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Demographic Change and Regional Competitiveness: The Effects of Immigration and Ageing

Jacques Poot

University of Waikato
Te Whare Wānanga ō Waikato
HAMILTON NEW ZEALAND

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University of Waikato
Private Bag 3105
Hamilton
New Zealand
www.waikato.ac.nz/wfass/populationstudiescentre
pscadmin@waikato.ac.nz

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Demographic Change and Regional Competitiveness: The Effects of Immigration and Ageing[*]

Jacques Poot[#]

Abstract

The demographic profile of a region is usually seen as a slowly changing background phenomenon in the analysis of regional competitiveness and regional growth. However, regional demographic change can have a significant impact on regional competitiveness and such change is often more rapid and profound than at the national level. In turn, regional population size, growth, composition and distribution are endogenous to regional economic development. This paper focuses on the impact of population ageing and immigration on aspects of regional competitiveness such as innovation, entrepreneurship and productivity. Immigration and ageing trends have generated huge separate literatures but it is argued here that it is fruitful to consider these trends jointly. Theoretically, there are many channels through which immigration and population ageing can affect regional competitiveness. There is empirical evidence that population ageing reduces regional competitiveness, while immigration – particularly of entrepreneurs and highly skilled workers to metropolitan areas – enhances competitiveness. Much of the available literature is based on small-scale case studies and rigorous econometric research on the impact of demographic change at the regional level is still remarkably rare. Some directions for further research are suggested.

Keywords: regional competitiveness, immigration, population ageing, innovation

JEL Classification: F22, J11, O31, R11

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[#] Population Studies Centre, University of Waikato, Private Bag 3105, Hamilton, New Zealand.
Email: jpoot@waikato.ac.nz

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1. Introduction

Two demographic phenomena have been attracting increasing attention in recent years throughout the world. One of these is the growth in international migration, leading to a doubling of the number of people living outside their country of birth since 1960, to close to 200 million at present (e.g. United Nations 2006). The other is the increase in the number and the proportion of older people in the population in many developed countries, due to below replacement fertility, increasing life expectancy and a post World War II baby boom generation commencing to reach retirement ages (e.g. Lee 2003). The latter trend is commonly referred to as population ageing, although the term age-structural transition would be more appropriate (Pool 2005).

Generally, these trends are seen as long-term demographic forces that operate in the background of the national economy and for which there may be a relatively long time frame of anticipation and policy response, even if there remains debate about appropriate policy measures.[1] Certainly, there is some consensus in the literature that the impact of immigration on income per head, unemployment rates and other economic indicators in receiving countries may be rather modest at the macro level (e.g., Poot and Cochrane 2005). The difficult economic issues are primarily those of *distribution* of the impact. While the aggregate net economic impact may be small, there may be losers (such as low skilled native born workers in host countries) and winners (such as owners of capital in host countries and the migrants themselves). Similarly, one major economic issue in population ageing is again one of *distribution*, namely the viability of transfer of income from those who are active in the labour market to those who are not. In this context, however, there is also concern about population ageing leading to lower productivity growth and lesser flexibility in the labour market. Other economic issues include the rising health care costs and the appropriate health insurance system.

At a smaller spatial scale, there is considerable diversity in the extent of demographic change and in the issues. Economic performance may have at this level a much stronger link with population size/scale, density, growth and composition, although the causality certainly goes both ways: from economic performance to demographic characteristics and vice versa (e.g., Poot 2005). While population growth of developed countries nowadays rarely exceeds more than a fraction of 1 percent per annum (and has commenced to decline in countries such as Japan and Germany), the population of cities and regions may grow much faster or, instead, decline fairly rapidly.

In such regional population change, migration (internal and international) and population ageing are closely linked. Migrants tend to be relatively young (because migration has the greatest economic return to the young), leading to ageing populations in sending regions and more youthful ones in receiving regions. Where youthfulness creates economic dynamism that has both pecuniary and non-pecuniary benefits to inward migrants, a positive feedback loop is created that contributes, for example, to rural depopulation.

In interesting example is the case of Japan recently reported in *The Economist* (2006). The population of Japan is expected to decline from 128 million to 100

[1] A simple argument is that one trend can offset the other: given the typical age profile of migrants, immigration can slow down ageing. However, in the long-run this is demographically ineffective unless immigrants have above replacement fertility. Moreover, the level of immigration required to offset ageing in many cases unrealistically high (see e.g. Holzmann 2005 on the European case).

million over the next half century due to population ageing. In rural areas the change will be even more pronounced, as young people continue to move out. Small rural communities, such as *The Economist*'s example of Ogama along the Sea of Japan may vanish completely. Other peripheral populations, such as the city of Yubari (on the northern island of Hokkaido) which declined from more than 100,0000 to 13,000 people, attempt to resort to tourism promotion or the sale of lifestyle blocks of land to ex-urbanites to stop further decline. Overall, some 7 million baby boomers are expected to retire in 2007 alone and the number is increasing further in the following years. These trends are by no means unique to Japan.

This paper focuses on how immigration and population ageing could affect regional competitiveness. The concept of competitiveness at the regional level is open to different interpretations (see Gardiner et al. 2004), but the focus is here on a range of factors that can enhance regional economic outcomes, such as entrepreneurship, innovation, the availability of human capital and total factor productivity. These may be thought off collectively as enhancing 'regional competitiveness' (see e.g. Poot 2000).

The next section briefly reviews the conventional macroeconomic perspective on population growth and national or regional economic growth. Section 3 then considers the potential impact of immigration on regional competitiveness. Section 4 focuses on the impact of the changing age structure. In both cases, the distinction is made between macro level and micro level empirical evidence. It will be concluded that both in the migration literature and the literature on the impact of ageing on productivity, that there are a number of theoretically opposite effects on regional competitiveness, so that the assessment of any overall impact will be an empirical matter. In this respect, particularly research on the relationship between innovation and demographic change is still in its infancy. The final section sums up and provides some suggestions for further research.

2. Endogenous population and endogenous regional competitiveness

One of the difficulties in assessing the impact of demographic change on regional competitiveness is that the causality runs both ways, as noted in the introduction. Population change affects regional economic outcomes and at the same time the fundamental demographic forces of fertility, mortality and migration are all affected by economic conditions. There is, however, asymmetry in empirical evidence. On the one hand, the economic determinants of demographic behaviour have been well-researched and there is a rather large body of empirical evidence regarding the important role played by such economic effects vis-à-vis often harder to quantify social, political and institutional forces (e.g. Rosenzweig and Stark 1997). On the other hand, while standard theories of economic growth are often conclusive regarding the impact of demographic change, this causal link is empirically more difficult to establish due to myriad other economic influences on regional growth and competitiveness that may 'swamp' the impact of changing demographic conditions.

Let us consider both directions of this two-way interaction in turn, starting with the impact of regional competitiveness on population. Firstly, when regional competitiveness is high and buoyant economic conditions result in high income, this will induce lower fertility. The key mechanisms through which this occurs are increases in female post-compulsory education (in response to higher returns to education), higher female wage rates (which increases the time cost of child rearing)

and increasing female labour force participation. Low fertility will induce population ageing in the growing region in the long-run, but buoyant economic conditions will lead in the short term to net inward migration that generates a more youthful age structure.

A higher level of regional income is also instrumental in increasing life expectancy and encouraging better health care. A positive correlation between income and life expectancy is well established, although the causality runs again both ways (Bloom and Canning 2000). Zhang and Zhang (2005) find that increasing longevity reduces fertility and raises the rate of economic growth. There appears to be no limit yet to the potential for further increases in life expectancy (Oeppen and Vaupel 2002).

Furthermore, highly competitive regions attract more migrants internally and, when permitted, internationally. With respect to the latter, there is a clustering of immigrants in metropolitan areas and to specific areas within such cities (see e.g. Gorter et al. 1998). This is consistent with the notion of the city as the engine of economic growth (e.g. Jacobs 1984). Migrant clustering can be a self-reinforcing process, even though over time there is spatial dispersion of any given cohort of immigrants. Card and Lewis (2005) found, for example, that Mexican immigrants in the United States are now much more dispersed than two decades ago due to internal migration of migrants initially settling in Los Angeles and due to "new cities" increasingly becoming the first destination of Mexican migrants.

Turning to the theories of the impact of population change on economic growth, immigration and population ageing do not feature of course explicitly in the conventional Solow-Swan neoclassical growth model for a closed economy. In that model population growth is an exogenous parameter that affects the steady-state capital intensity but not the exogenous rate of long-run economic growth. For given savings behaviour, higher population growth then implies a lower capital intensity and therefore lower income per capita. In a spatial setting in which migration is in the "right" direction but faces significant barriers or in which people continue to have home country attachment, differences in population growth can lead to persistent differences in income or even divergence (e.g., Nijkamp and Poot 1998; Larramona and Sanso 2006). In open economy growth models, such as the Braun model of perfect capital mobility and imperfect labour mobility in a small open economy, higher immigration speeds up convergence to the long-run steady state growth rate (see Barro and Sala-i-Martin 2004, section 9.1.3).[2] However, taking into account that migration is a selective process (with the more able and educated more likely to migrate) and affects education decisions, spatial convergence is by no means guaranteed (e.g., Kanbur and Rapoport 2005).

Because there have been, and continue to be, significant barriers to international migration, as well as capital not necessarily flowing in the 'right' direction, it is not surprising that cross-country growth regressions have tended to find a negative impact of population growth on economic growth (e.g., Birdsall et al. 2001). Besides the diminishing returns to the capital needed for the larger population and the presence of resource constraints, other factors responsible for the negative effect of population growth on economic growth are lower labour force participation due to higher fertility, higher demographic dependency and lower saving rates. Recent econometric research suggests that demographic change can play a major role in explaining cross-country growth differences (Kelley and Schmidt 2005).

[2] For a survey of recent endogenous growth models with immigration, see Levine et al. (2003).

At the regional level, however, inward migration may lead to higher labour force participation and higher levels of investment. Consequently, a negative effect of population growth on regional economic growth is then less obvious and the reverse causation will be stronger: regional economic growth will induce population growth.

Traditional non-spatial growth theories adopt the assumption of constant returns to scale so that the *scale* of population is irrelevant to the growth path. In contrast, endogenous growth models often have an increasing returns technology in which population scale can positively affect the long-run growth rate. The greater scale may also be due to greater integration of different areas (see, e.g., Rivera-Batiz and Romer 1991). Population growth itself can be endogenous in this context, as endogenous fertility can lead the scale of the economy to grow over time while increasing returns translates this increase in scale into rising per capita income (Jones 1995). The presence of endogenous fertility in endogenous growth models can create multiple equilibria in which high growth and low growth paths are both feasible and the actual outcome depends on initial conditions (e.g. Becker et al. 1990).

As in non-spatial growth models, population growth has also often been assumed exogenous in spatial growth models (e.g., Black and Henderson 1999), but this would be inconsistent with observed patterns of population redistribution, human capital investments and agglomeration externalities that lead to increasing urbanisation and growing urban/rural differences (see, e.g., Fujita and Thisse 2002). Of course, positive feedback loop processes of increasing agglomeration can eventually turn around when agglomeration diseconomies such as increasing scarcity of land, congestion, pollution, social exclusion and crime start to encourage outward migration.

When looking at the empirical evidence of the effect of population on economic growth, the huge cross-country growth regressions literature may have some relevance for the regional issue as well. Firstly, population *size* appears to be an insignificant determinant and population *growth* has a statistically significant negative affect, as noted earlier. At the country level, empirical research suggests that a small population it in itself no impediment to high income (e.g. Armstrong and Reid 2004).

Of more importance, however, is the issue of geographic location. Remoteness continues to have a negative impact on economic performance, despite cheaper travel and communication technologies having led to what some call a “death of distance” (e.g. Poot 2004). The positive effect of agglomeration is reflected in a positive relationship between economic growth and population density. The combined effect of these trends is a growing spatial polarisation: rising relative levels of income in globally connected metropolitan cities, with a relative decline of peripheral regions. At the same time, intra-metropolitan income inequality is increasing too.

As noted earlier, immigrants are particularly attracted to faster growing metropolitan areas. This begs the question to what extent they are simply attracted to the fruits of metropolitan competitiveness, or whether their presence makes an additional contribution to entrepreneurship and productivity growth. This will be considered in the next section.

3. Effects of immigration on regional competitiveness

The economic impact of immigration is complex and has many dimensions. This is illustrated in Figure 1, reproduced from a recent Australian report (Productivity Commission 2006). Despite the growing importance of immigration as a contributor

to national and regional population change, remarkably little is known about its impact on regional competitiveness and productivity. Broadly speaking, high levels of immigration coincide with higher economic growth and with agglomeration, but such association is no proof of causation. There are three channels through which immigration can improve competitiveness and productivity. These are (1) acceleration of productivity improvements associated with new investment induced by immigration, including possible scale effects; (2) through increasing innovation and entrepreneurship; and (3) through improving allocative efficiency. Let us consider each of these in turn.[3]

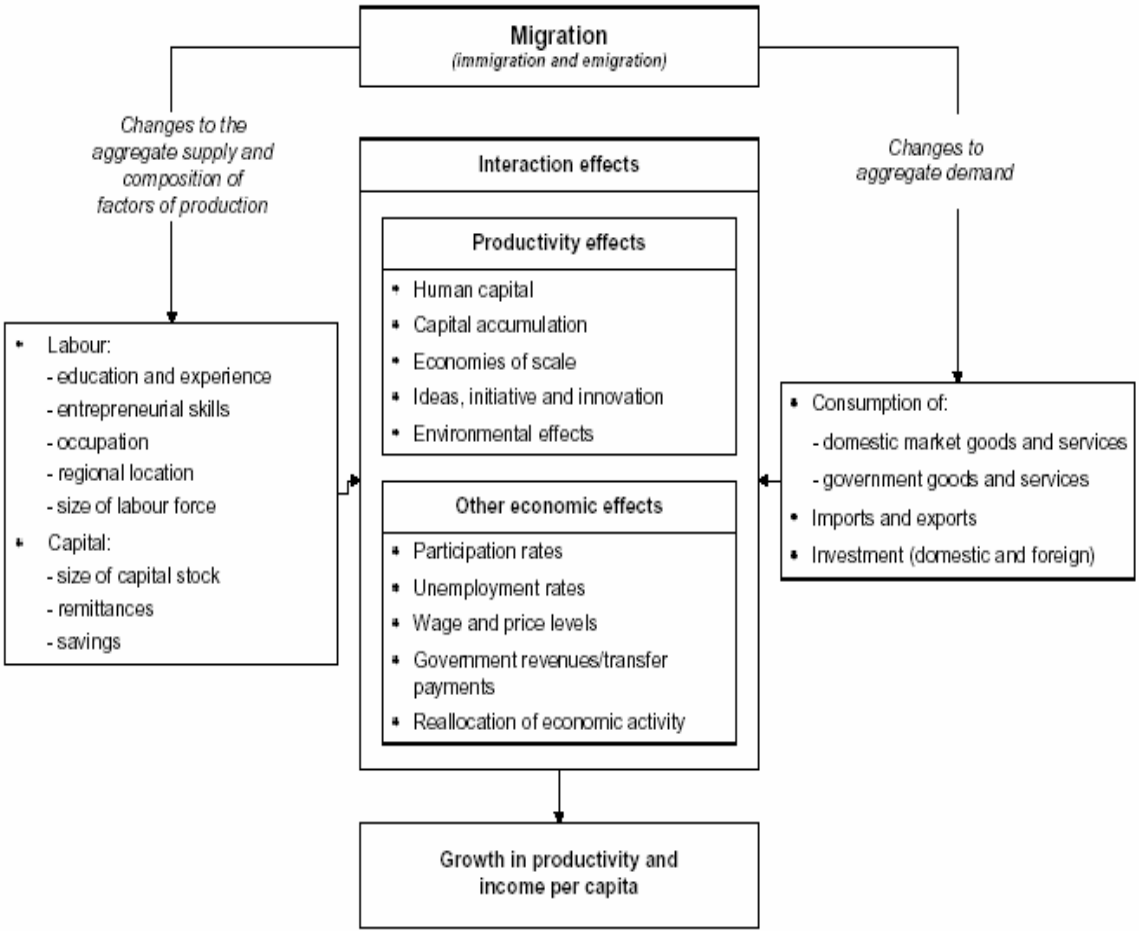

Fig. 1 An overview of the economic impacts of migration

Source: Productivity Commission (2006)

Firstly, growth in the labour force through immigration raises the return to capital. This encourages investment until eventually the risk-adjusted rate of return is again spatially equalised. To the extent that the additional investment embodies the latest technologies, immigration can enhance total factor productivity. This effect is dependent, however, on the sectoral allocation of the additional investment. Given the growth in the number of households, increased residential building activity is very likely (Poot et al. 1988; Saiz 2003). However, this type of investment is likely to have

[3] This section has benefited from comments from Steven Stillman.

less technological spillover benefits than fixed capital formation in, say, high-tech sectors. To assess whether immigration benefits the latter, an econometric shift-share analysis of sectoral change following an immigration 'wave' would be needed.

The second way that immigration can enhance competitiveness is through Schumpeterian innovation. This occurs when immigrants bring new ideas, work in 'sunrise' industries and occupations, or set up new businesses. Immigrants may have higher rates of self-employment and may be less risk averse than the locally born population. The growing international mobility of professionals that may be referred to as a "brain exchange" or "talent flow" is also likely to contribute to competitiveness of destination regions. It can furthermore be argued that growing social or ethnic diversity due to immigration encourages innovation and entrepreneurship (e.g., Audretsch and Keilbach 2004), although the effect on growth is by no means easy to detect (Alesina and La Ferrara 2005). A counterargument is that diversity creates a less cohesive society that may, through eroding social capital and trust, reduce competitiveness.

The third way that immigration can affect economic growth is through improving economic efficiency. It can be argued that migrants are more responsive to economic signals because of a lack of 'cumulative inertia' and thus help keep the economy moving. The fact that migrants are younger, on average, also tends to make them more willing and able to adjust to economic change. Immigration also increases the size of the regional economy, which can potentially lead to more competition and efficiency.

To the extent that immigration is controlled by government agencies, and therefore at least partially exogenous, the overall impact of the effects mentioned above should be detectable in time series modelling of total factor productivity (TFP). However, the impact of immigration on productivity has been inadequately researched throughout the world. Poot (1993) provided some very tentative New Zealand evidence that there is only a weak effect of immigration causing productivity improvements (using the concept of Granger causality), but a much stronger effect of net migration responding positively at times when TFP growth is faster than usual.

An additional knowledge gap exists at the micro-level: evidence of the transmission mechanisms through which immigrants increase productivity of individual firms: through 'working and trying harder' or through passing on their own skills to the locally born, or through their entrepreneurial activities. The absence of conclusive evidence is the more remarkable given that immigration policy is often motivated by these as yet not well quantified spillover benefits in terms competitiveness and productivity. There are many micro-level studies of migrant entrepreneurship, but such studies are often of a qualitative nature and based on very small samples. Such studies do suggest that there are significant qualitative differences in terms of entrepreneurial activity between migrants groups defined by ethnicity or birthplace. There is some evidence that informal networks are crucial for business success (see e.g. Masurel et al. 2002).

In some countries, particularly those that recruit entrepreneurial migrants through the "points-based admission system' (Canada, Australia and New Zealand), there is a need to distinguish between active and passive investment: spillover benefits are likely to be less if migrant financial capital is invested in the existing capital stock rather than used as start-up capital for new enterprises.

Little empirical evidence exists on how immigration affects regional productivity growth. This is not surprising given the difficulty to disentangle a number of effects. Firstly, immigration is itself endogenous and disproportionally in

the direction of fast growing cities. Secondly, immigration makes the labour force more youthful, so that age and diversity effects must be considered separately. Thirdly, the impact in the long-run may be different from that in the short-run. Quispe-Agnoli and Zavodny (2002) found that in the U.S. labour productivity increased more slowly in states that attracted a larger share of immigrants during the 1980s, but argued that this might be a short-run rather than long-run effect.

Two additional effects through which international migration can indirectly affect regional competitiveness are through trade and through international linkages that result from a country's diaspora remaining in touch with their country and region of birth. With respect to trade, several recent studies have found that immigration has a positive effect on trade between the source country of the immigrants and the host country.[4] Two basic causes for this effect have been identified. Firstly, immigrants tend to have a preference for the products from their home countries, as a matter of taste or due to emotional attachment. Secondly, immigrants can reduce transaction costs of bilateral trade with their home countries either through individual characteristics such as business contacts or through more generic traits such as language.

While the positive correlation between immigration and trade has been generally confirmed, it is important to distinguish the effect on imports from the effect on exports. By and large, the elasticity of the effect of immigration on exports is less than the elasticity of the effect on imports. A good example is the study by Wagner et al. (2002). Using cross-provincial variation in immigration in Canada, these authors find that immigrants expand exports to their native country, but also stimulate imports from this country. The Canadian data suggest that the effect on imports may be triple that on exports. Other research, similarly suggests that immigration leads to deterioration of the trade balance (see, e.g. Ching and Chen 2000). These effects are likely to vary with the characteristics of the migrants and their countries of birth.

The evidence on a deteriorating trade balance following an immigration wave is consistent with the expectation that immigration-induced population growth generates excess demand. If this is just a short-run effect, it may not be of great concern. More important are the dynamic gains from increased trade. When growth in trade encourages innovation and entrepreneurship in the sectors in which the migrants are employed, competitiveness may increase in the long run.

The emphasis in this section has been on an inflow of foreign born workers. However, in areas with low or middle income levels, the main driver of population change may be emigration. Moreover, regions with large levels of immigration sometimes experience also large levels of emigration. Such emigration is a combination of outward migration of natives and return or onward migration of earlier immigrants. The potential role of the *diaspora* in economic development is attracting increasing attention in middle income countries. The diaspora phenomenon is clearly linked with global economic integration and the growing mobility of professional and other skilled workers. In the global market for 'talent', such links can be exploited for development (see e.g. Cervantes and Guellec 2002 and Henoch 2006 for reviews). A recent example is that of how Russia's diaspora contribute to a competitive edge in the software industry (Bardhan and Kroll 2006).

There are various ways in which regions can benefit from diaspora. The first is through encouraging return migration by means of special tax treatment or training and investment subsidies. Governments can also develop diaspora knowledge

[4] References can be found in Poot and Cochrane (2005).

networks through promoting business associations or virtual clusters through the internet. There can also be integration of home and host regions through joint ventures and other forms of cooperation. Finally, incentives may be created to channel remittances to productive investment in the home region.

It has been noted that, for good economic reasons, the propensity to cross borders is much higher among young workers rather than older workers. Consequently, net inward migration of young workers can reduce ageing of the population in sub-replacement fertility regions. [5] However, as noted earlier, immigration cannot permanently halt population ageing, unless migrants have above-replacement fertility. The literature suggests that, with rising incomes, immigrant fertility may drop to that of the host population.[6] The next section reviews the benefits of youthfulness of a population with respect to innovation, competitiveness and growth.

4. Effects of population ageing on regional competitiveness

Population ageing can refer to either an increasing share of older persons in the population (structural ageing), or an increase in the number of older persons (numerical ageing), or both. Population ageing has received widespread attention throughout the developed world in recent years as many countries are experiencing below replacement fertility, while life expectancy continues to increase. In addition, there will be a retirement bulge over the next two decades due to the retirement of large cohorts of post-WWII baby boomers. This peristalsis effect will generate very rapid increases in the number of 'old old' towards the middle of the century. To cite *The Economist* (2004) "..a larger generation of old folk than ever before will need support for longer than ever before from a population of working age that is shrinking continuously….". However, population ageing is also affecting emerging and less developed economies. For example, the population of Asia – while still younger than the West at present – will age faster than the West (e.g., Mason et al. 2006). The case of China, given its huge population, rapid development and low fertility, is likely to have an impact globally (e.g. Eberstadt 2004).

Like immigration, population ageing affects the economy also in many ways, see for example Hurd (1997) for a review of microeconomic issues while Weil (1997) provides a macroeconomic review. This literature tends to emphasise public policy problems associated with population ageing. More recent literature downplays such problems and takes a more optimistic stance of 'positive ageing' through policy responses and market forces that will encourage older persons to continue to make economic contributions that will avoid or overcome many problem. In addition, resources that were allocated to the young are freed up in many countries and generate a (temporary) phase of an increasing proportion of the population at the key labour

[5] Population ageing is also leading in many developed countries to particular regions growing rapidly through retirement migration. Such migrants are of course primarily attracted to amenities such as a pleasant climate, natural attractions and recreational facilities. This type of migration shifts the sectoral structure to labour-intensive services of eldercare. However, specialisation in these types of services may impede a region's long-run competitiveness if the services are primarily non-traded and they generate a demand for lesser skilled workers. Interestingly, it is increasingly argued that one benefit of immigration is specifically to meet this increasing demand for eldercare workers (e.g., Easton 2006).

[6] For example, Smith and Edmonston (1997, chapter 3) note that fertility differences exist between immigrants in the US and the native-born population, but that the differences diminish with later generations.

force ages. This provides a so-called 'demographic dividend' (e.g., Lee 2003) although this dividend requires investment in education and training of the workers in order to reap the benefits of this 'window of opportunity' (Pool 2005).

This section briefly reviews both the macroeconomic and the microeconomic links between population ageing and competitiveness.[7] The effect of population aging on labour productivity is theoretically indeterminate (Cutler et al. 1990). Disney (1996) for instance, argues that an increasingly mature workforce will have higher levels of work experience and therefore might be expected to achieve higher levels of productivity than a younger workforce. Furthermore, as the aggregate cost of schooling falls when there are fewer young people, more intensive training of the young becomes affordable and may lead to subsequent productivity growth (Ermisch 1995, p 333; Fougere and Merette 1999).

It is also possible that the slower labour force growth implied by an ageing population leads to a higher relative price of labour and therefore provides a greater incentive to innovate through capital investment or research and development (e.g., Romer 1990). However, there are also endogenous growth models in which lower population growth results in less human capital accumulation and therefore a lower growth rate of labour productivity (e.g, Steinman et al. 1998). Moreover, if population ageing is associated with high levels of dissaving, this may increase the cost of capital and lower investment.[8] Furthermore, since labour mobility (geographic, occupational, industrial, or job to job) is inversely related to age, population ageing may also lower productivity growth through slowing down structural adjustment in the economy. In addition, population ageing shifts demand in the economy to labour-intensive services where the potential for productivity growth may be less (van Groezen et al. 2005). Finally, Canton et al. (2002) argue that when older people face a higher cost of adopting new technologies, political pressure in a democratic system may slow down innovation adoption in an ageing society.

Some empirical evidence is now emerging on the overall impact of all these effects. At the cross-country level, Lindh and Malmberg (1999) find that the 50-64 age group had a positive influence on labour productivity growth, whereas the 65 plus group had a negative effect and other age groups ambiguous effects. Using Canadian provincial data, Tang and MacLeod (2006) find that older workers are, on average, less productive than younger workers and that labour force ageing has a modest negative impact on productivity growth. Similarly, Brunow and Hirte (2006) find that differences in age structure induce differences in per capita output growth across European regions. The most significant (positive) growth is generated by the age group of 30 to 44 year old. Using a large panel of developed and developing countries, Feyrer (2005) found that it was the relative size of the age group 40 and 49 that particularly associated with productivity growth.

What could be micro-level physiological phenomena that underpin such productivity effects? Robertson and Tracy (1998) provide a review of the literature on age, health and work and show that there are many factors that affect the productivity of older workers. There is evidence that older workers remain highly productive within a field that they know well and where long experience is beneficial. However, when they perform work where they are required to reorient themselves to new task

[7] An extensive review of both the macro and micro literature on the impact of population ageing on innovation and productivity growth can be found in Prskawetz et al. (2005).

[8] This effect is likely to be more pronounced in relatively closed imperfect capital markets. There is little evidence of a global shortage of capital and demographically driven upward pressure on global interest rates at present.

requirements and to solve novel problems, their performance is below that of younger workers (Smith 1996). This effect appears to be compounded by work task complexity. This means that as task complexity increases, mental agility becomes more important and this compounds the age-induced productivity effect (Myerson et al. 1990). This can become particularly problematic as the rapid pace of technological change increases the importance of being able to assimilate new techniques and adapt to new ways of working (Skirbekk 2003, pp. 7-8). However, there appears to be a 'use it' or 'lose it' dynamic for some skills, such as literacy skills. Workers who are employed in environments that require continual learning are less susceptible to a decline in their ability to acquire new skills (OECD 1998, p. 138). This implies that any tendency for the ability to acquire new skills to decline with age can, at least in part, be ameliorated by continued training. With respect the impact of individual ageing on creativity and entrepreneurship, psychologists argue that there is as yet little known on this and there is particularly in this area a need for substantive longitudinal studies (e.g. Simonton 2000).

The potential impact of population ageing on innovation can be gauged from interesting recent research by Jones (2005), who studied the age at which individuals make their greatest intellectual contribution, using data on Nobel Prize winners and great inventors. Jones finds that the age at which the mind is most innovate increased by about 6 years over the 20th Century. The main reason is that the 'researcher training period' appears to have become longer. The later age of peak intellectual productivity does not lead to a shift in productivity beyond early middle age. This implies that individual innovators are productive over a narrower span of their life cycle and Jones estimates that individual life cycle innovation potential has declined by 30 percent. For a given population size, this would of course reduce the aggregate output of innovators.[9] This study is complemented by a wide range of contributions by economists (using e.g. evidence from supervisors' ratings or piece rate samples) and by psychologists on cognitive abilities, that do detect declining individual productivity after mid-life (e.g., Prskawetz et al. 2005).

However, the consequences of population ageing due to these effects may not be as grim as the above suggests. It can be argued that the fewer innovations that are produced at higher age are more likely to be the result of reduced *incentives* to innovate at such ages than a physiological diminished ability for intellectual creativity. Introducing incentives to innovate at older age (e.g. through flat organisational structures in which older persons are not disproportionally required to take on managerial responsibilities), the regional impact of the change in average individual innovativeness can become negligible. In any case, innovation is closely linked to agglomeration and economic scale, not average innovativeness per firm or knowledge worker. This suggests that agglomeration effects (possibly reinforced by globalisation and immigration) may offset the impact of work force ageing on innovation.

The physiological consequences of aging are of course not limited to the cognitive but can manifest themselves also in the greater propensity for illness and injury at older ages that could affect an individual worker's output, increases the cost of employing older persons, or that could induce a worker to withdraw from the work force earlier than otherwise. There is evidence, however, that the impact of ill health on productivity has been declining over time (Manton et al. 1997). This process will

[9] An obvious solution to this problem would be to remove institutional barriers to later retirement. The benefits of this for the life course output of leading researchers are even further enhanced by the fact that reaching the status of Nobel prize winner appears to itself lead to increasing life expectancy (Rablen and Oswald 2007).

also be assisted by the large shift of the work force from physical and injury-prone employment to white collar employment (OECD, 1998).

When current incentives for early retirement in many developed nations are removed, the productivity of older workers can be effectively enhanced by further human capital investments. Skills acquisition by older workers raises a number of issues. Given that the working life left to an older worker is shorter than that left to a younger worker there is a shorter time period in which the older worker can employ their newly acquired skills and, for the cognitive reasons suggested above, it maybe more time consuming, and thus costly to impart new skills to older workers. This creates clear incentives to concentrate training and skill development in the early part of a worker's career (OECD 1998, p 129). Set against this is the lower job mobility of older workers (Dixon 2003, p 71). As employers assess the profitability of investment in training not in terms of the employee's remaining working life but in terms of their expected remaining tenure with the firm, it may prove that the lower quit rate of older workers will increase the rate of return on training investment compared to younger workers. The rapidity of technical change will also impact on the employers' calculation of the likely period over which the cost of training will be amortized. Hence if the skills workers have devalued rapidly because of technological change, the importance of a long 'pay back period' for investment in training would diminish, relatively favouring older workers. Conversely if there is indeed a deterioration of the ability to acquire new skills with age, rapidly changing skills needs would disadvantage older workers.

5. Final comments

This paper focused on two current demographic trends common to many developed economies: population ageing and increasing immigration. The paper considered the impact of these two phenomena on regional competitiveness at both the macro and micro levels. The review drew on two strands of literature that developed largely independently but show remarkable similarity. Both with respect to population ageing and with respect to immigration, there are many channels through which these demographic trends can affect regional competitiveness. These were briefly reviewed in the paper. There is empirical evidence that population ageing reduces regional competitiveness, while immigration – particularly of entrepreneurs and highly skilled workers to metropolitan areas – enhances competitiveness.

Such findings add weight to the suggestion that increased immigration may be the policy solution to offset the economic impact of ageing. Certainly, population pyramids in developing countries bulge precisely at the younger age groups where the numbers in the developed countries are declining. Moreover, as noted earlier, ageing may generate an increase in certain types of services that can be met by immigrant workers. In addition, immigrants might take the housing vacated by retiring workers moving out of dormitory suburbs and thereby avoid a collapse of house prices (Myers 2007). However, while immigration can slow down ageing, the levels needed to halt this are unrealistically high and, moreover, when such level are not sustained, ageing may even accelerate subsequently. In any case, it is unlikely that immigration will provide the solution to population decline in all regions that currently face rapid ageing and net outward migration. While a managed contraction of activity is politically not as attractive to sell to constituents as a growth strategy, the "mindset" for policy formulation may need to move away from the "importance in numbers" and

there is no doubt that some regions cannot avoid planning for decline (e.g. Stimson 2002). The main concern will be to generate productivity growth and real income gains in these situations, while using the available resources in a sustainable way.

In this respect, much of the available literature on the impact of immigration and ageing on productivity and competitiveness is based on small-scale case studies and rigorous econometric studies of the impact of demographic change at the regional level are still remarkably absent.

At the macro-level, there is an urgent need for time series analysis of the potential link between immigration waves and total factor productivity growth. At the regional level, there is also a need to study the link between dynamic benefits of agglomeration and immigrant clustering in agglomerations. It would be particularly interesting to assess whether immigrants are concentrated in industries that have high levels of innovation and rates of total factor productivity growth. However, given the endogeneity of the spatial distribution of migrants, the search for suitable instrumental variables in spatial econometric modelling of the link between immigration and regional competitiveness would be a first requirement.

At the micro-level, the Schumpeterian effects of immigration in terms of benefits for innovation and entrepreneurship also still warrant further attention. Much of the existing literature is based on small scale qualitative studies. Another potentially fruitful endeavour of inquiry is the difference between regions in terms of the extent to which there are existing links with their diaspora, or the extent to which such links could be developed in the future.

With respect to population ageing, it appears that the negative impact of population ageing on regional competitiveness may be relatively small as long as policies are in place for productivity enhancement of the older work force. What is needed, therefore, is a careful assessment of the barriers to re(training) of older workers and the barriers to their job, geographic, occupational and industrial labour mobility.

With respect to such barriers, population ageing and immigration have an additional feature in common that has not been addressed in the present paper. This is the existence of discrimination in the labour market, which may for example be reflected in relatively high unemployment rates among older workers and certain immigrant groups. Economic theory suggests that in a competitive environment discrimination is not sustainable. However, due to asymmetric information and other labour market imperfections, discrimination against older workers and against immigrant workers may persist (see e.g. Cain 1986 for a classic survey). It is clear that such discrimination can potentially be an impediment to regional competitiveness. The impact of discrimination of older workers and migrants groups on regional innovation and entrepreneurship appears a largely unexplored research topic, as well as an issue to be addressed by regional policy makers.

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