

Intergenerational Economic Mobility in Taiwan

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Abstract

The purpose of this paper is to estimate intergenerational mobility of income with respect to Father-Sons pairs in Taiwan using two-sample two-stage method. Our empirical analysis uses two survey data sets: the Panel Study of Family Dynamics (PSFD) from 2004 to 2006 and the Report on the Survey of Family Income & Expenditure in Taiwan Area (RSFI) in 1983. The estimation results with statistical annual income and predicted annual income suggest the elasticity of 0.2-0.24 for father-sons pairs using multiyear averages to consider measurement error.

JEL classification: D31, J62

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1. Introduction

The extent of intergenerational transmission of economic status from parents to their children is considered as one of the measures of inequality of economic opportunity. Individual economic conditions, such as life-time income, might be affected by innate ability, acquired ability by education, family background, preferences for occupation and life-style, and even good luck. Some of these factors are likely to inherit from parental characteristics that affect economic status, or to be affected by parental economic status directly. In societies with higher correlation between parental income and children's, one's born and brought up can be important for economic success more than other societies.

Following the seminal work by Solon (1992) and Zimmerman (1992), quite a few

studies estimate the intergenerational elasticity of son's earnings with respect to father's income, by correcting measurement error in single-year income whenever possible. As a result, increasing number of international studies contribute to illustrate the extent of intergenerational transmission of economic status across countries as summarized in Solon (2002). It becomes widely acknowledged that estimates of the intergenerational elasticity of the United States (Solon, 1992; Zimmerman, 1992) or Britain (Dearden, Machin and Reed, 1997) are generally higher than those of Scandinavian countries (Björklund and Jäntti, 1997; Bratberg, Nilsen, and Vaage, 2005; Bratsberg, Røed, Raaum, Naylor, Jäntti, Eriksson, and Österbacka, 2007). Recent studies suggest that Italy (Mocetti, 2007; Piraino, 2007), Brazil (Dunn, 2007), and Japan (Ueda, 2009) are also included in less mobile countries as well as the United States and Britain with the elasticity of 0.4-0.6, and that Canada (Corak and Heisz, 1999), Australia (Leigh, 2007), and Singapore (Ng, 2007) are rather similar to Scandinavian countries with the elasticity of 0.3 or less.

This paper estimates intergenerational mobility of earnings and income for father-son relation in the case of Taiwan, using the Panel Study of Family Dynamics (PSFD), compiled by Academia Sinica of the Republic of China (Taiwan). This data set consists of observations that provide son's income and father's characteristics information. Father's income in our analysis is taken out from the Survey of Family Income & Expenditure in Taiwan Area (RSFI) according to the information from PSFD, and by applying the two-sample two-stage method proposed by Björklund and Jäntti (1997). The estimation result from father-son pairs using multiyear measure suggests that the elasticity is about 0.20 with annual income.

The remainder of this paper is structured as follows. Section 2 describes the empirical framework employed in this paper following the relevant literature. Section 3 explains the source data and variables. Section 4 presents estimates of the intergenerational elasticity in Taiwan. Section 5 gives a summary.

2. Framework of Empirical Analysis

2.1 Basic Framework to Estimate Intergenerational Mobility

Recent studies on intergenerational mobility mostly follow the empirical framework by Solon (1992). Let y_0 denote life-time economic status for a parent in family i , and y_1 denote the same variable for the offspring. Economic status is usually represented by log earnings or log income. The relationship of intergenerational economic status is expressed as

$$(1) \quad y_{1i} = a_0 + \rho y_{0i} + \varepsilon_i$$

where a_0 is a constant, ε_i is an error term, and ρ indicates the intergenerational elasticity of son's earnings with respect to parental earnings. The life-time economic status is not usually observed, however. Observed are short-time economic status (e.g., annual earnings) of the son y_{1it} at time t and the same variable of the father y_{0is} at time s for father-son pair i . With considering age (or experience) effect, short-time economic status of the son expressed as

$$(2) \quad y_{1it} = y_{1i} + a_1 A_{1it} + a_2 A_{1is}^2 + u_{1is}$$

where A_{1it} is the age of the son i at time t , a_1 and a_2 are coefficients, and u_{1is} is an error term. Short-time economic status of the father is similarly expressed as

$$(3) \quad y_{0is} = y_{0i} + b_1 A_{0is} + b_2 A_{0is}^2 + u_{0is}$$

where A_{0is} is the age of the father i at time s , b_1 and b_2 are coefficients, and u_{0is} is an error term. With substituting equations (2) and (3) into equation (1), short-time economic status of the offspring is expressed as

$$(4) \quad \begin{aligned} y_{1it} &= a_0 + \rho y_{0is} + a_1 A_{1it} + a_2 A_{1it}^2 - \rho b_1 A_{0is} - \rho b_2 A_{0is}^2 + \{\varepsilon_i + u_{1it} - \rho u_{0is}\} \\ &\equiv a_0 + \rho y_{0is} + a_1 A_{1it} + a_2 A_{1it}^2 + \tilde{b}_1 A_{0is} + \tilde{b}_2 A_{0is}^2 + \tilde{\varepsilon}_i \end{aligned}$$

Then, the elasticity ρ is estimated using short-time economic status and the ages of the offspring and the parent. However, the OLS estimate of ρ might be downward biased because of measurement error caused by the correlation between y_{0is} and $\tilde{\varepsilon}_i$.

Solon (1992) proposes two approaches to correct the downward bias. One approach is to apply a several-period average to y_{0is} . The estimate is still downward biased, but the bias can be reduced. Another approach is instrumental variables (IV) estimation using education or social status of the father as instruments. The IV estimate might be upward biased if father's education (or social status) is positively correlated with ε_i .

Therefore, it is considered that an estimate with several-period average is a lower bound, and that an IV estimate is an upper bound of the intergenerational elasticity.

2.2 Two-Stage Approach using Predicted Economic Status of Father

In order to estimate equation (4), both parent's and offspring's earnings or income data are required. Therefore, the analysis demands long-running survey, such as Panel Survey of Income Dynamics (PSID) in the United States, involving observations of father's and his son's earnings or income.

Björklund and Jäntti (1997) propose an alternative approach that applies predictive earnings using parental characteristics such as education or occupation, as an imperfect substitute for parental earnings. Assuming that the life-time economic status of the parent y_{0i} is explained as a vector of parental characteristics q_{0i} associated with a vector of coefficients α , equation (3) is rewritten as

$$(5) \quad y_{0is} = q_{0i}\alpha' + b_1A_{0is} + b_2A_{0is}^2 + u_{0is}$$

At the first stage the life-time economic status of the parent \hat{y}_{0i} is predicted by $q_{0i}\alpha'$ where $\hat{\alpha}$ is an estimate of α . At the second stage, the following equation

$$(6) \quad y_{1it} = a_0 + \rho \cdot \hat{y}_{0i} + a_1A_{1it} + a_2A_{1it}^2 + \{\varepsilon_i + u_{1it}\}$$

is estimated using the prediction. This approach enables an estimation using a cross-sectional sample without observing actual parental earnings or income, provided that parental characteristics are observed. Furthermore, this approach is similar to the IV estimation that avoids the measurement error on father's earnings, although it might lead upward bias similar to the IV estimation (Solon, 2002). Therefore, an estimate of the two-stage approach is also considered as an upper bound of the estimate.

3. Data of the Analysis

Our empirical analysis uses two survey data sets: the Pane Study of Family Dynamics (PSFD), compiled by Academia Sinica of the Republic of China (Taiwan) and the Report on the Survey of Family Income & Expenditure in Taiwan Area (RSFI), 1983, carried out by Directorate-General of Budget, Accounting and Statistics Executive Yuan.

The short-time economic status of son is represented by actual annual income reported in PSFD. The data set PSFD is collected by the stratified random sampling method. It is a longitudinal survey of the income activities of households and household

members residing in Taiwan areas from 1998. The survey includes about 3000 households with the head of family aged from 25 to 65. It contains the information about annual incomes of individuals and households. Personal characteristics include age, years of schooling, annual income, etc. Income is reported as earned income in total during the previous year after taxes. Father's information includes age, education and occupation. The analysis uses micro data obtained from the 2004–2006. 745 samples of man aged of 30–49 in 2006 restricted to whose fathers is aged of 30–59 in 1983 were selected to do our statistics analysis.

The father's actual annual income is not observed in PSFD. Therefore, the lifetime economic status is represented by statistic annual income reported in the second data set (RSFI). The date set RSFI is also investigated by the stratified random sampling method. Both interviews and account-keeping are used to collect data in the survey. It contains the annual income information distributed into age, education level and occupation. The sampled households are interviewed once a year for major items of income and expenditure of the year. We use the statistical income with samples aged of 30–39 and 40–49 collected in 1983 as father's economics status. Unfortunately, it is not distributed in gender. Then upper bias exists in father's annual income considering women's income is lower compared with men's in Taiwan area in general.

The son-father sample is analyzed using the two-sample two-stage approach. We tried three ways in order to obtain father's lifetime economic status. In the first way, we use statistical income as collected in 1983 as father's lifetime economic status. In the second way, it is predicted by estimating the equation (5) using the statistical information from RSFI in 1983, in order to complement the sample that did not cover all ages and educational levels. In the estimation, age of father is fixed to the middle value of the statistical range, 34.5 or 45.5. Educational levels of father are captured by dummy variables of Primary school and below, Junior middle (vocational), High school, Senior vocational school, Junior college and University, Graduate School and above. Occupational characteristics are captured by dummy variables for 1) Legislators, government administrators, business executives and managers, 2) Professionals, 3) Technicians and associate professionals, 4) Clerks, 5) Service workers and shop and market sales workers, 6) Agriculturist, animal husbandmen, hunter, 7) forester and fishermen, 8) Craft and related trades workers, 9) Plant and machine operators and assemblers, 10) Elementary occupations, 11) Others, for regularly-employed, temporary-employed, and self-employed.

The same method is also applied in the third way, estimate function (5) using information of income, education, occupation and actual age from PSFD in 2002.

Different from the first two ways, the estimated income is obtained by gender.

Table 1 presents characteristics regarding the sample in 2004-2006 with father's statistical annual income in 1983. Average ages are around 39 for sons and 46 for fathers. The annual income of son is reported as earned income in total during the previous year before taxes, and transformed into the real term using Consumer Price Index.

Table 2 present the educational correlation between son and father. It shows that son has more probability to receive higher education with higher educated father, meaning that son whose father has higher education level will has more probability to receive higher income in general.

4. Estimation Results of Intergenerational Elasticity

Table 3 describes estimates of the elasticity for Father-Son Pairs using information from PSDF and RSFI. Case (A) presents result estimated with Statistical income in 1983, Case (B) presents result estimated by Predicted income with RSFI, and Case (C) presents result estimated by Predicted income with PSFD. All of the coefficients are significant with 0.01 statistical intervals. In case A, the elasticity in single year is estimated to 0.2160, 0.2355 and 0.2053, around 0.2. It is similar to Case B and a little higher than in Case C. Estimates using multi-year measure are a little higher than single year but also around 0.2. These results confirm that the intergenerational elasticity for Father-Son Pairs using annual income by Two-Stage Approach is likely of 0.19-0.24 in Taiwan area.

Findings from related literature suggest that estimated elasticity varies across studies. The estimate of 0.19-0.24 is almost equivalent to those from Canada, Sweden, and Finland (Table 1 in Solon, 2002), or suggested estimate of 0.2-0.3 from Australia by Leigh (2007).and fairly smaller than the estimate of 0.4 from the U.S. by Solon (1992), Sweden by Björklund and Jäntti (1997) that report the elasticity of 0.28, and estimates of 0.53 from the U.S. by Solon,(1992), 0.39–0.44 from Britain by Dearden et al. (1997), 0.5 from Italy by Mocetti (2007) and Piraino (2007).

In an international comparison of the estimates from relevant studies, it seems that Taiwan belongs to relatively mobile countries such as Scandinavian countries, rather than less-mobile countries such as the United States or Britain. Among Eastern Asian countries, the estimate from Taiwan seems to be smaller than those of 0.41-0.46 for married sons in the case of Japan by Ueda (2009), or those of 0.23-0.28 that may be underestimated due to the data limitation of young sons aged 23-29 in the case of

Singapore by Ng (2007).

Finally, recent studies have found nonlinear relation for intergenerational earnings mobility. An S-shaped relation of log earnings between parents and offspring has been found by Corak and Heisz (1999) in Canada, Bratsberg et al. (2007) in Norway, and Ueda (2009) for married sons and single daughters in Japan. Also, a convex relation is found by Bratberg et al. (2005) in Nordic countries, with low elasticity for low-income fathers and increasing elasticity for middle-income and high-income fathers. In contrast, a linear relation is found by Bratberg et al. (2005) in the United States and Britain, and by Ueda (2009) for married daughters in Japan. Figure 1 describes S-shaped relation of log income in the three cases in Taiwan area. The nonlinear relation is observed in high income class, suggests the elasticity is underestimated in case A and Case B with linear estimation. However, it is nearly linear relation for in Case C.

5. Summary

This paper has estimated intergenerational mobility of annual income in the case of father-son relation in Taiwan using two-sample two-stage method. We use two survey data sets: the Pane Study of Family Dynamics (PSFD) from 2004 to 2006 and the Report on the Survey of Family Income & Expenditure in Taiwan Area (RSFI) in 1983. We tried three ways in order to simulate father's lifetime economic status. In the first way, we use statistical income as collected in 1983 as father's lifetime economic status. In the second way, father's annual income is predicted using the statistical information from RSFI in 1983, and in the third way, using information from PSFD in 2002. The estimation results suggest the elasticity of 0.2-0.24 for father-sons paris using multiyear averages to consider measurement error. It seems that sons from the poorest families are not given equal opportunities to sons from poorer than average.

References

- Amemiya, Takeshi (1974), "The nonlinear two stage least squares estimator," *Journal of Econometrics* 2, 105-110.
- Amemiya, Yasuo (1985), "Instrumental variable estimator for the nonlinear error-in-variables model," *Journal of Econometrics* 28, 273-289.
- Björklund, Anders, and Markus Jäntti (1997), "Intergenerational Income Mobility in Sweden Compared to the United States," *American Economic Review* 87-5, 1009-1018.
- Bratberg, Espen, Øivind Anti Nilsen, and Kjell Vaage (2005), "Intergenerational Earnings Mobility in Norway: Levels and Trends," *Scandinavian Journal of Economics* 107-3, 419-435.
- Bratsberg, Bernt, Knut Røed, Oddbjørn Raaum, Robin Naylor, Markus Jäntti, Tor Eriksson, and Eva Österbacka (2007), "Nonlinearities in Intergenerational Earnings Mobility: Consequences for Cross-Country Comparisons," *Economic Journal* 117, C72-C92.
- Carroll, Raymond, David Ruppert, Leonard Stefanski, and Ciprian Crainiceanu (2006), *Measurement Error in Nonlinear Models* (2nd ed.), Chapman & Hall/CRC.
- Chadwick, Laura, and Gary Solon (2002), "Intergenerational Income Mobility among Daughters," *American Economic Review* 92-1, 335-344.
- Cook, J., and L. Stefanski (1994), "Simulation Extrapolation Estimation in Parametric Measurement Error Models," *Journal of the American Statistical Association* 89-428, 1314-1328.
- Corak, Miles, and Andrew Heisz (1999), "The Intergenerational Earnings and Income Mobility of Canadian Men: Evidence from Longitudinal Income Tax Data," *Journal of Human Resources* 34-3, 504-533.
- Couch, Kenneth A., and Thomas A. Dunn (1997), "Intergenerational Correlation in Labor Market Status: A Comparison of the United States and Germany," *Journal of Human Resources* 32-1, 210-232.
- Dearden, Lorraine, Stephen Machin, and Howard Reed (1997), "Intergenerational Mobility in Britain," *Economic Journal* 107, 47-66.
- Dunn, Christopher (2007), "The Intergenerational Transmission of Lifetime Earnings: Evidence from Brazil," *The B.E. Journal of Economic Analysis & Policy* 7-2, Article 2.
- Eide, Eric R., and Mark H. Showalter (1999), "Factors Affecting the Transmission of Earnings Across Generations: A Quantile Regression Approach," *Journal of Human*

Resources 34-2, 253-267.

Fertig, Angela R. (2003), "Trends in Intergenerational Earnings Mobility in the United States," *Journal of Income Distribution* 12 (3-4), 108-130.

Grawe, Nathan (2006), "Lifecycle bias in estimates of intergenerational earnings persistence," *Labour Economics* 13, 551-570.

Grawe, Nathan (2004a), "Reconsidering the Use of Nonlinearities in International Earnings Mobility as a Test for Credit Constraints," *Journal of Human Resources* 34-3, 504-533.

Grawe, Nathan (2004b), "International mobility for whom? The experience of high- and low-earnings sons in international perspective," in Miles Corak (ed.), *Generational Income Mobility*, Cambridge University Press.

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Hao, Lingxin, and Daniel Naiman (2007), *Quantile Regression*, SAGE Publications.

Haider, Steven, and Gary Solon (2006), "Life-Cycle Variation in the Association between Current and Lifetime Earnings," *American Economic Review* 96-4, 1308-1320.

Koenker, Roger (2005), *Quantile Regression*, Cambridge University Press.

Leigh, Andrew (2007), "Intergenerational Mobility in Australia," *The B.E. Journal of Economic Analysis & Policy* 7-2, Article 6.

Mocetti, Sauro (2007), "Intergenerational Earnings Mobility in Italy," *The B.E. Journal of Economic Analysis & Policy* 7-2, Article 5.

Murphy, Kevin M. and Robert H. Topel (1985), "Estimation and Inference in Two-Step Econometric Models," *Journal of Business & Economic Statistics* 3-4, 370-379.

Ng, Irene (2007), "Intergenerational Income Mobility in Singapore," *The B.E. Journal of Economic Analysis & Policy* 7-2, Article 3.

Piraino, Pastrizio (2007), "Comparable Estimates of Intergenerational Income Mobility in Italy," *The B.E. Journal of Economic Analysis & Policy* 7-2, Article 1.

Raaum, Oddbjørn, Bernt Bratsberg, Knut Røed, Eva Österbacka, Tor Eriksson, Markus Jäntti, and Robin Naylor (2007), "Marital Sorting, Household Labor Supply, and Intergenerational Earnings Mobility across Countries," *The B.E. Journal of Economic Analysis & Policy* 7-2, Article 7.

Solon, Gary (2002), "Cross-Country Differences in Intergenerational Earnings Mobility," *Journal of Economic Perspectives* 16-3, 59-66.

Solon, Gary (1992), "Intergenerational Income Mobility in the United States," *American Economic Review* 82-3, 393-408.

Ueda, Atsuko (2009), "Intergenerational Mobility of Earnings and Income in Japan,"

B.E. Journal of Economic Analysis & Policy 9-1, Article 54.

Zimmerman, David (1992), "Regression toward Mediocrity in Economic Stature,"

American Economic Review 82-3, 409-429.

Table 1: Sample Characteristics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Age of son	745	38.95168	5.370702	30	49
Age of father	745	45.98926	7.046115	30	59
Annual Income of son in 2004 (Taiwan \$)	519	603235.5	357472.5	6174.745	3704847
Annual Income of son in 2005	494	670929.3	439685.3	60356.1	4828488
Annual Income of son in 2006	472	620664.6	374421	10000	2500000
Annual Income of father in 1983	745	181146	90251.58	68768	470646
log Annual Income of son in 2004	519	13.14541	0.6246873	8.728223	15.12515
log Annual Income of son in 2005	494	13.26983	0.5316836	11.00802	15.39004
log Annual Income of son in 2006	472	13.16857	0.6245807	9.21034	14.7318
log Annual Income of father in 1983 in statistics	745	11.98106	0.5147945	11.13849	13.06186
log predicted income of father with RSFI	745	10.28704	0.5067165	9.488088	11.42319
log predicted income of father with PSFD*	713	12.1803	0.5508173	11.33121	13.27776

*Occupational code of 11(others) is dropped.

Table 2: Correlation of education level between fathers and sons

Education level of father		Educational level of son						Total
		Primary school	Junior middle (vocational)	High school	Senior vocational school	Junior college and University	Graduated school and above	
Below Primary school	0.13	0.05	0.40	0.38	0.09	0.06	0.02	1.00
Primary school	0.51	0.01	0.16	0.45	0.23	0.12	0.04	1.00
Junior middle (vocational)	0.12	0.00	0.07	0.43	0.28	0.19	0.03	1.00
High school	0.16	0.00	0.04	0.19	0.34	0.30	0.13	1.00
Senior vocational school	0.03	0.00	0.00	0.14	0.27	0.32	0.27	1.00
Junior college and University	0.05	0.00	0.00	0.15	0.18	0.41	0.26	1.00
Graduated school and above	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00
Total	1.00	0.01	0.15	0.37	0.23	0.17	0.07	1.00

Table 3: Estimates results using statistical income and predicted income of fathers

Annual Income of son	n	Annual Income of father	Coef.	Std. Err.	P>t
2004	519	Case A Statistical income in 1983 (sum of man and women)	0.2160	0.0539	0.000
2005	494		0.2355	0.0483	0.000
2006	472		0.2053	0.0600	0.001
2004~2005	450		0.2146	0.0466	0.000
2005~2006	434		0.2379	0.0475	0.000
2004~2006	402		0.2231	0.0457	0.000
2004	519	Case B Predicted income with RSFI (sum of man and women)	0.2095	0.0522	0.000
2005	494		0.2347	0.0472	0.000
2006	472		0.2143	0.0598	0.000
2004~2005	450		0.2159	0.0446	0.000
2005~2006	434		0.2417	0.0475	0.000
2004~2006	402		0.2244	0.0451	0.000
2004	500	Case c Predicted income with PSFD (man only)	0.1885	0.0498	0.000
2005	477		0.2102	0.0445	0.000
2006	455		0.2206	0.0512	0.000
2004~2005	431		0.1955	0.0424	0.000
2005~2006	418		0.2235	0.0441	0.000
2004~2006	386		0.2097	0.0427	0.000

Figure 1.1. Distribution of son income and father's statistical income

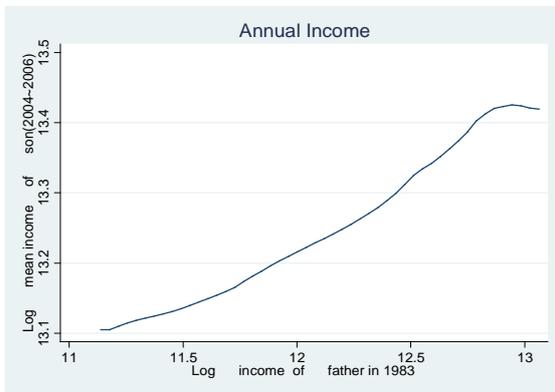


Figure 1.2. Distribution of son income and father's predicted income with RSFI

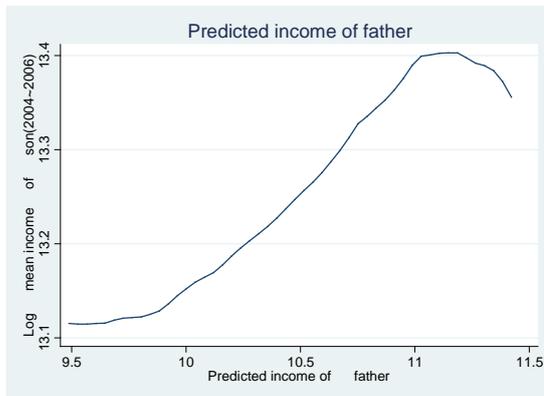


Figure 1.3. Distribution of son income and father's predicted income with PSFD

