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SESSION III

Measuring Australia's human capital development: the role of post-school education and the impact of population ageing

Submitted by Australian Bureau of Statistics [1]

INTRODUCTION

1.   As perhaps the most important asset of a country, human capital is a key concept in economic analysis and policy discourse. It is relevant for addressing questions such as what are the returns to education, how can a country enhance the productive capacity of its workforce, what is the likely impact of an ageing population on economic growth. At present, systematic measures of human capital are available for very few countries. This presents researchers and policy makers with a dilemma: how are we to understand the role of human capital for the economic and social progress if we do not have agreement on how to measure it? It is the responsibility of national statistical agencies to inform debates and decision making processes. What is their role in supporting the measurement of human capital as a part of official statistics?

2.   The under-development of measures of human capital as official statistics arises from several factors. First there needs to be agreement on the concept. To what extent should non-economic aspects of human capital be incorporated and what theoretical and practical challenges

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[1] This paper has been prepared at the invitation of the secretariat.

does this pose? Despite many years of effort by generations of economists, there is still some way to go before we have a consensus on how the economic dimension of human capital should be measured. Should this measurement be undertaken in a national accounting context? Human capital is harder to measure than physical capital as it has to be measured by indirect means. How might national statistics agencies set about reaching agreement on a broad approach to measuring human capital? What are the conceptual and methodological challenges they need to overcome. Finally, this work requires expertise, knowledge and skills in numerous fields including the system of national accounts, productivity/economic growth, labour/education economics. Should we official statistical agencies invest in this work out of our limited resources?

3.   In response to increasing demand for statistics related to the measurement of human resource in Australia, the Australian Bureau of Statistics (ABS) has started on a research program on the measurement of human capital. To make our task more manageable, we are dealing only with the 'economic' component of human capital. This does not imply that the 'non-economic' aspects are not important. So far this project has produced systematic but experimental estimates of the size of human capital stock, the formation of human capital by education and working experience (both gross and net).[2]

4.   Given the measurement methods available in the relevant literature, we have chosen the Jorgenson-Fraumeni lifetime labour income approach (Jorgenson, D and B. Fraumeni, 1989) as the basis of our accounting framework for human capital, with some modifications. This method measures the stock of human capital as the discounted present value of expected lifetime labour market income. In accounting for factors contributing to the growth of the human capital stock over time, we focus attention on the roles of post-school education and increased working experience for young workers. In accounting for factors causing the depletion of the existing human capital stock, we estimate the impact of population ageing on the availability of human resource for undertaking market labour activities. In so doing, we also take into account the growth of human productive capacity over time. In valuing the magnitudes of these human capital flows, we use per capita lifetime labour incomes and its changes over time as the valuation basis.

5.   Population ageing is an important economic issue facing developed countries, generating many studies and debates. The analysis of population ageing and policy initiatives for dealing with it require the availability of relevant statistics. Our measurement framework of human capital contributes to this by providing quantitative assessment of the impact of population ageing on human capital development. Our estimates show that since the early 1990s, the human capital stock in Australia has been depreciating at an accelerated rate due to population ageing, and this trend has been counterbalanced by increasing investment in education and training. Our measurement framework could be also used for evaluating to what extent the accelerating depletion of human capital stock caused by population ageing could be alleviated by encouraging older people to stay in the workforce longer, in particular for those with advanced human capital skills. This framework could be used for comparing relative effectiveness of various policy solutions in dollar terms.

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[2] See Wei, H (2004) and Wei, H (forthcoming).

6.   In compiling these measures of human capital development for Australia, we have encountered numerous theoretical and practical issues and challenges. By discussing these issues and presenting our experimental estimates of human capital stock and flows, we hope that this paper could draw attention to the measurement issues of human capital and generate robust debates about how and what to do in putting human capital into the domain of official statistics.

I.   MEASUREMENT SCOPE

7.   Human capital can be defined in various ways, depending on the issues at hand. Human capital can be broadly defined as the productive capacity embodied in individuals. This definition is adopted by a recent report of the World Bank (2006, p.89). A person's productive capacity is related to a variety of factors, such as knowledge and skills, physical and mental conditions, life experience and attitude. As the 'knowledge and skills' is the most important determinant in a person's productive capacity, human capital can be also defined as the knowledge and skills embodied in individuals. This is the definition adopted by the OECD (1998, p.9).

8.   The 'knowledge and skills' definition focuses attention on the contribution of education and training to a person's human capital formation. This is more in line with the conventional approach of the human capital theory, formulated by Schultz (1961) and Becker (1964) in the early 1960s. Some other authors extend the concept of human capital to consider the roles of health and other factors in a person's human capital formation. Ideally, all major factors that facilitate the formation and enhancement of productive capacities of human beings should be considered in developing comprehensive measurement of human capital. However, from a practical point of view, knowledge and skills are relatively easier to measure. In addition, there exist rich data sources on variables that could serve as proxies of knowledge and skills, such as educational attainment and labour market earnings. Due to these considerations, we adopt 'the knowledge and skills' definition of human capital in our research program on the measurement of human capital.

9.   Human capital (knowledge and skills) can be accumulated in various forms: education, working experience, innate ability, etc. Even within the category of education, it includes formal schooling activities including compulsory primary and secondary education, post-school education such as universities and vocational training institutions. It also includes informal education in the form of learning within family and early childhood settings and self studies. It would be a daunting task to include all these factors in the measurement of human capital in one go. To make our job more manageable, we focus attention on post-school education and working experience, two major contributors in human capital formation and the central themes of an enormous outpouring of literature in labour and growth economic studies.

10.   Human capital (knowledge and skills) can be broadly categorized into two kinds: the baseline knowledge and skills, and advanced knowledge and skills. This categorization is similar to that used in the World Bank report which divides human capital into raw labour and skilled labour (World Bank, 2006, p.88). Our research work focuses on the growth of advanced knowledge and skills, defined as those acquired through formal post-school studies including universities degrees and vocational training programs.

11.   Human capital plays an important role in market activities as well as in non-market activities. Education does not only have positive effect on labour productivity and hence on labour market earnings, it also helps improve the overall ability to undertake non-market activities and enrich personal lives. These non-economic returns to education are no less important as the impact on market labour activities and the economic success of both individuals and nations. Accordingly, human capital can be either defined as "…relevant to economic activities (OECD 1998, p 9)", or as "…facilitate the creation of personal, social and economic well-being (OECD 2001, p18)." Since the ABS research work focuses on the role of human capital in enhancing the economic performance, the market dimension of human capital is adopted in our research program at this stage. In valuing the human capital produced by education, we exclude these non-economic benefits in projecting lifetime labour incomes, because human capital in non-market activities is harder to measure, and is subject to more controversies.

12.   Human capital, embodied knowledge and skills, has multiple dimensions. Conceptually, human capital skills can be categorized into three broad kinds: generic skills, firm-specific skills and task specific skills. Ideally, measures of human capital should capture these three dimensions. At present, we use educational attainment as a measure of generic skills. Information on the occupation and industry could capture firm-specific skills. At this stage though, we do not have systematic data about the distribution of human capital across different industries.

13.   As far as working experience is concerned, we do not have direct observations on this important aspect of human capital. We use age as a proxy for measuring working experience. As we will show later in this paper that ageing has both positive and negative impact on human capital formation. This study attempts to measure the impact of population ageing on human capital development in Australia.

II.   METHODOLOGY

14.   Our methodology is based on the Jorgenson-Fraumeni lifetime labour income approach. Unlike the standard financial method, which calculates present value of a capital project by discounting the cash flows in each period to the present and adding up to obtain the present value of the investment, Jorgenson and Fraumeni simplifies this procedure by a backward recursion. It is assumed that all individuals retire at age 75 and have no labour income and therefore zero human capital. For individuals at other ages, their lifetime labour incomes are equal to their current incomes plus the present values of lifetime labour incomes of those with one year older. For example, an individual's lifetime labour income at age 74 is his current labour income only because he will retire next period. For an individual at age 73 his lifetime labour income is his current labour income plus the lifetime labour income of the preceding 74 year old person, adjusted by income growth and survival factors. By working backward in this way for all possible combinations of sex and education level, all individuals' lifetime labour incomes can be derived.

15.   Within the Jorgenson and Fraumeni human capital accounting framework, all individuals in an economy are cross-classified by sex/educational attainment/age, and the stock of human capital is obtained by multiplying lifetime labour incomes by the corresponding number of

persons in each sex/education/age category and aggregating across these sex/education/age groups. The change in human capital stock from period to period is viewed as the sum of human capital formation, net of depreciation and revaluation. Human capital formation itself comes from population growth (both new babies and immigration) and increments to lifetime incomes due to investment in formal education. Depreciation on human capital arises from ageing, deaths and emigration. Net human capital formation is the difference between gross formation and depreciation. Revaluation on human capital comes from changes in lifetime labour incomes over time for each age/sex/education groups.

16.   One important advantage associated with the Jorgenson-Fraumeni approach is its ability to account for the effect on human capital formation of current schooling activities – that is, it can account for additional human capital embodied in those individuals who are still participating in formal education and who anticipate improved employment and income prospects as a result. In addition, the Jorgenson-Fraumeni approach can be used to measure option values generated by undertaking additional schooling activities, in particular basic school education.[3] The concept of option value, which is defined as the potential for possibly greater returns associated with completing certain educational levels, has received increasing attention in the recent return-to education literature.[4]

17.   In applying the Jorgenson-Fraumeni approach to the Australia data, we have made several modifications. One of the major concerns with the Jorgenson and Fraumeni approach is that estimation of lifetime labour incomes based on current cross-sectional information is subject to short-term business cycle effects: it tends to under-estimate lifetime labour incomes in recession years and over-estimate in booming years. To remove biases caused by business cycle effects associated with estimates of lifetime labour incomes based on current cross-section data, we use repeated cross-section data from the 1981-2001 Australian Census, which combine all years of the census data to follow each sex/education/age cohort over its life cycle.

18.   There are many other forms of returns to human capital, such as the values created in unpaid household production, and potentially, leisure. How to value non-market labour activities is a contentious issue. Jorgenson and Fraumeni adopt the concept of full income including non-market income as well as market income. The non-market income is based on imputations to leisure time. The after-tax wage rates are used to impute the incomes of leisure time. This choice attracts understandable criticism. For example, is it appropriate to value a PhD holder's work in the garden at a higher rate than that for someone who only completed secondary education? In order to avoid these complications, the estimates of human capital in our study are confined to market labour activities. The valuation of non-market activities is beyond the scope of our present study.

19.   The Jorgenson and Fraumeni's accounting framework covers all individuals in the population. Our study is confined to the working age population aged 18-65 years. Like many economic growth and productivity studies, we are concerned with the growth and development of human capital embodied in the working age population. Therefore, only post-secondary

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[3] For applying the Jorgenson-Fraumeni lifetime income approach to measure option values generated by secondary education, see Wei, H (2007).
[4] For a brief literature survey on this topic, see Heckman, J.J., Lochner, L.j., and Todd, P.E., (2005).

education is accounted as investment in human capital formation.[5] Accordingly, other factors causing changes in the human capital stock, such as additions of turning-working-age persons and immigrates to the working-age population, are treated as other volume changes, equivalent to the category 'Other changes in assets account' in the SNA93.

20.   The Jorgenson and Fraumeni's accounting system only considers formal education in its estimates of investment in human capital that enhances individuals' skills and knowledge, with the component of on-the-job training being mixed with its estimation of depreciation on human capital. The standard human capital theory also emphasizes the role of on- the-job training in human capital formation. This study provides separate estimates of investment due to working experience.

21.   The Jorgenson and Fraumeni's measurement system of human capital accumulation account is based on the rich data base on market labour activities. In contrast, our study uses the full Australian Census data for the period 1981 - 2001. As there is no direct information on labour earnings in the Census data, our research has to use the Census income variable, which contains all sources of incomes, as a proxy of labour earnings. In the lack of information on hours worked in the Census data for pre 2001 period, our study makes no attempt to separate hourly labour compensation and hours worked in the measurement of total labour earnings. Further more, our study is based on the aggregate level without occupation/industry details.

III.   MAIN FINDINGS

22.   Applying the modified Jorgenson-Fraumeni method, described in the preceding section, to the Australian Census data for 1981, 1986, 1991, 1996 and 2001, we produce five snapshots of age-earnings profiles for four broad categories of educational attainment for both men and women over this twenty year period. Combining these age-earnings profiles together, we derive per capita measures of lifetime labour market incomes for each age/sex/education cohort, and applies these per capita measures to the number of people in the corresponding cohort. By aggregating across all cohorts, we obtain the estimates of the human capital stock for Australia.

Table 1. The stock of human capital for Australia: 1981-2001 (millions of 2001 dollars)

		1981	1986	1991	1996	2001
Male	Higher Degree	42,917	52,562	92,185	127,009	161,362
	Bachelor Degree	244,123	315,558	448,212	607,439	733,190
	Skilled Labour	840,709	943,680	1,039,949	1,143,195	1,259,752
	Unqualified	1,540,987	1,685,260	1,889,659	1,950,974	1,957,450
	Sub Total	2,668,736	2,997,060	3,470,005	3,828,618	4,111,754
Female	Higher Degree	9,485	14,002	30,389	55,730	90,579
	Bachelor Degree	106,458	160,347	305,251	489,443	663,789
	Skilled Labour	349,437	420,986	429,201	488,993	553,664
	Unqualified	1,251,790	1,353,062	1,569,421	1,623,914	1,616,411
	Sub Total	1,717,170	1,948,398	2,334,262	2,658,080	2,924,442
Total		4,385,906	4,945,457	5,804,266	6,486,698	7,036,196

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[5] Hill (2003) makes the similar recommendation in his proposed accounting system for human capital.

23.   Table 1 presents the experimental estimates of the human capital stock for Australia in 2001 constant dollars. Two patterns are noticeable from these figures. First, the stock of human capital in Australia has increased by 60 per cent between 1981 and 2001, characterized by sharply rising share of aggregate human capital attributable to more educated workers. Second, increases in the more highly qualified components of human capital have been much faster for women than for men. For example, the value of female higher degree holders' human capital has increased nearly ten-fold during the twenty year period. The human capital of men with higher degrees has nearly quadrupled over the same period. The value of female bachelor degree holders' human capital is over six times higher in 2001 than 1981, while during the same period the corresponding value for men has tripled.

24.   Table 2 presents the experimental estimates of human capital accumulation account in 2001 dollars. In contrast to the original Jorgenson and Fraumeni's accumulation account for human capital, which measures human capital formation as comprising of all types of education and demographic changes as well, our modified accumulation account focuses attention on the contribution of post-school education and working experience to the growth of human capital stock, with demographic changes being treated as other volume changes. In a broad sense, depreciation on human capital is a measure of the impact of population ageing on the availability of human capital skills for labour market activities (as persons become older, they have less working life for using human capital in the labour market).

Table.2 Human capital accumulation accounts (millions of 2001 dollars)

	1981–86	1986–91	1991–96	1996-2001
MALE				
Opening Balance	2,668,736	2,997,060	3,470,005	3,828,618
Investment in Education				
Investment in post-school education	62,060	81,564	103,468	102,938
Depreciation on post-school investment	-31,687	-34,465	-46,942	-61,551
Net formation by post-school investment	30,373	47,099	56,526	41,388
Experience Factor				
Gross on-the-job investment	319,201	300,113	277,664	251,974
Depreciation on the job investment	-47,128	-47,547	-47,055	-49,897
Net on-the-job investment	272,073	252,565	230,608	202,077
Persons Turning Working Age	485,721	554,633	534,861	549,963
Ageing of Base Level Human Capital	-584,722	-632,549	-670,121	-689,796
Immigrants	136,760	208,898	155,619	184,047
Revaluation	76,679	131,589	151,234	120,925
Omissions & Errors (including emigrants)	-88,561	-89,290	-100,114	-125,467
Changes in Human Capital Stock	328,323	472,945	358,613	283,136
Closing Balance	**2,997,060**	**3,470,005**	**3,828,618**	**4,111,754**
FEMALE				
Opening Balance	1,717,170	1,948,398	2,334,262	2,658,080
Investment in Education				
Investment in post-school education	37,593	63,876	87,765	90,750
Depreciation on post-school investment	-11,713	-14,312	-20,911	-31,295
Net formation by post-school investment	25,880	49,564	66,854	59,455
Experience Factor				
Gross on-the-job investment	123,785	110,013	140,482	145,821
Depreciation on the job investment	-19,635	-20,520	-25,380	-29,225
Net on-the-job investment	104,150	89,492	115,102	116,596

	1981–86	1986–91	1991–96	1996-2001
Persons Turning Working Age	340,898	404,026	394,857	410,493
Ageing of Base Level Human Capital	-334,273	-369,916	-451,445	-493,475
Immigrants	90,999	145,939	120,448	136,928
Revaluation	55,078	113,785	128,765	89,715
Omissions & Errors (including emigrants)	-51,504	-47,026	-50,762	-53,351
Changes in Human Capital Stock	231,228	385,864	323,818	266,362
Closing Balance	**1,948,398**	**2,334,262**	**2,658,080**	**2,924,442**

25.   Some brief explanatory notes for Table 2 are provided below. The numbers in the opening balance are taken from the subtotals in Table 1. The investment in post-school education, measured as incremental increases to lifetime labour incomes due to additional schooling activities, includes schooling activities for bachelor, higher degree and vocational studies. To match the definition of investment in human capital, depreciation is defined as deletions of additional lifetime labour incomes of those individuals with post school education due to their ageing. The investment in working experience is measured as incremental increases in lifetime labour incomes to those with additional years of working experience. The key assumption underlying such estimation is that increases in labour earnings as people get older are attributable to on-the-job training.

26.   Depreciation of on-the-job investment is measured similarly as in the case of investment in education. The item 'Persons Turning Working Age' measures the additions to the existing human capital stock from the under-working age sub-population of the previous accounting period that have joined the workforce in the current accounting period, as the base level education group. The growth of human capital beyond the base level for this group of population during the current accounting period is accounted in the category of investment in post-school education. The item 'Ageing of the Base Level Human Capital' measures deletions of lifetime labour incomes of all individuals (including those with post school education attainments) as unskilled labour (depletions of the corresponding additional human capital skills are covered in the depreciation estimates for the investment in education and experience factor categories). The item 'Revaluation' measures the changes in real lifetime labour incomes over time (holding age as constant). As there is no sufficient information to derive estimates of emigrants, the item 'Omissions &Errors' includes the deletions of the human capital stock caused by emigration. More details and associated caveats are provided in the forthcoming ABS research paper on the measurement of human capital flows.

27.   The preliminary findings from the flow accounting exercise paint a mixed picture for Australian human capital development over the last two decades. The figures show that the gross human capital formation by investment in post-school education has grown at a rapid pace: its contribution to the growth of human capital stock rose from 19% for men and 16% for women during the early 1980s, to 36% for men and 34% for women in the period 1996–2001. However, the magnitudes of depreciation also have trended upwards strongly since the first half of 1990s, which significantly have slowed down the growth of human capital stock. As a result, the growth of net human capital formation slowed down significantly. This phenomenon essentially reflects the impact of population ageing on long-term growth prospect of human resources available for sustainable economic growth and development.

IV.   IMPACT OF POPULATION AGEING

28.   The ultimate cause of depreciation on human capital is finite work life. As people get older, they have less working periods available for market activities. The estimates of depreciation are measures of the impact of population ageing on the stock of human resources in the economy in dollar terms. This depreciation can be examined through a number of components in Table 2: ageing of base level human capital; depreciation on the investment in post school education; and depreciation of on-the-job investment. Ageing of the base level human capital is, to some extent, compensated for by persons turning working age. As can be see from Table 2, the net effect of these is negative and the gap between the two is increasing over time. It is more pronounced for males than females. Indeed for females the increased labour force participation of women during the 1980s as more women combined work with family responsibilities meant that contribution to human capital growth of young women turning working age exceeded the loss due to ageing. However by the 1990s the pattern for women was similar to males. As can be seen also from Table 2, the growth of human capital has slowed down since 1991, from $473bn to $283bn in 2001 for males and from $386bn to $266bn for females. Both depreciation on the investment in post school education and on-the-job investment are contributing to this.

29.   It has long been recognised that human capital is an important source of long-term economic growth. Our figures show that population ageing is reducing the net growth of human capital. To counter the impact this may have on long-term economic growth various solutions and policy options might be contemplated. Our measurement framework could be used for quantifying the effects of these policy choices on the size of human capital stock. For example, it could help answer the following questions: What is the necessary percentage increase in the labour force participation rate to counteract the impact of population ageing in the short term? To what extent the increase in productivity through investment in education and training could compensate the depletion of human resources caused by population ageing?

V.   CHALLENGES AND FUTURE DEVELOPMENT

30.   The systematic measurement of human capital presents difficult challenges for an official statistical agency like the ABS. Conceptually, there are various tough decisions, choices and assumptions that have to be made. These include issues related to evaluation of non-market activities, ability biases, influences of institutional factors on determination of wage rates and so on. From the practical point of view, the job is equally challenging. It is a daunting task to reconcile inconsistencies between various data sources. Probably the fundamental challenging issue is the fact that source data does not directly measure human capital and has to be manipulated to do so, sometime in less than ideal ways.

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