S E D A P

A PROGRAM FOR RESEARCH ON

SOCIAL AND ECONOMIC DIMENSIONS OF AN AGING POPULATION

An Invitation to Multivariate Analysis: An Example About the Effect of Educational Attainment on Migration Propensities in Japan

Atsushi Otomo and Kao-Lee Liaw

SEDAP Research Paper No. 113

AN INVITATION TO MULTIVARIATE ANALYSIS: AN EXAMPLE ABOUT THE EFFECT OF EDUCATIONAL ATTAINMENT ON MIGRATION PROPENSITIES IN JAPAN

ATSUSHI OTOMO AND KAO-LEE LIAW

SEDAP Research Paper No. 113

December 2003

Note: This paper is cross listed as No. 388 in the McMaster University QSEP Report Series.

An Invitation to Multivariate Analysis:

An Example About the Effect of

Educational Attainment on Migration Propensities in Japan

Atsushi Otomo and Kao-Lee Liaw

December 2003

Atsushi Otomo is Technical Adviser, ICONS International Cooperation Inc., Tokyo, Japan.
Kao-Lee Liaw is a QSEP Research Associate and a faculty member of the School of Geography and Geology, McMaster University.

An Invitation to Multivariate Analysis:

An Example About the Effect of

Educational Attainment on Migration Propensities in Japan

ABSTRACT

To provide a strong motivation for students to learn multivariate statistics and the multivariate way of thinking, this paper uses an easily understandable example of ascertaining the effect of educational attainment on migration propensity in Japan. With cross-tabulations and a logistic model, we demonstrate the necessity of the multivariate approach by showing that the control for the effect of gender is indispensable for revealing the true effect of educational attainment. We further identify two conditions under which valid inference about the effect of a factor depends critically on the control for another factor. Finally, we identify an apparent contradiction between tabulated and logistic results and present a resolution to it.

Keywords: multivariate analysis, logistic model, odds ratios

1. INTRODUCTION

There are two kinds of data that are used for studying the relationships of the variables that are involved in real-world processes: *observational* and *experimental*. Observational data are obtained from observing real-world processes (e.g. the data collected from a survey that elicits answers to questions about the incidences and characteristics of migration from the time of birth to the date of survey). Experimental data are generated from experiments in which certain factors are controlled so that the relationships between key variables can be more easily ascertained (e.g. the data collected from an experiment in which the volume of an airmass is fixed so that the relationship between the temperature and pressure of the airmass can be more easily studied).

The data for studying a human behaviour (e.g. migration) and the consequent socioeconomic process (e.g. urbanization, suburbanization, or counter-urbanization) are usually of the observational type. Since many factors are likely to be involved and can not be practically controlled in the real-world, the usefulness of the observational data can be enhanced by collecting information on many relevant factors so that the relationship between a dependent variable and a specific explanatory factor of interest to a researcher can be properly assessed in the context of other influential factors via some multivariate model. Essentially, a well-specified multivariate model for analyzing observational data is analogous to a well-designed experiment for generating experimental data: both have the advantage of reducing the risk of making a misleading inference that results from the failure to control for the effect of one or more influential causal factors. In short, multivariate methodology tends to be particularly important in demography and other social sciences.

The main purpose of this paper is to use a simple real-world example to help students appreciate the importance of the multivariate perspective so that they can be motivated to learn multivariate statistics or at least a multivariate way of thinking. Our presentation consists of three parts. The first and most important part uses only *tabulations* of individual observations that can be easily understood by students who do not have any formal training in statistics. The tabulations will show that without a proper control for the effect of a related explanatory factor, the table showing the dependence of a variable on an explanatory factor of interest to a researcher can become very misleading. The second part introduces a *logistic model* that can not only reproduce the key informations of the tabulations but also provide additional informations for gaining a better understanding of the conditions under which the computed effect of an explanatory factor becomes misleading if the effect of another explanatory factor is not controlled for. This part should be easy to read for those with some background in regression

analysis and can be used as a concrete example for learning the use of probability models. The third part introduces an *interaction term* into the logistic model in order to deal with questions about the interaction between two explanatory factors. This part will not be presented in the main text of the paper. Rather, it is done in an appendix, because it can probably be well understood only by those who are experienced users of multivariate models in their research. We hope that the three parts of this paper can be used by the instructors who appreciate the usefulness of substantively meaningful examples at both elementary and advanced levels of *applied* statistics.

Our real-world example is about an attempt at explaining the propensities to make interprefectural migration at the time of marriage in Japan by educational attainments. We hypothesize that the migration propensities tend to be higher for those with higher educational attainments. This hypothesis is based on the idea that those with better education tend to have greater information and contact fields so that their marital partners are more likely to be located outside of their own resident prefecture, especially in a prefecture with a good chance of getting a professional job. To test this hypothesis, we use the micro data of the 1986 national survey on migration history (IPP, 1988) and select the adults who are either college or university graduates. Typically, it takes two and four years to complete college and university education, respectively. According to our hypothesis, university graduates are expected to be more prone to make interprefectural migration at marriage than are college graduates.

2. DATA ANALYSIS USING TABULATIONS

We start our investigation by paying attention to only the dependent variable and the educational factor that are considered in our hypothesis. An interprefectural migration is said to have occurred if the prefecture of residence immediately before marriage is different from the

prefecture of residence immediately after marriage. By cross-tabulating the individuals in the survey data according to migration status and educational attainment, we obtain the information shown in Table 1. Here the dependent variable is represented by a migration rate, which is obtained by dividing the number of interprefectural migrants by the size of the at-risk population.

For college graduates, the migration rate is 22.8% (i.e. 245/1,075*100%). For university graduates, it is 18.1%. Contrary to our hypothesis, these migration rates indicate that university graduates were less prone to make interprefectural migration than were college graduates. This finding is inconsistent with many other findings confirming the enhancing effect of educational attainment on long-distance migration in various countries (e.g. Long, 1988; Newbold & Liaw, 1994; Liaw & Kawabe, 1994; Liaw & Lin, 2001). What has gone wrong?

To pursue the investigation further, we notice the fact that Japan is a male-oriented society in which brides are more likely to move to the location of grooms rather than the other way round. It seems likely that our hypothesis may be supported by the data, if we control for the strong effect of gender. Thus, we make a three-way cross-tabulation of the observations in the survey data and obtain the education-specific migration rates for each gender (Table 2). Among males, the migration rate turns out to be 6.9% for college graduates and 12.5% for university graduates. Among females, it is 29.9% for college graduates and 42.4% for university graduates. In other words, after controlling for the effect of gender, the empirical data indeed support our hypothesis that the higher the educational attainment, the greater the propensities to make interprefectural migration.

The above finding has two important implications. First, in designing the questions of a survey questionnaire, the researcher must not ask only the questions that are directly relevant to her/his specific theory or policy concerns. Rather, she/he should review the broad literature and

ask questions about all factors that are shown in the literature to be highly influential factors. Our finding indicates that the chance of making valid inferences from survey data can be greatly enhanced if questions about such influential factors are included in the questionnaire. More specifically, a researcher who is not interested in gender issues must still ask a gender question in the survey, if he wants to understand the effect of educational attainment on the migration behavior at marriage in Japan. Second, compared with a bivariate perspective, a multivariate perspective is less prone to lead to a misleading inference from empirical data.

For the readers who have not taken any training in statistics and have no intention to do so, we wish that they would keep these two important implications in mind before leaving this paper behind at this point. For others, please continue reading.

3. DATA ANALYSIS USING A LOGISTIC MODEL

Although it is a very useful tool for uncovering the inherent relationship between two variables in the context of one or two more variables, multidimensional cross-tabulation becomes increasingly unwieldy when the researcher wants to control for the effects of two or more explanatory factors. Its unwieldiness is particularly severe when each of the explanatory factors is represented by a large number of categories, because the researcher may end up with the task of making an inference from an unreasonably large number of tables. A more abstract but analytically more effective way to study empirical data from the multivariate perspective is to use a multivariate statistical model. If the values of the dependent variable are not restricted to a particular range, and if the scatter diagrams suggest a linear relationship, a linear regression model may be used. When the values of the dependent variable are restricted to the range between zero and one (or 100%), it is common to use a logistic or a probit model (Cox, 1989).

In this section, we will show that a logistic model can be used (1) to generate the key

informations obtained from the above cross-tabulations, (2) to yield the so-called p-values that can be used to assess whether certain computed effects are statistically significant (i.e. not likely the result of sampling errors), and (3) to identify the conditions under which the control for the effect of an extraneous factor becomes essential for avoiding the risk of making a misleading inference about a hypothesized relationship from empirical data.

The formulation of the logistic model for explaining a person's propensity to make interprefectural migration at marriage by educational attainment and gender is as follows. Let i be used to identify a person in question. We use P_i to represent her/his probability of making interprefectural migration, U_i to represent her/his educational attainment, and F_i to represent her/his gender. More specifically, U_i is a dummy variable that assumes the value of 1, if person i is a university graduate. Otherwise, it assumes the value of 0. F_i is another dummy variable that assumes the value of 1, if person i is female. Otherwise, it assumes the value of 0. Considering educational attainment and gender as two explanatory factors, we write down the logistic model as:

$$P_i = \exp(B_o + B_1 * U_i + B_2 * F_i) / \{ 1 + \exp(B_o + B_1 * U_i + B_2 * F_i) \},$$

where exp( ) is the exponential function, and B_o, B_1 and B_2 are unknown coefficients to be estimated. We expect both B_1 and B_2 to turn out as positive values, because the propensity to make interprefectural migration is expected to be enhanced by having a university education and being female. We use the Logistic procedure of SAS to fit various specifications of this model to the survey data. The estimation method used by this procedure is the maximum likelihood method.

By using educational attainment as the only explanatory factor, our first specification of the logistic model yields the estimation result shown in the top panel of Table 3. The estimated coefficient of U_i (-0.2924) turns out to have a "wrong" sign. The very large magnitude of the

associated t-statistic (-16.8) and equivalently the very small p-value (0.0000) indicate that it is extremely unlikely that the perverse effect of education attainment revealed by the estimation result is due to sampling errors.

The estimated coefficients in the top panel indicate that the estimated model is:

$\underline{P}_i = \exp(-1.2202 - 0.2924*U_i) / \{ 1 + \exp(-1.2202 - 0.2924*U_i) \}$

where $\underline{P}_i$ is the predicted probability. By letting U_i be 0 and 1 in turn, we find that $\underline{P}_i = 0.228$ for a college graduate, and $\underline{P}_i = 0.181$ for a university graduate. These predicted probabilities are identical to the corresponding migration rates in Table 1 that were generated by the method of cross-tabulation.

By using both educational attainment and gender as explanatory factors, our second specification of the logistic model yields the estimation result shown in the middle panel of Table 3. Now, we find that in the context of gender, the estimated coefficient of U_i (0.5764) indeed turns out to have a positive sign, as we have hypothesized. Based on the large t-statistic (4.5) and equivalently the very small p-value (0.0000) associated with this estimated coefficient, we are highly confident that the positive effect of educational attainment is not a spurious result from sampling errors.

The estimated coefficients of the second specification indicate that the estimated logistic model is:

$\underline{P}_i = \exp(-2.5385 + 0.5764*U_i + 1.6785*F_i) / \{ 1 + \exp(-2.5385 + 0.5764*U_i + 1.6785*F_i) \}$

By substituting all possible combinations of the values of U_i and F_i into the above equation, we get the following predicted probabilities:

$\underline{P}_i = 0.057$ for a male college graduate,

$\underline{P}_i = 0.123$ for a male university graduate,

$\underline{P}_i = 0.297$ for a female college graduate,

$\underline{P}_i = 0.430$ for a female university graduate.

These predicted probabilities are very similar to the corresponding migration rates in Table 2 that were generated by a three-dimensional cross-tabulation. This strong similarity suggests that there seems to be no need for using a "saturated" logistic model to study the effects of the two explanatory factors in question. Note that, as will be shown in the appendix, the saturated model for our empirical problem contains an additional term that is created by using the product of U_i and F_i as an additional explanatory variable. It has the ability of generating predicted probabilities that are exactly identical to the migration rates shown in Table 2.

From the methodological point of view, the most intriguing question is why the estimated effect of educational attainment becomes misleading when the effect of gender is not controlled for. The answer lies in two basic facts. First, U_i and F_i have a strong negative correlation. The simple correlation coefficient between them is -0.51, the magnitude of which is very great in light of the fact that it is computed from micro data. This strong negative correlation results from the fact that most college students were female, whereas most university students were male. This fact is a reflection of the domination of the Japanese society by a patriarchal value system that presumed that a two-year college education was good enough for a polished lady, whereas a four-year university education was essential for a successful household head.[1] Second, in terms of the impact on the propensities to make interprefectural migration at marriage, the gender effect is much stronger than the education effect. This is reflected by the fact that the coefficient of F_i (1.6785) is about three times the coefficient of U_i (0.5764). In other words, the effect of the male-oriented residential arrangement is much stronger than the effect of

---

[1] The university entrance rate for Japanese females increased substantially in the 1990s (from 15.2% in 1990 to 31.5% in 2000). However, the gender gap remains quite large, because during the same period, the corresponding rate for Japanese males increased from 33.4% to 47.5% (Statistics Association, 2001, p. 115).

educational attainment.   As a consequence of these two basic facts, the omission of F_i from the logistic model forces U_i to become a perverse proxy for maleness and hence to assume a misleading negative coefficient.

Based on the above analysis, we now state the two general conditions under which the control for another explanatory factor (say, F_{2i}) should be seriously considered in order to avoid making a misleading inference about the effect of an explanatory factor of interest to the researcher (say, F_{1i}).

Condition 1: (i) F_{1i} and F_{2i} have a strong negative correlation; (ii) the effects of F_{1i} and F_{2i} on the dependent variable are in the same direction; and (iii) the effect of F_{2i} is much stronger than that of F_{1i}.

Condition 2: (i) F_{1i} and F_{2i} have a strong positive correlation; (ii) F_{1i} and F_{2i} have opposite effects on the dependent variable; and (iii) the effect of F_{2i} is stronger than that of F_{1i}.

To get a more concrete understanding of the problem, let us pretend that our research interest is in the gender effect rather than the education effect. Is it alright that we assess the effect of gender without controlling for the effect of education? By cross-tabulating the observations of the survey data only by gender and migration status, we find in Table 4 that the migration rate is much higher for females (32.9%) than for males (11.1%), which clearly supports the idea that the residential arrangement was strongly male-oriented. Similarly, using gender as the only explanatory factor, our third specification of the logistic model yields a positive coefficient for F_i (1.3688), which is significantly different from zero (see the bottom panel of Table 3). Thus, the effect of the male-oriented tradition on migration propensities can be easily detected without controlling for the effect of education. The reason for it is that the gender effect is much stronger than the education effect. In other words, the third part of Condition 1 does not apply here. However, it is important to point out that the strength of

gender's effect has been understated when the effect of education is not controlled for: the coefficient of F_i has been reduced from 1.6785 in Specification 2 to 1.3688 in Specification 3. In other words, the failure to control for the effect of education has resulted in *somewhat* misleading information about the effect of gender.

Finally, to demonstrate the consistency between the cross-tabulation and logistic results, we show that the estimated model for the third specification is

$\underline{P}_i = \exp(-2.0837 + 1.3688 \cdot F_i) / \{ 1 + \exp(-2.0837 + 1.3688 \cdot F_i) \}$,

which implies that the predicted migration probabilities are

$\underline{P}_i = 0.111$ for a male, and $\underline{P}_i = 0.329$ for a female. Both of these predicted probabilities correspond exactly to the migration rates shown in Table 4.

Experienced users of probability models, please continue to read the appendix about the usefulness of *odds ratio* as a means to resolve an apparent contradiction between tabulated and logistic results.

4. CONCLUSION

In order to provide a strong motivation for students to learn multivariate statistics and the multivariate way of thinking, we have used an easily understandable example of an attempt at ascertaining the enhancing effect of educational attainment on the propensities to make interprefectural migration at marriage in Japan. The example shows that the failure to control for the effect of gender leads to a misleading inference about the effect of educational attainment. Such a misleading inference from empirical data represents not only a waste of the researcher's time and effort but also a serious hindrance to the development of sound theories.

An important implication of our result is that it is very important to make a *broad* literature review before starting an empirical research and designing a survey questionnaire. In

other words, the researcher should become familiar with the literature outside his specific schools of thought and policy concerns. Otherwise, he may miss the information on a factor that has to be controlled for in order to reduce the risk of making a misleading inference from empirical data.

One of our contributions is the identification of two conditions under which the chance of making a valid inference about the effect of an explanatory factor (say, F_{1i}) is enhanced by controlling for another explanatory factor (say, F_{2i}):

Condition 1: (i) F_{1i} and F_{2i} have a strong negative correlation; (ii) the effects of F_{1i} and F_{2i} on the dependent variable are in the same direction; and (iii) the effect of F_{2i} is much stronger than that of F_{1i}.

Condition 2: (i) F_{1i} and F_{2i} have a strong positive correlation; (ii) F_{1i} and F_{2i} have opposite effects on the dependent variable; and (iii) the effect of F_{2i} is stronger than that of F_{1i}.

It is worth noting that our advice to include two highly correlated explanatory factors into a multivariate model goes against the common advice that such explanatory factors should not be included in the same model (Hair **et al**, 1992, p. 36; Johnson & Wichern, 1992, p. 313). The common advice is based on the concern that the standard errors of the estimated coefficients of such explanatory factors may become too large. But, our example has demonstrated that the basis for the common advice is overly simplistic.

Finally, our inquiry about whether the education effect is stronger for females than for males (see the appendix) has uncovered two important points about measurement: (1) *odds* is better than *probability* as a measure of *propensity*, although the latter is intuitively more appealing than the former; and (2) *odds ratio* is better than the *difference between two probabilities* as a measure of *the effect of a change in an explanatory factor*. By using these

better measures, the apparent contradiction between the result of cross-tabulation and the estimated result of a multivariate statistical model vanishes.

APPENDIX

IS THE EDUCATION EFFECT ON MIGRATION PROPENSITIES STRONGER FOR FEMALES THAN FOR MALES?

In this appendix, we enquire about whether the effect of educational attainment on the propensities to make interprefectural migration is stronger for females than for males. In pursuing this enquiry, we first encounter an apparent contraction between the results of different approaches and then find a way to resolve the contradiction. Since the contradiction is likely to be encountered by other users of multivariate statistics, our finding should be of interest to researchers in various fields.

We see in the left panel of Appendix Table 1 that the change in educational attainment from college to university raises the migration rate by 12.4 % (i.e. 42.4% minus 29.9%) for females and 5.6% (i.e. 12.5% minus 6.9%) for males. Does this empirical finding indicate that the education effect is stronger for females than for males? One way to answer this question is to introduce the interaction variable "$U_i * F_i$" into the second specification of the logistic model and to see if it has an estimated coefficient that is positive and significantly different from zero. If so, the answer is "yes". Otherwise, the answer may be "no". In the left panel of Appendix Table 2, we see that the estimated coefficient of this interaction variable turns out to be a small negative value (-0.11) that is not significantly difference from zero (p-value = 0.7021). In other words, the logistic analysis does not provide any support for the idea that the education effect is stronger for females than for males.

Should we base our inference on the result of the logistic analysis? To answer this question, we will take two approaches. First, we replace the migration rate by the odds of migration as a measure of migration propensity and then use *odds ratio* as a measure of the

impact of a change in the value of an explanatory factor. Second, we replace the logistic model by a probit model, which is another widely used probability model (Cox, 1989).

In the right panel of Appendix Table 1, we see that among males, the odds of migration is 0.0742 for college graduates and 0.1424 for university graduates so that the impact of the change from college to university is represented by an odds ratio of 1.9. Among females, the odds of migration is 0.4269 for college graduates and 0.7348 for university graduates, yielding an odds ratio of 1.7 for representing the effect of the educational improvement. Thus, in terms of odds ratio, the education effect is about the same for the two sexes. Since it is actually slightly higher for males than for females, the use of the odds ratio also does not provide any support for the idea that the education effect is greater for females than for males.

To apply a probit model to the survey data, we use the SAS Logistic procedure with the "Link = Normit" option. The estimation result is shown in the right panel of Appendix Table 2. The estimated coefficient of the interaction $U_i * F_i$ turns out to be a slightly positive value (0.0037) that is not significantly different from zero (p-value = 0.9805). Thus, the probit analysis again does not provide any support for the idea that the education effect is stronger for females than for males.

In sum, we conclude that the effect of education on the migration propensity does not differ between the two sexes. In reaching this conclusion, we have found two important points about measurement: (1) *odds* is better than *probability* as a measure of *propensity*, although the latter is intuitively more appealing than the former; and (2) *odds ratio* is better than the *difference between two probabilities* as a measure of the effect of a change in an explanatory factor.

References

Cox, D. R. (1989) *The Analysis of Binary Data*, 2nd Edn (London, Chapman and Hall).

Hair, J. F., Jr., Anderson, R. E., Tatham, R. L. and Black, W. C. (1992) *Multivariate Analysis with Readings*, 3rd Edn (New York, Macmillian Publishing Company).

IPP (Institute of Population Problems) (1988) *National Survey on Migration in Japan, 1986: A Study of Its Histories, Determinants and Consequences*, Field Survey Series (Tokyo, IPP, Ministry of Health and Welfare). (text in Japanese)

Johnson, R. A. and Wichern, D. W. (1992) *Applied Multivariate Statistical Analysis*, 3rd Edn (Englewood Cliff, N. J., Prentice Hall).

Liaw, K. L. and Kawabe, H. (1994) "The dependence of marriage migration in Japan on personal factors and ecological Variables," *Mathematical Population Studies*, 4, pp. 235-258.

Liaw, K. L. and Lin, J. P. (2001, December) "Primary migration of the Taiwanese young labor force in the context of economic restructuring and globalization: an explanation based on the 1990 census," *Journal of Population Studies* (the journal of Japanese Population Association), 29, pp. 7-27.

Long, L. (1988) *Migration and Residential Mobility in the United States* (New York, Russell Sage Foundation).

Newbold, K.B. and Liaw, K. L. (1994) "Return and onward interprovincial migration through economic boom and bust in Canada, from 1976-81 to 1981-86," *Geographical Analysis*, 26, pp. 228-245.

Statistics Association. (2001) *Toukei de Miru Nihon (Statistical View of Japan)* (Tokyo, Statistics Association). (in Japanese)

Table 1. Misleading information about the effect of eudational attainment on the propensities to make interprefectural migration at marriage in Japan.

Educational attainment	Number of migrants (persons)	Size of at-risk population (persons)	Migration rate (%)
College	245	1,075	22.8
University	221	1,224	18.1
Total	466	2,299	20.3

Data Souce: The 1986 national survey on migration history.

Table 2. Meaningful information about the effect of educational attainment on the propensities to make interprefectural migration at marriage in Japan.

Educational attainment	Number of migrants (persons)	Size of at-risk population (persons)	Migration rate (%)
	Male		
College	23	333	6.9
University	124	995	12.5
	Female		
College	222	742	29.9
University	97	229	42.4

Table 3. Estimation results of different specifications of a logistic model for explaining the propensities of making interprefectural migration at marriage in Japan.

Variable	Coefficient	t-statistic	P-value
Specification 1: Gender is ignored.			
Intercept	-1.2202	-16.8	0.0000
University	-0.2924	-2.8	0.0049
Specification 2: Both educational attainment and			
gender are considered.			
Intercept	-2.5385	-18.4	0.0000
University	0.5764	4.5	0.0000
Female	1.6785	12.6	0.0000
Specification 3: Educational attainment is ignored.			
Intercept	-2.0837	-23.8	0.0000
Female	1.3688	12.3	0.0000

Note: The simple correlation between "University" and "Female" is -0.508 implying a tolerance level of 0.742 in Specification 2.

Table 4. Somewhat misleading information about the effect of gender on the propensities to make interprefectural migration at marriage in Japan.

Educational attainment	Number of migrants (persons)	Size of at-risk population (persons)	Migration rate (%)
Male	147	1,328	11.1
Female	319	971	32.9
Total	466	2,299	20.3

Appendix Table 1. Is the effect of educational attainment on inter-prefectural migration propensities stronger for females than for males?

Educational	Migration rate (%)		Odds of migration	
attainment	Male	Female	Male	Female
College	6.9	29.9	0.0742	0.4269
University	12.5	42.4	0.1424	0.7348
Difference in				
migration rate	5.6	12.4	----	----
Odds ratio	----	----	1.9	1.7

Appendix Table 2. Estimation results of the logit and probit models with an interaction term between educational attainment and gender.

Explanatory variable	Logistic model			Probit model		
	Coef.	t-statistic	P-value	Coef.	t-statistic	P-value
Constant	-2.6011	-12.0	0.0000	-1.4825	-14.2	0.0000
University	0.6517	2.8	0.0059	0.3303	2.8	0.0045
Female	1.7499	7.6	0.0000	0.9557	8.3	0.0000
University * Female	-0.1087	-0.4	0.7012	0.0037	0.0	0.9805

SEDAP RESEARCH PAPERS

Number	Title	Author(s)
No. 1:	Population Aging and Its Economic Costs: A Survey of the Issues and Evidence	F.T. Denton B.G. Spencer
No. 2:	How Much Help Is Exchanged in Families? Towards an Understanding of Discrepant Research Findings	C.J. Rosenthal L.O. Stone
No. 3:	Did Tax Flattening Affect RRSP Contributions?	M.R. Veall
No. 4:	Families as Care-Providers Versus Care-Managers? Gender and Type of Care in a Sample of Employed Canadians	C.J. Rosenthal A. Martin-Matthews
No. 5:	Alternatives for Raising Living Standards	W. Scarth
No. 6:	Transitions to Retirement: Determinants of Age of Social Security Take Up	E. Tompa
No. 7:	Health and Individual and Community Characteristics: A Research Protocol	F. Béland S. Birch G. Stoddart
No. 8:	Disability Related Sources of Income and Expenses: An Examination Among the Elderly in Canada	P. Raina S. Dukeshire M. Denton L.W. Chambers A. Scanlan A. Gafni S. French A. Joshi C. Rosenthal
No. 9:	The Impact of Rising 401(k) Pension Coverage on Future Pension Income	W.E. Even D.A. Macpherson
No. 10:	Income Inequality as a Canadian Cohort Ages: An Analysis of the Later Life Course	S.G. Prus
No. 11:	Are Theories of Aging Important? Models and Explanations in Gerontology at the Turn of the Century	V.L. Bengtson C.J. Rice M.L. Johnson
No. 12:	Generational Equity and the Reformulation of Retirement	M.L. Johnson
No. 13:	Long-term Care in Turmoil	M.L. Johnson L. Cullen D. Patsios
No. 14:	The Effects of Population Ageing on the Canadian Health Care System	M.W. Rosenberg

Number	Title	Author(s)
No. 15:	Projections of the Population and Labour Force to 2046: Canada	F.T. Denton C.H. Feaver B.G. Spencer
No. 16:	Projections of the Population and Labour Force to 2046: The Provinces and Territories	F.T. Denton C.H. Feaver B.G. Spencer
No. 17:	Location of Adult Children as an Attraction for Black and White Elderly Migrants in the United States	K.-L. Liaw W.H. Frey J.-P. Lin
No. 18:	The Nature of Support from Adult *Sansei* (Third Generation) Children to Older *Nisei* (Second Generation) Parents in Japanese Canadian Families	K.M. Kobayashi
No. 19:	The Effects of Drug Subsidies on Out-of-Pocket Prescription Drug Expenditures by Seniors: Regional Evidence from Canada	T.F. Crossley P. Grootendorst S. Korkmaz M.R. Veall
No. 20:	Describing Disability among High and Low Income Status Older Adults in Canada	P. Raina M. Wong L.W. Chambers M. Denton A. Gafni
No. 21:	Parental Illness and the Labour Supply of Adult Children	P.T.Léger
No. 22:	Some Demographic Consequences of Revising the Definition of #Old&to Reflect Future Changes in Life Table Probabilities	F.T. Denton B.G. Spencer
No. 23:	Geographic Dimensions of Aging: The Canadian Experience 1991-1996	E.G. Moore D. McGuinness M.A. Pacey M.W. Rosenberg
No. 24:	The Correlation Between Husband's and Wife's Education: Canada, 1971-1996	L. Magee J. Burbidge L. Robb
No. 25:	The Effect of Marginal Tax Rates on Taxable Income: A Panel Study of the 1988 Tax Flattening in Canada	M.-A. Sillamaa M.R. Veall
No. 26:	The Stability of Self Assessed Health Status	T.F. Crossley S. Kennedy
No. 27:	How Do Contribution Limits Affect Contributions to Tax-Preferred Savings Accounts?	K. Milligan

SEDAP RESEARCH PAPERS

Number	Title	Author(s)
No. 28:	The Life Cycle Model of Consumption and Saving	M. Browning T.F. Crossley
No. 29:	Population Change and the Requirements for Physicians: The Case of Ontario	F.T. Denton A. Gafni B.G. Spencer
No. 30:	Nonparametric Identification of Latent Competing Risks and Roy Duration Models	G. Colby P. Rilstone
No. 31:	Simplified Estimation of Multivariate Duration Models with Unobserved Heterogeneity	G. Colby P. Rilstone
No. 32:	Structural Estimation of Psychiatric Hospital Stays	G. Colby P. Rilstone
No. 33:	Have 401(k)s Raised Household Saving? Evidence from the Health and Retirement Study	G.V. Engelhardt
No. 34:	Health and Residential Mobility in Later Life: A New Analytical Technique to Address an Old Problem	L.M. Hayward
No. 35:	2 ½ Proposals to Save Social Security	D. Fretz M.R. Veall
No. 36:	The Consequences of Caregiving: Does Employment Make a Difference	C.L. Kemp C.J. Rosenthal
No. 37:	Fraud in Ethnocultural Seniors' Communities	P.J.D. Donahue
No. 38:	Social-psychological and Structural Factors Influencing the Experience of Chronic Disease: A Focus on Individuals with Severe Arthritis	P.J. Ballantyne G.A. Hawker D. Radoeva
No. 39:	The Extended Self: Illness Experiences of Older Married Arthritis Sufferers	P.J. Ballantyne G.A. Hawker D. Radoeva
No. 40:	A Comparison of Alternative Methods to Model Endogeneity in Count Models. An Application to the Demand for Health Care and Health Insurance Choice	M. Schellhorn
No. 41:	Wealth Accumulation of US Households: What Do We Learn from the SIPP Data?	V. Hildebrand
No. 42:	Pension Portability and Labour Mobility in the United States. New Evidence from SIPP Data.	V. Andrietti V. Hildebrand
No. 43:	Exploring the Effects of Population Change on the Costs of Physician Services	F.T. Denton A. Gafni B.G. Spencer

SEDAP RESEARCH PAPERS

Number	Title	Author(s)
No. 44:	Reflexive Planning for Later Life: A Conceptual Model and Evidence from Canada	M.A. Denton S. French A. Gafni A. Joshi C. Rosenthal S. Webb
No. 45:	Time Series Properties and Stochastic Forecasts: Some Econometrics of Mortality from the Canadian Laboratory	F.T. Denton C.H. Feaver B.G. Spencer
No. 46:	Linear Public Goods Experiments: A Meta-Analysis	J. Zelmer
No. 47:	Local Planning for an Aging Population in Ontario: Two Case Studies	L.M. Hayward
No. 48:	Management Experience and Diversity in an Ageing Organisation: A Microsimulation Analysis	T. Wannell M. Gravel
No. 49:	Resilience Indicators of Post Retirement Well-Being	E. Marziali P. Donahue
No. 50:	Continuity or Change? Older People in Three Urban Areas	J. Phillips M. Bernard C. Phillipson J. Ogg
No. 51:	Intracohort Income Status Maintenance: An Analysis of the Later Life Course	S.G. Prus
No. 52:	Tax-Preferred Savings Accounts and Marginal Tax Rates: Evidence on RRSP Participation	K. Milligan
No. 53:	Cohort Survival Analysis is Not Enough: Why Local Planners Need to Know More About the Residential Mobility of the Elderly	L.M. Hayward N.M. Lazarowich
No. 54:	Unemployment and Health: Contextual Level Influences on the Production of Health in Populations	F. Béland S. Birch G. Stoddart
No. 55:	The Timing and Duration of Women's Life Course Events: A Study of Mothers With At Least Two Children	K.M. Kobayashi A. Martin-Matthews C.J. Rosenthal S. Matthews
No. 56:	Age-Gapped and Age-Condensed Lineages: Patterns of Intergenerational Age Structure Among Canadian Families	A. Martin-Matthews K. M. Kobayashi C.L. Rosenthal S.H. Matthews

SEDAP RESEARCH PAPERS

Number	Title	Author(s)
No. 57:	The Relationship between Age, Socio-Economic Status, and Health among Adult Canadians	S.G. Prus
No. 58:	Measuring Differences in the Effect of Social Resource Factors on the Health of Elderly Canadian Men and Women	S.G. Prus E. Gee
No. 59:	APOCALYPSE NO: Population Aging and the Future of Health Care Systems	R.G. Evans K.M. McGrail S.G. Morgan M.L. Barer C. Hertzman
No. 60:	The Education Premium in Canada and the United States	J.B. Burbidge L. Magee A.L. Robb
No. 61:	Student Enrolment and Faculty Recruitment in Ontario: The Double Cohort, the Baby Boom Echo, and the Aging of University Faculty	B.G. Spencer
No. 62:	The Social and Demographic Contours of Contemporary Grandparenthood: Mapping Patterns in Canada and the United States	C.L. Kemp
No. 63:	Changing Income Inequality and the Elderly in Canada 1991-1996: Provincial Metropolitan and Local Dimensions	E.G. Moore M.A. Pacey
No. 64:	Mid-life Patterns and the Residential Mobility of Older Men	L.M. Hayward
No. 65:	The Retirement Incentive Effects of Canada's Income Security Programs	M. Baker J. Gruber K. Milligan
No. 66:	The Economic Well-Being of Older Women Who Become Divorced or Separated in Mid and Later Life	S. Davies M. Denton
No. 67:	Alternative Pasts, Possible Futures: A "What If" Study of the Effects of Fertility on the Canadian Population and Labour Force	F.T. Denton C.H. Feaver B.G. Spencer
No. 68:	Baby-Boom Aging and Average Living Standards	W. Scarth M. Souare
No. 69:	The Invisible Retirement of Women	L. McDonald
No. 70:	The Impact of Reference Pricing of Cardiovascular Drugs on Health Care Costs and Health Outcomes: Evidence from British Columbia – Volume I: Summary	P.V. Grootendorst L.R. Dolovich A.M. Holbrook A.R. Levy B.J. O'Brien

SEDAP RESEARCH PAPERS

Number	Title	Author(s)
No. 71:	The Impact of Reference Pricing of Cardiovascular Drugs on Health Care Costs and Health Outcomes: Evidence from British Columbia – Volume II: Technical Report	P.V. Grootendorst L.R. Dolovich A.M. Holbrook A.R. Levy B.J. O'Brien
No. 72:	The Impact of Reference Pricing of Cardiovascular Drugs on Health Care Costs and Health Outcomes: Evidence from British Columbia – Volume III: ACE and CCB Literature Review	L.R. Dolovich A.M. Holbrook M. Woodruff
No. 73:	Do Drug Plans Matter? Effects of Drug Plan Eligibility on Drug Use Among the Elderly, Social Assistance Recipients and the General Population	P. Grootendorst M. Levine
No. 74:	Living Alone and Living with Children: The Living Arrangements of Canadian and Chinese-Canadian Seniors	M.A. Pacey
No. 75:	Student Enrolment and Faculty Recruitment in Ontario: The Double Cohort, the Baby Boom Echo, and the Aging of University Faculty (Revised and updated version of No. 61)	B.G. Spencer
No. 76:	Gender Differences in the Influence of Economic, Lifestyle, and Psychosocial Factors on Later-life Health	S.G. Prus E. Gee
No. 77:	Asking Consumption Questions in General Purpose Surveys	M. Browning T.F. Crossley G. Weber
No. 78:	A Longitudinal Study of the Residential Mobility of the Elderly in Canada	Y. Ostrovsky
No. 79:	Health Care in Rural Communities: Exploring the Development of Informal and Voluntary Care	M.W. Skinner M.W. Rosenberg
No. 80:	Does Cognitive Status Modify the Relationship Between Education and Mortality? Evidence from the Canadian Study of Health and Aging	J.C. Brehaut P. Raina J. Lindsay
No. 81:	Agreement Between Self-Reported and Routinely Collected Health Care Utilisation Data Among Seniors	P. Raina V. Torrance-Rynard M. Wong C. Woodward
No. 82:	Age, Retirement and Expenditure Patterns: An Econometric Study of Older Canadian Households	F.T. Denton D.C. Mountain B.G. Spencer
No. 83:	Understanding the Relationship between Income Status and the Restrictions in Instrumental Activities of Daily Living among Disabled Older Adults	P. Raina M. Wong

SEDAP RESEARCH PAPERS

Number	Title	Author(s)
No. 84:	Location of Adult Children as an Attraction for Black and White Elderly *Return* and *Onward* Migrants in the United States: Application of a Three-level Nested Logit Model with Census Data	K-L. Liaw W.H. Frey
No. 85:	Changing Income Inequality and Immigration in Canada 1980-1995	E.G. Moore M.A. Pacey
No. 86:	The Dynamics of Food Deprivation and Overall Health: Evidence from the Canadian National Population Health Survey	L. McLeod M.R. Veall
No. 87:	Quebec's Lackluster Performance in Interprovincial Migration and Immigration: How, Why, and What Can Be Done?	K-L. Liaw L. Xu M. Qi
No. 88:	Out-of-Pocket Prescription Drug Expenditures and Public Prescription Drug Programs	S. Alan T.F. Crossley P. Grootendorst M.R. Veall
No. 89:	The Wealth and Asset Holdings of U.S.-Born and Foreign-Born Households: Evidence from SIPP Data	D.A. Cobb-Clark V. Hildebrand
No. 90:	Population Aging, Productivity, and Growth in Living Standards	W. Scarth
No. 91:	A Life-course Perspective on the Relationship between Socio-economic Status and Health: Testing the Divergence Hypothesis	S.G. Prus
No. 92:	Immigrant Mental Health and Unemployment	S. Kennedy
No. 93:	The Relationship between Education and Health in Australia and Canada	S. Kennedy
No. 94:	The Transition from Good to Poor Health: An Econometric Study of the Older Population	N.J. Buckley F.T. Denton A.L. Robb B.G. Spencer
No. 95:	Using Structural Equation Modeling to Understand the Role of Informal and Formal Supports on the Well-being of Caregivers of Persons with Dementia	P. Raina C. McIntyre B. Zhu I. McDowell L. Santaguida B. Kristjansson A. Hendricks L.W. Chambers

SEDAP RESEARCH PAPERS

Number	Title	Author(s)
No. 96:	Helping to Build and Rebuild Secure Lives and Futures: Intergenerational Financial Transfers from Parents to Adult Children and Grandchildren	J. Ploeg L. Campbell M. Denton A. Joshi S. Davies
No. 97:	Geographic Dimensions of Aging in Canada 1991-2001	E.G. Moore M.A. Pacey
No. 98:	Examining the "Healthy Immigrant Effect" in Later Life: Findings from the Canadian Community Health Survey	E.M. Gee K.M. Kobayashi S.G. Prus
No. 99:	The Evolution of High Incomes in Canada, 1920-2000	E. Saez M.R. Veall
No. 100:	Macroeconomic Implications of Population Aging and Public Pensions	M. Souare
No. 101:	How Do Parents Affect the Life Chances of Their Children as Adults? An Idiosyncratic Review	J. Ermisch
No. 102:	Population Change and Economic Growth: The Long-Term Outlook	F.T. Denton B.G. Spencer
No. 103:	Use of Medicines by Community Dwelling Elderly in Ontario	P.J. Ballantyne J.A. Marshman P.J. Clarke J.C. Victor
No. 104:	The Economic Legacy of Divorced and Separated Women in Old Age	L. McDonald A.L. Robb
No. 105:	National Catastrophic Drug Insurance Revisited: Who Would Benefit from Senator Kirby's Recommendations?	T.F. Crossley P.V. Grootendorst M.R. Veall
No. 106:	WAGES in CANADA: SCF, SLID, LFS and the Skill Premium	A.L Robb L. Magee J.B. Burbidge
No. 107:	A Synthetic Cohort Analysis of Canadian Housing Careers	T.F. Crossley Y. Ostrovsky
No. 108:	The Policy Challenges of Population Ageing	A. Walker
No. 109:	Social Transfers and Income Inequality in Old-age: A Multi-national Perspective	R.L. Brown S.G. Prus

SEDAP RESEARCH PAPERS

Number	Title	Author(s)
No. 110:	Organizational Change and the Health and Well-Being of Home Care Workers	M. Denton I.U. Zeytinoglu S. Davies
No. 111:	Stasis Amidst Change: Canadian Pension Reform in an Age of Retrenchment	D. Béland J. Myles
No. 112:	Socioeconomic Influence on the Health of Older People: Estimates Based on Two Longitudinal Surveys	N.J. Buckley F.T. Denton A.L. Robb B.G. Spencer
No. 113:	An Invitation to Multivariate Analysis: An Example About the Effect of Educational Attainment on Migration Propensities in Japan	A. Otomo K-L. Liaw