the ageing of the population, from increases in living standards and from new demands in health and education.

There are risks involved in not meeting labour demand. First, unmet labour demand may force up wages more rapidly than is desirable. Evidence of the impact of labour demand upon wages is provided by the boom states of Queensland and Western Australia where, in recent years, wages have risen substantially. The second major risk is that projects that would enhance Australia's long-term productivity might be delayed along with major projects related to environmental improvement and new energy sources.

McDonald and Temple (2009) showed that even a theoretical maximum increase in participation rates by age would have only a limited impact on meeting likely future labour demand. Fertility has a very important long-term effect on the supply of labour and, for the benefit of the longer-term future, this effect should not be ignored. Maintaining fertility around its present level would be a good result for Australia. However, in the short to medium term (the next 20 years), immigration is the only means available to meet large aggregate increases in labour demand in Australia. In terms of meeting future demand for specific skills, domestic training would also play a vital role. The report argues that it would be beneficial to have better estimates of the skills required in the Australian labour force in the next 15-20 years.

Whatever immigration or participation strategy is followed, the modeling shows that, with constant productivity, a sharp fall in Australia's per capita GDP growth is inevitable from 2010 to 2020. After that, per capita GDP growth starts to rise again reaching a new peak around 2040 and thereafter remaining relatively high (Figure 14). This is simply the result of the inevitable ageing of Australia's population, the retirement of the large baby-boom generation. The analysis in the report is not conclusive but if any conclusion were to be drawn it would be that levels of migration between about 160,000 and 210,000 seem to have the 'best' impact by 2050 on ageing of the population and the rate of growth of GDP per capita. It is less easy to draw this conclusion for years earlier than 2050, thus, the choice is a choice for the long term and, because of this, may have less relevance because of the unpredictable changes that may occur in the next 40 years. The result has meaning more from the perspective that, if migration at this level is consistent

with labour demand over the next two decades, it clearly does not present problems for the long-term state of the economy. Rather it would be consistent with the long-term healthy state of the economy.

While this report argues that immigrants will be important to the construction of productive infrastructure in Australia, if increased immigration proceeds without investment in new infrastructure, especially urban infrastructure, the result could be reductions in productivity through increased congestion and inefficiency. Thus, a plan relating to Australia's future levels of immigration must be coordinated with policy for urban infrastructure especially housing, transport, water and appropriate energy supply. With constant fertility and net migration at 180,000 per annum, Australia's population would rise to 35.9 million by 2050. This is a large increase and most of the additional population would be settled in the existing cities all of which are already under strain from infrastructure shortages.

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APPENDIX 1

Methods and Limitations

Projections of Population and Labour Supply

For the underlying population, labour supply and GDP per capita projections, we draw upon MoDEM 2.0 available from www.pc.gov.au. The mathematical and theoretical underpinnings of the model are found in Cuxson, Hou and Fry, 2007. The underlying model for the projection of population and labour supply is as follows:

Using the base demographic data, we define the population in year, y+1 for aged j+1 as:

$$P_{i,j+1}^{y+1} = P_{i,j}^{y} S_{i,j}^{y} \left[1 + M_{ij}^{y}\right], \qquad j \geq 0 \qquad [1]$$

Given:

$P_{i,j}^{y}$ is the population of sex (i) at age (j) in year (y)

$M_{i,j}^{y}$ is the age-sex specific net migration intensity

$S_{i,j}^{y}$ is the age-sex specific survival ratio

The projected labour supply by age and sex ($LS_{i,j+1}^{y+1}$) is than calculated using the age-sex specific participation rate ($PR_{i,j+1}^{y+1}$):

$$LS_{i,j+1}^{y+1} = P_{i,j+1}^{y+1} \times PR_{i,j+1}^{y+1} \qquad j \geq 15 \qquad [2]$$

With the above specifications, we define a number of scenarios for the key parameters of interest:

(i.) set of fertility scenarios which vary b_j^y

(ii.) the set of migration scenarios which vary $m_{i,j}^{y}$ and;

(iii.) the set of labour force participation scenarios that vary $PR_{i,j+1}^{y+1}$.

Using these simple projection methods, it is also possible to create synthetic histories of the labour supply for the projection period.

In the previous paper (McDonald & Temple, 2009), we used a five year labour supply projection model to project population, labour supply and target labour supply growth rate. To calculate annualized growth rates in the previous paper, we estimated the following:

$$\log(1+r) = \frac{\log\left(\frac{LS^{y+n}}{LS^{y}}\right)}{n} \qquad [3]$$

This method of calculating the annualised labour supply growth rates are used as they are more accurate than arithmetic growth rates when using five-year age cohort data (Rowland, 2003). In the *current paper* we use a single model with single year of age, single year projections. Given that the results are not grouped data, we use arithmetic growth rates.

Projections of GDP Per Capita

It is important to recognise that the GDP projections are not forecasts. Rather, they are simulations based upon assumptions about population, productivity and labour force participation. Indeed, when interpreting these results, it is the relative differences between the different models that should be considered and not the actual levels of GDP growth. The substantial limitations of the GDP projections are noted below and should be considered when interpreting the results:

- The underlying full and part time average hours worked, part time work share, unemployment and participation rates and productivity profiles are assumed to remain constant between domestic and migrant workers. In reality, there are differences between the two groups with respect to these characteristics (Productivity Commission, 2006).

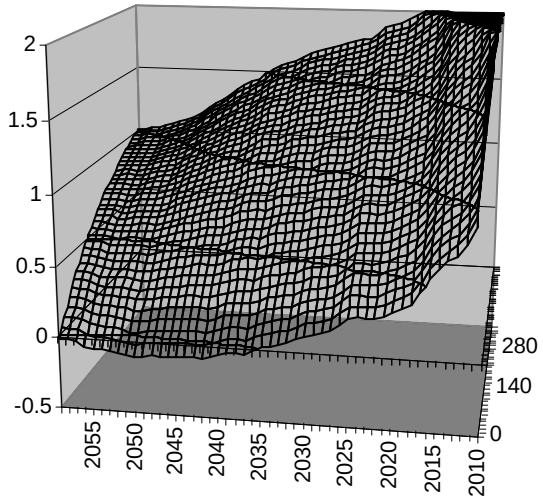
- The underlying full and part time average hours worked, part time work share, unemployment rates and productivity profiles are the baseline rates from MoDEM 2.0.
- The underlying full and part time average hours worked, part time work share, unemployment rates and productivity profiles of migrants are assumed to be the same as domestic born Australians. These parameters may very well differ substantially between visa groups. Further analysis here is particularly warranted.
- The simulations take no account of macroeconomic shocks affecting growth. In reality, GDP per capita growth exhibits substantial short term variation across the time.
- The simulations take no account of labour demand.

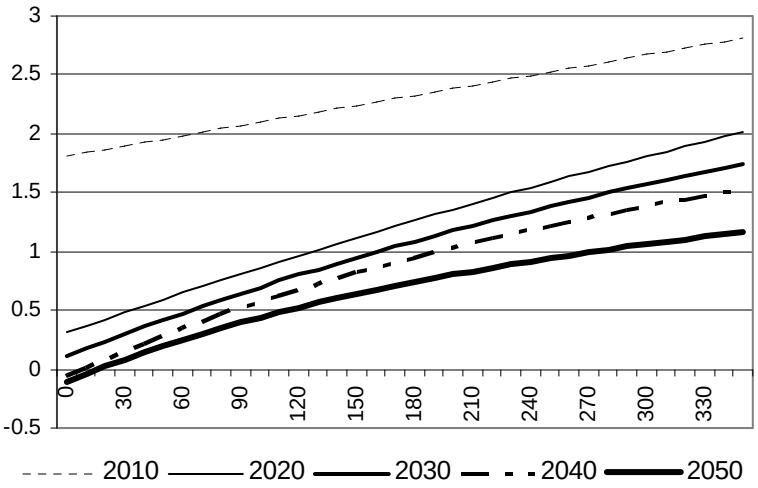
APPENDIX 2

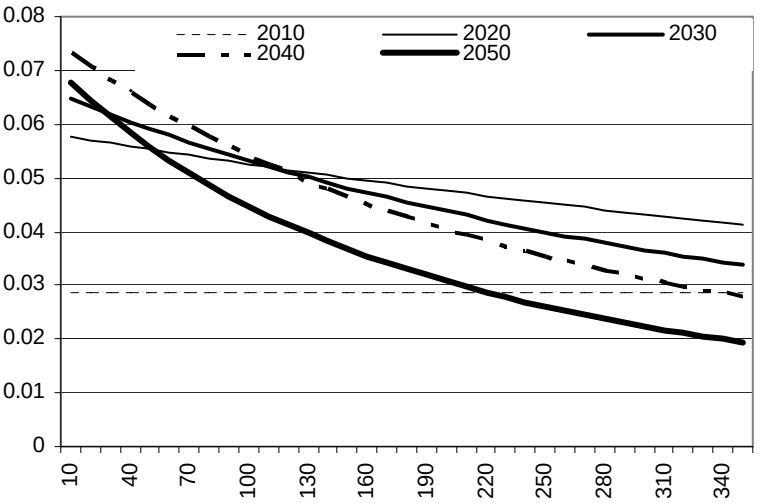
This appendix includes a vast amount of information on the incremental effect of an additional 10,000 migrants on key variables of interest. For each variable (1 variable per page), the following graphs are shown:

1. A 3-dimensional graph with years running across the front axis and increments of 10,000 migrants on the side axis.
2. A 2-dimensional graph showing for 5 years (2010, 2020, 2030, 2040, 2050) the variation in the variable by 10,000 increments of migration.
3. A 2-dimensional graph showing for 5 years (2010, 2020, 2030, 2040, 2050) the **marginal** effect of a 10,000 increase in migration on the variable of interest.

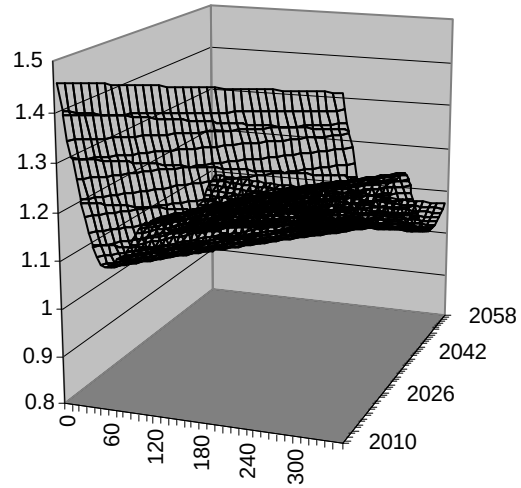
LABOUR SUPPLY GROWTH

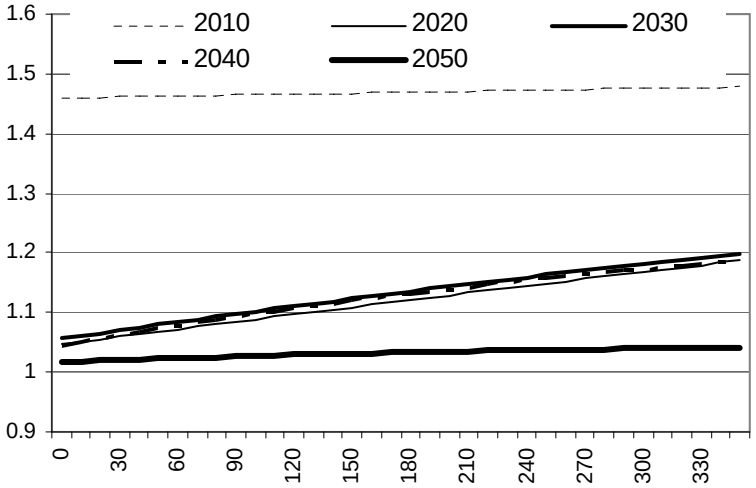


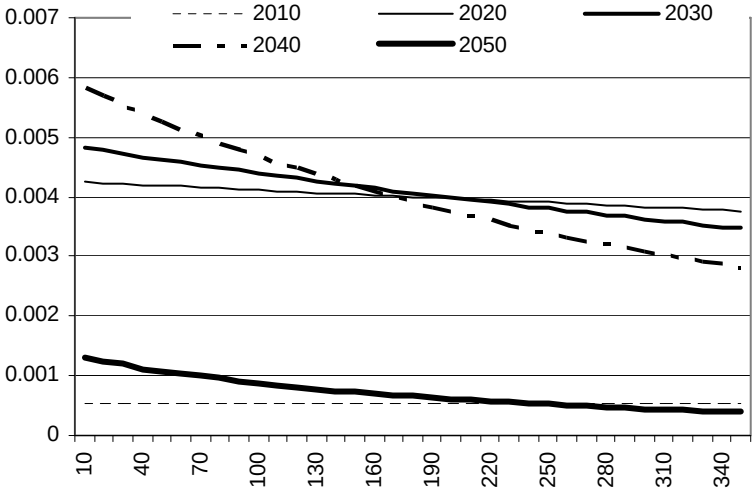




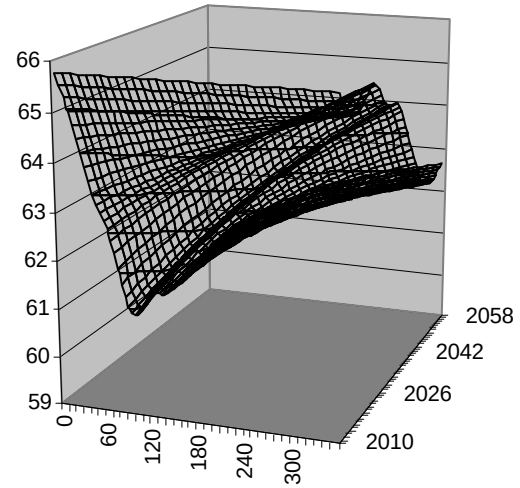
LABOUR SUPPLY ENTRY EXIT RATIO

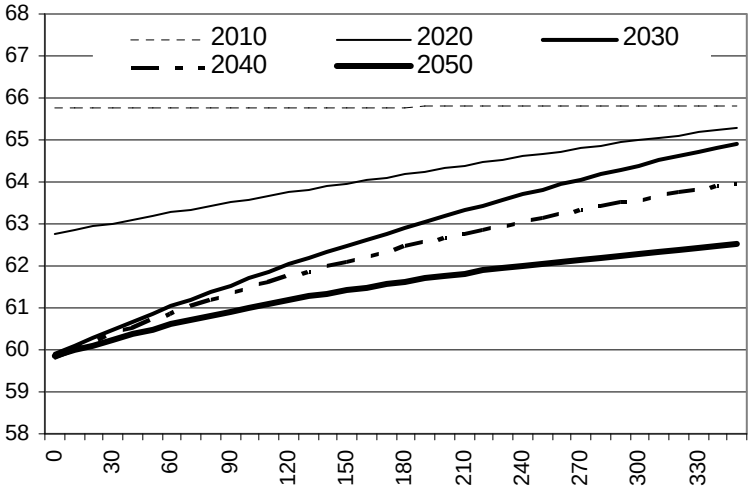


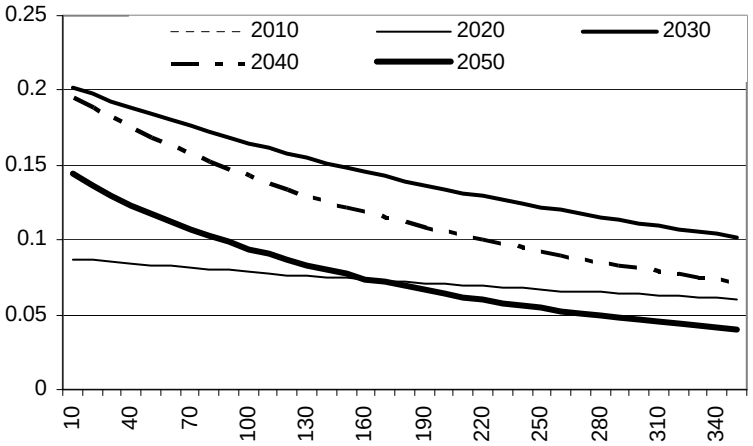




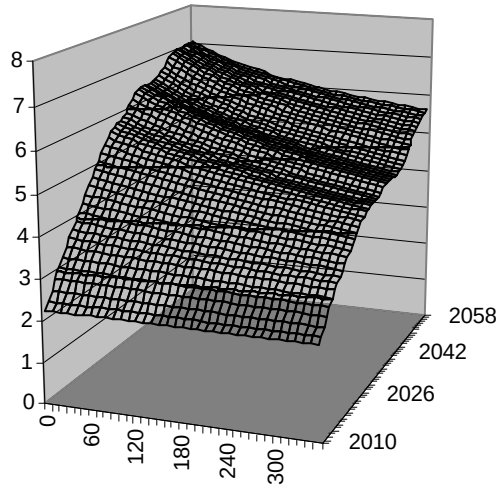
LABOUR SUPPLY AGED 25-54

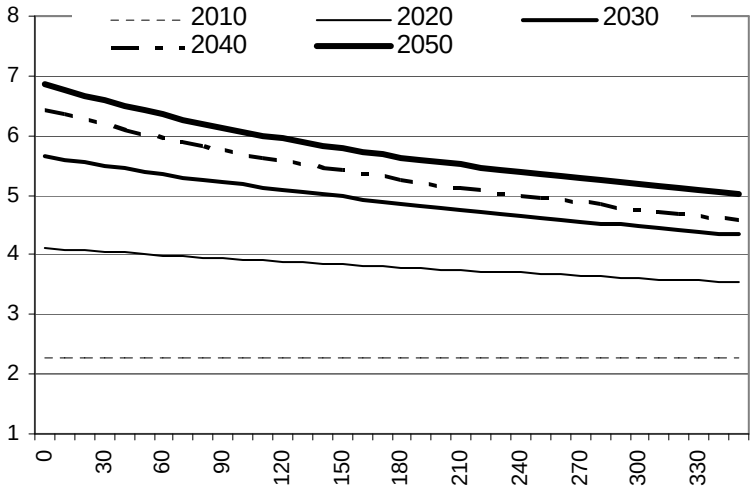


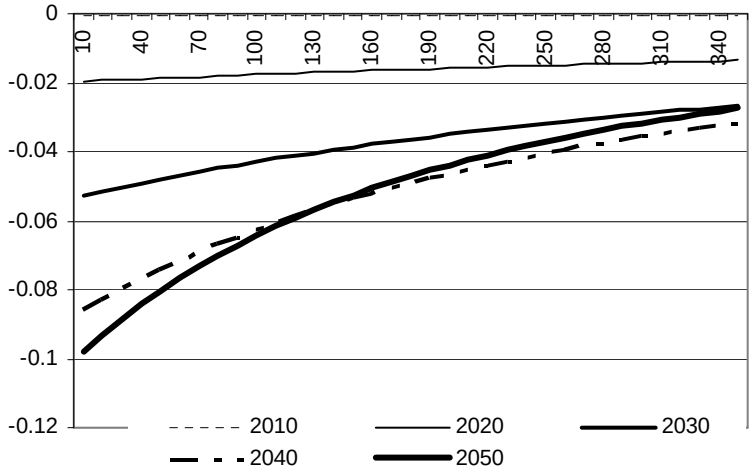




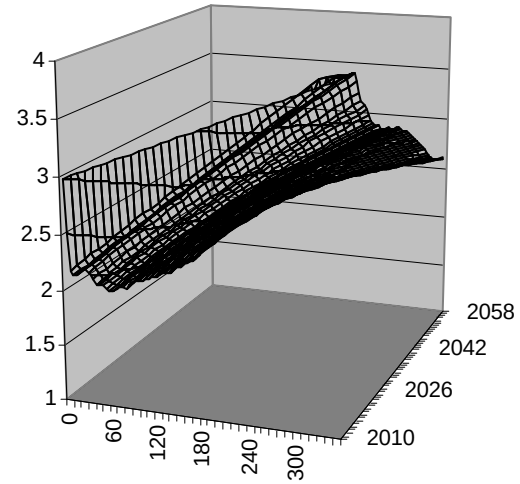
LABOUR SUPPLY AGED 65+







GDP GROWTH


4
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2042
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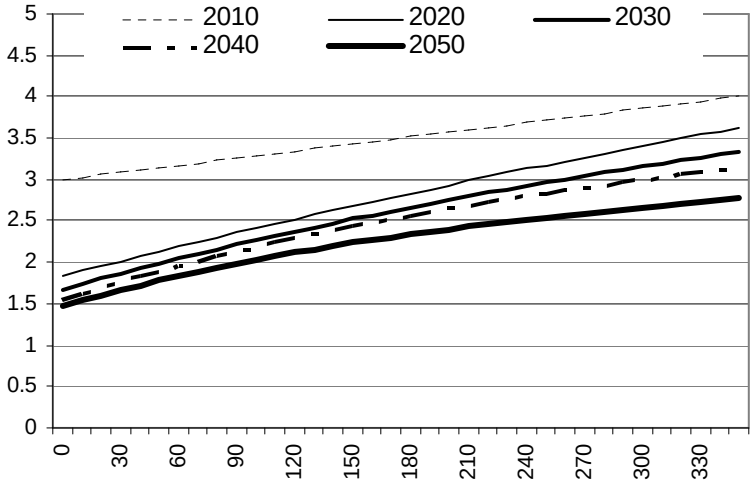
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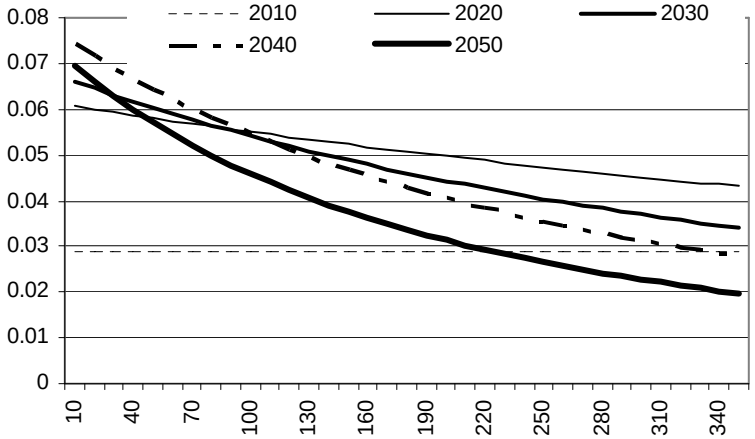
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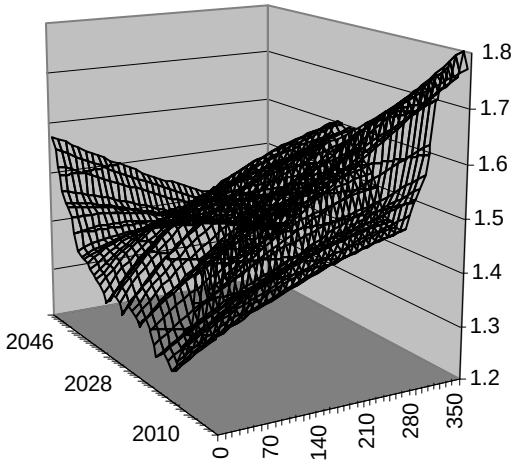
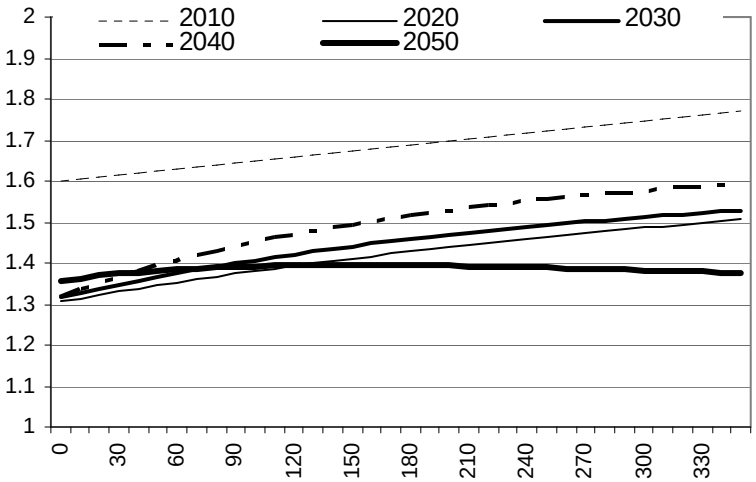
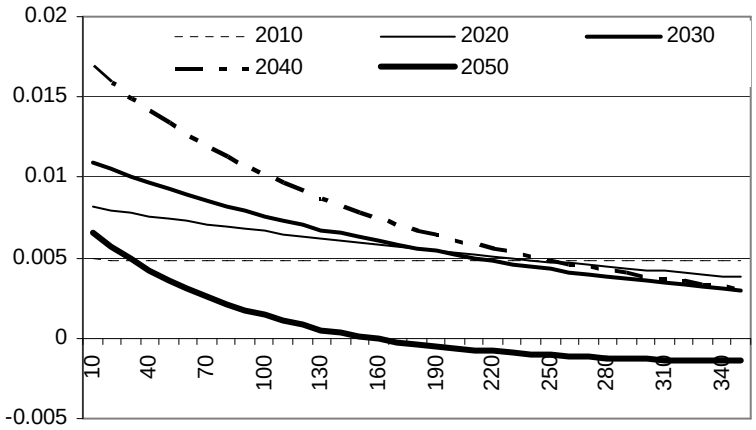
340

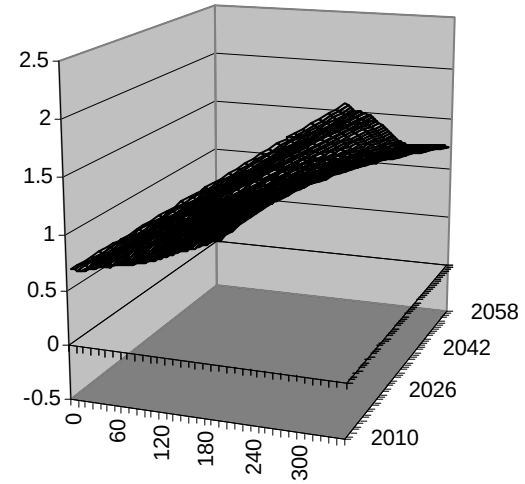
GDP PER CAPITA GROWTH

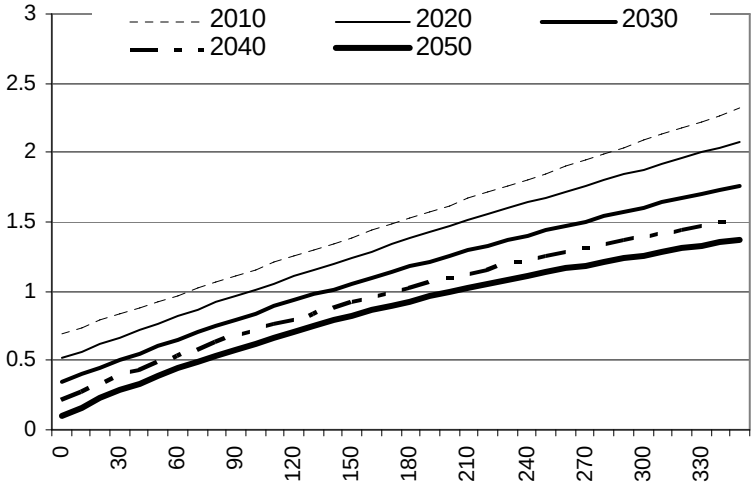


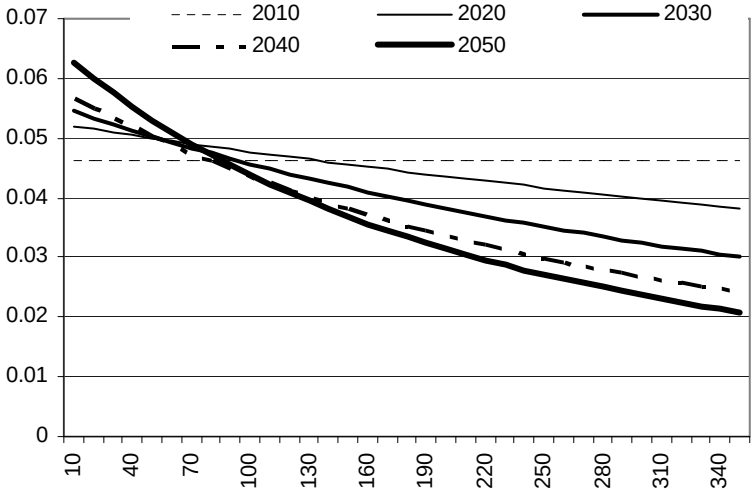




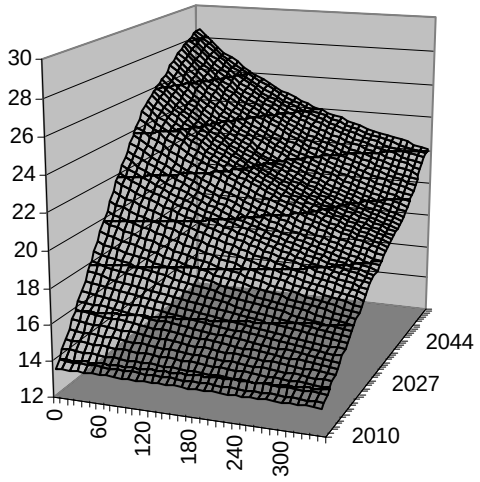
POPULATION GROWTH

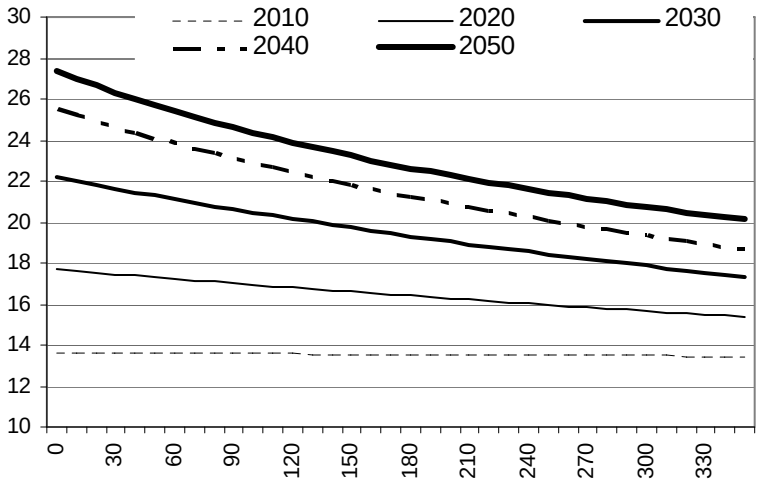


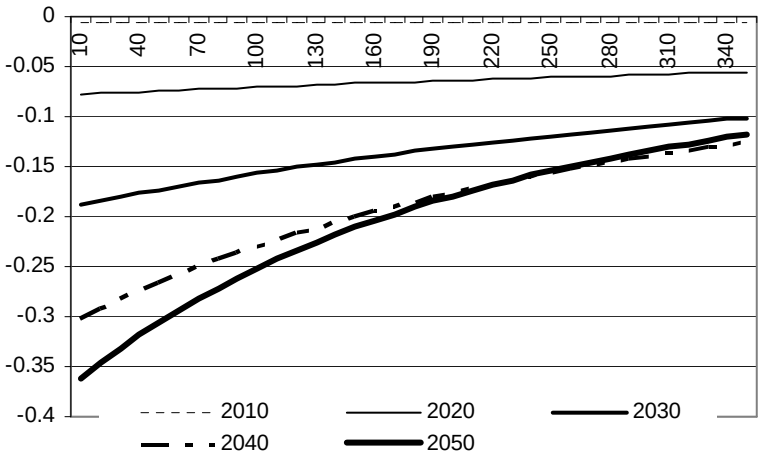




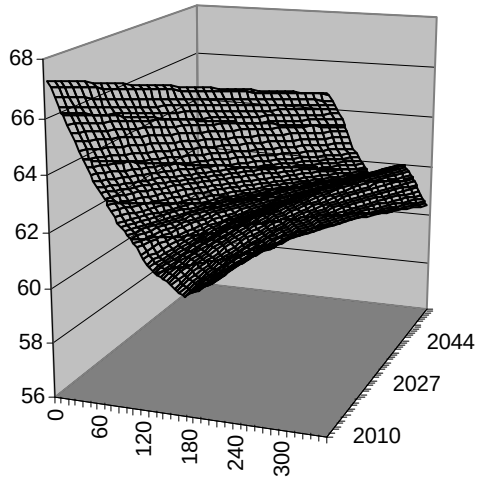
POPULATION AGED 65+ (%)

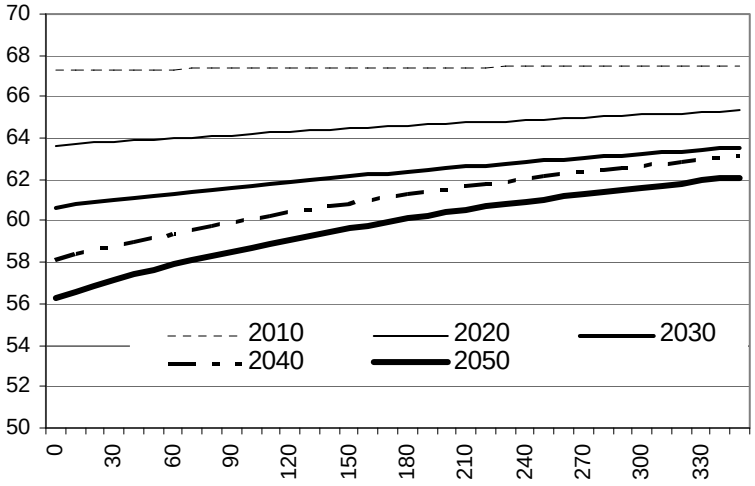


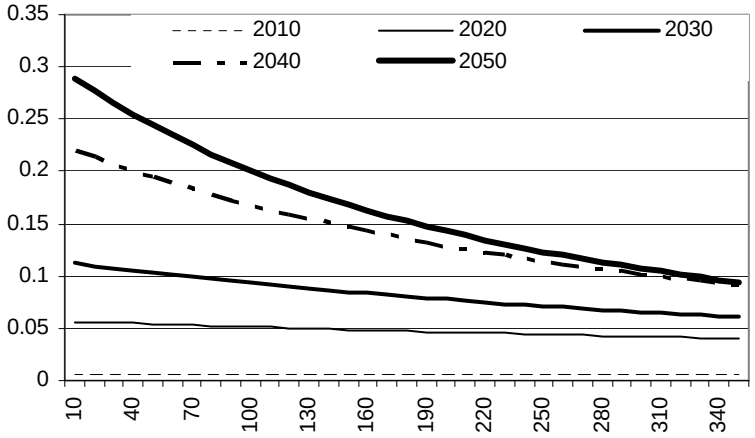




WORKING AGE POPULATION (%)







POPULATION AGED <15 (%)