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**The Intergenerational Transmission of Income  
and Education: A Comparison of Japan and France**

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**EUROPEAN UNIVERSITY INSTITUTE, FLORENCE**  
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## **Abstract**

The paper compares the extent of intergenerational earnings and educational correlation in Japan and France. It uses very similar repeated surveys that provide information on educational attainment and family background, conducted in Japan and France. To insure comparability, similar sample restrictions and specifications are imposed. For Japan, we use waves 1965, 1975, 1985, 1995 and 2005. For France, we use waves 1965, 1970, 1977, 1985, 1993 and 2003. Intergenerational elasticity in years of education can be readily estimated using available information. On the other hand, intergenerational earnings elasticity cannot be directly measured given the lack of information on parental income in both surveys. This leads us to apply Bjorklund and Jantti(1999) two sample instrumental variables estimation strategy. Lastly, we discuss to what extent differences in earnings mobility is related to differences in educational mobility and to differences in returns to education between the two countries.

## **Keywords**

intergenerational mobility; earnings; education; Japan; France

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# 1 Introduction

Inspired by the seminal work of Conlisk (1974), Atkinson (1981) and Becker and Tomes (1979; 1986), a recent series of studies have examined the extent of income mobility across generations in developed economies. They have revealed that in some countries a large fraction, of up to one half, of economic advantage or disadvantage is transmitted from one generation to the next, within families. There are, however, two important limitations with existing empirical studies. First, available evidence have mostly concentrated on North America and Western Europe. While they have revealed sizeable differences across countries in the extent of income mobility, very little is known of other parts of the world, in particular on Asian countries.<sup>1</sup> Second, beyond the measurement of the degree of intergenerational association, there is still considerable uncertainty regarding the structural determinants of intergenerational income mobility. In particular, the extent to which differences in the intergenerational mobility process, observed across countries and over time, are driven by such key ingredients as labor market institutions, wage inequality and educational policy is still unclear. This study provides an analysis of the extent of intergenerational mobility in earnings and education in Japan, a country so far absent from empirical evaluations. Furthermore, in order to provide a point of comparison for our results on Japan, and to discuss factors affecting the extent of intergenerational mobility, we undertake a comparison with intergenerational mobility in France.

Several reasons make the study of intergenerational earnings mobility in Japan particularly interesting and relevant. One of them is that there is considerable uncertainty regarding whether Japan exhibits high or low intergenerational mobility, in comparison to other countries. On the basis of class mobility, Ishida, Goldthorpe and Erikson (1991) conclude that Japan does not significantly deviate from the “core” fluidity model shared by most industrialized societies. However, Ishida (1993) indicates that mobility is indeed lower in Japan than in Britain and the United States and suggests that this may reflect the crucial influence of educational strategies. At the same time, the Japanese society is often seen as an equal society. This seems in particular the case on the labor market where

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<sup>1</sup>Lillard and Kilburn (1995) and Grawe (2004) are two noteworthy exceptions who address the issue of intergenerational earnings mobility in Malaysia, Nepal and Pakistan.

earnings differentials remain compressed (Gottschalk and Smeeding, 2000). This combination of relatively low social mobility and limited cross-sectional income inequality leads to ambiguous predictions regarding the extent of intergenerational earnings mobility : on the one hand existing sociological evidence point to a low degree of mobility in education and occupational status; on the other hand, the occupational hierarchy will be mapped into a rather compressed earnings structure which may lead to a small degree of differentiation in human capital accumulation strategies and overall, to a low degree of earnings mobility. This makes a strong case for reconsidering Japanese intergenerational mobility in a comparative perspective. In so doing, one of our objective is to shed light on the old but unsettled debate on Japanese “exceptionalism”.

In this respect, focusing on the transmission of income - rather than occupation, social status or education - provides more than a useful complement to the standard sociological studies of intergenerational mobility. There are two main reasons for studying income mobility. First, income is a crucial determinant of individual well-being and not only, nor primarily an aspect of individual socio-economic status - as taken into account in social prestige scores - but more fundamentally. Hence the analysis of its transmission across generations is of paramount importance from a welfare perspective. Second, the comparison overtime and across countries of the extent social and educational mobility is often difficult, because of the lack of comparability of social and educational classifications and the need to account for structural mobility. In comparison, the quantitative nature of income makes the analysis of intergenerational income mobility more simple and comparisons across countries and over time much easier.

Assessing whether a specific country displays high or low mobility in the absolute, is often very difficult. This is why we develop a comparative assessment of intergenerational mobility in Japan and France. Several features of France’s socio-economic setting make this country an interesting case for comparison. As far as its labor market is concerned, France is largely viewed as a heavily regulated labor market, in which minimum wage and collective bargaining result in a much more compressed wage structure than observed in most developed economies, and where firing costs translate into low rates of job mobility over the career. These two features makes the French labor market close to the Japanese

situation. Things are less clear cut when it comes to the educational system. On the one hand, the French education system is strongly hierarchical, in particular for higher education, coming close, in this respect, to the Japanese case. On the other hand, the degree of private monetary investment in children's education seems much less pronounced in France, where secondary and tertiary education is close to completely free of tuition fees. Hence at first sight, comparing France and Japan, in terms of their degree of intergenerational earnings mobility, seems an interesting way to assess the contribution of the educational system to the transmission of economic inequality.

Another argument for comparing Japan and France lies in the type of data available in both countries. As discussed in several papers (Jenkins, 1987; Grawe, 2006), the measurement of intergenerational mobility is very sensitive to specification issues and seemingly minor changes in the sample used or the estimated model can lead to large variations in the estimation results. Hence, to conduct a meaningful international comparison of intergenerational mobility requires that the same specification be estimated in the different countries. We pay great attention to this aspect in our comparison of Japan and France. In each country, our analysis relies on a several waves of a survey designed to study social mobility (the SSM survey in Japan and the FQP survey in France) and conducted at regular interval since around 1960 (1955 for Japan and 1964 for France). One should emphasize that the type of information collected is very similar in each country. Furthermore, since none of these surveys collects direct information on parental income, our estimation for each country relies on Björklund and Jäntti (1997)'s two-sample instrumental variable method.

Overall, Japan appears as a rather mobile society. Two main findings emerge from our analysis. First, intergenerational earnings mobility in Japan appears rather high, compared to what is usually found in Western developed countries. We find an intergenerational earnings elasticity of about .3 for Japan against around .5 for France. The value we find for Japan is slightly higher than the one found for Scandinavian countries and comparable to Canadian estimates. It is lower than in continental Europe and all the more so than in the US and UK. Second, the higher intergenerational earnings mobility found in Japan is associated with both a relatively low return to education on the labor market and a high

educational mobility. For instance, the intergenerational regression coefficient for education amounts in Japan to around .3, which is much lower than the value we find for France and, more generally, in many developed countries.

The rest of the paper is organized as follows. Section 2 discusses a standard intergenerational earnings transmission model and illustrates the relationship between earnings mobility, labor market inequality and educational mobility. Section 3 presents the econometric model. Section 4 describes the data. Section 5 discusses our main results.

## 2 Theoretical model

To illustrate the main structural determinants of intergenerational income mobility and to shed light on the interpretation of the commonly estimated intergenerational elasticity, we developed a simplified theoretical model, borrowed from Solon (2004). This model considers a simplified family model in which, at each period two generations coexist : one parent (generation  $t - 1$ ) and one child (generation  $t$ ). The parent is endowed with human capital, earn income, consume and invest in the child's human capital.

Let  $Y_{t-1}$  denote the parent's income,  $C_{t-1}$  her consumption and  $I_{t-1}$  her investment in her child's human capital. The budget constraint for generation  $t - 1$  is given by:

$$C_{t-1} + I_{t-1} = Y_{t-1} \quad (1)$$

Following Solon, assume that the technology that translates parental investment in child's human capital is given by :

$$H_t = \theta \log(I_{t-1}) + e_t \quad (2)$$

where  $H$  denotes human capital. This equation emphasizes two determinants of human capital accumulation. The first one consists in parental financial investment,  $I_{t-1}$ . This determinant should be understood in a broad sense, as including everything that money can buy, i.e. all parental influences that are directly determined by parental monetary resources. Direct education expenditures, such as tuition fees, are of course the most obvious

component of  $I_{t-1}$ . But parents can also influence their child's accumulation of human capital through, for instance, the choice of residential location. In fact, residential location is likely to influence human capital accumulation through, for instance, the composition of the peer groups or in cases where the allocation of pupils to schools is based on residential area. To the extent that location decisions are constrained by family income, this determinant is also captured by  $I_{t-1}$ . As discussed, for instance, in Becker and Tomes (1986) and Mulligan (1997), the reason why parental financial investment matters is that human capital accumulation cannot easily be financed from borrowing, in the presence of imperfect capital markets. Second, all other determinants of human capital attainment, including individual ability, aspirations, parental non-monetary investment,... Two comments must be added regarding the functional form adopted here. The parameter  $\theta$  is an index of the productivity of parental financial investment for human capital accumulation. The logarithmic specification implies that parental investment have a decreasing marginal effect on child's human capital.

The second determinant of human capital accumulation are non-financial determinants, denoted by  $e_t$ . This variable captures the combined influences of nature, nurture, social and cultural origin outside the causal impact of parental financial investment. Of course, such influences are likely to be transmitted within families and so will be correlated across generations. Following Becker and Tomes (1979), assume that  $e_t$  follows a first-order autoregressive process of the form:

$$e_t = \delta + \lambda e_{t-1} + \nu_t \quad (3)$$

In this equation,  $\nu$  is a random term independent of  $e_{t-1}$ . This equation amounts to saying that a fraction  $\lambda$  of parental non-monetary determinants of human capital are passed on to the next generation. Consequently, even in the absence of financial investment by the parents, human capital endowments will be correlated across generations, for reasons abundantly discussed in the social and educational mobility literature.

Lastly, individual income is determined by the amount of human capital using the following function :

$$\log Y_t = \mu + p H_t \quad (4)$$

where  $p$  denotes the returns to human capital.

To discuss parental investment, assume that the parent chooses her consumption and investment so as to maximize the following Cobb-Douglas utility function :

$$U = C_{t-1}^{1-\alpha} Y_t^\alpha \quad (5)$$

subject to the constraints of equations 1 to 4. In the utility function, the coefficient  $\alpha$  represents the degree of “altruism” of the parents or equivalently the weight of child’s welfare in the parent’s utility function.

Solving the above program, Solon shows that the optimal financial investment in the child’s human capital is given by :

$$I_{t-1} = \frac{\alpha\theta p}{1 - \alpha(1 - \theta)p} Y_{t-1} \quad (6)$$

Hence parental financial investment is increasing in parental income, parental altruism, the returns to human capital and the efficiency of human capital investments.

Substituting for optimal investment in equations 2 and 4, Solon also shows that the relationship between the income of consecutive generations is given by :

$$\log Y_t = \mu + \theta p \log \left[ \frac{\alpha\theta p}{1 - \alpha(1 - \theta)p} \right] + \theta p \log Y_{t-1} + pe_t \quad (7)$$

A similar equation applies to the relationship between the human capital endowment of successive generations.

Two sources of intergenerational correlation in income are embedded in equation 7. The obvious one is captured by the coefficient  $\theta p$  on  $\log Y_{t-1}$ . It corresponds to the “financial channel” already discussed. One should note that since the investment in children’s human capital rises with the returns to human capital, the effect of parental income on child’s income is also an increasing function of both  $p$  and  $\theta$ . The second source of intergenerational transmission arises from the term  $pe_t$ . Since the endowment in human capital is correlated across generations, independently of financial decisions, so will income.

Lastly, it should be noted that the linear regression of  $\log Y_t$  on  $\log Y_{t-1}$  suggested by

equation 7 will *not* allow to identify any of the structural parameters of the model. In particular, the estimated coefficient on parent's income will differ from the structural term  $\theta p$  and will not measure the causal effect of parental income on child's income. The reason is that the endowment in human capital  $e_t$  is not usually observable and will be part of the error term in the equation. However, this component of the error term is correlated with parent's income. Hence, the estimated coefficient on parent's income will capture both the financial channel and all other sources of intergenerational correlation in earnings. More precisely, as shown in Solon, in the steady state of the intergenerational income transmission process, the estimated coefficient, which we will refer to as  $\beta$ , will be given by :

$$\beta = \frac{\theta p + \lambda}{1 + \theta p \lambda}$$

### 3 Econometric model

As is common in the literature on intergenerational earnings mobility, our objective is to estimate the standard log-linear regression model in permanent income :

$$Y_i = \beta_0 + \beta X_i + e_i \tag{8}$$

where, with a slight change in notations,  $Y_i$  denotes the logarithm of the child's permanent income in family  $i$  and  $X_i$  the logarithm of his or her father's permanent income.  $\beta$  represents the intergenerational elasticity in earnings (IGE), i.e. the percent variation in child's income associated with a one percent change in father's income.

Estimating equation 8 imposes very stringent data requirements since it requires that permanent income (i.e. the full sequence of earnings over the entire working career) of both children and fathers be observed. Such requirements will of course rarely be met in existing data sets. In our case, available data is much more limited. For children we only observe current earnings. In the case of their fathers, we only have information on their education and occupation.

Despite not having direct information on father's income, it is still possible to estimate the IGE, using an imputation procedure commonly referred to as two-samples instrumental-

variables (TSIV), and first applied in intergenerational earnings mobility studies in Björklund and Jäntti (1997). However the fact that we only observe current income, and not permanent income, implies that we pay special attention to the possible lifecycle biases that may arise in the estimation of the IGE, as discussed in a recent paper by Grawe (2006).

### 3.1 Two samples instrumental variables estimation

The basic principles behind two samples instrumental variables is as follows. Equation 8 cannot be directly estimated since we do not observe father's income. However we observe a set of father's socio-demographic characteristics. These characteristics can be used to form a prediction of father's income. And one can show that substituting this predicted income for father's actual income  $X_i^f$  in the estimation still allows to correctly estimate the IGE. In this procedure, the prediction of father's income relies on an auxiliary sample, representative of the fathers' population, and in which we observe both income and the same socio-demographic characteristics that are available in the main sample, i.e. the one containing information on children and their fathers' characteristics.

Let  $Z_i$  denote a set of socio-demographic characteristics (e.g. education) of the father of a family indexed by  $i$ , that is part of a sample of families  $I$ . Assume that father's income,  $X_i$  can be written as :

$$X_i = Z_i\gamma + v_i \quad (9)$$

where  $v_i$  is an error term independent of  $Z_i$ .  $X_i$  is not observed in sample  $I$ . Yet, if there exists a sample  $J$  from the same population as  $I$ , it can be used to provide an estimate  $\hat{\gamma}$  of  $\gamma$ , derived from the estimation of :

$$X_j = Z_j\gamma + v_j + u_j \quad (10)$$

for family  $j$  in the sample  $J$ . Equation 10 uses current earnings  $X_{jt}$  to assess the impact of the variables  $Z_j^f$  on permanent earnings  $X_j$ .  $u_{jt}^f$  is a time-varying residual.

From the estimation of equation 10 , one can form a prediction of father's earnings in

sample  $I$ . This prediction can in turn be used to estimate  $\beta$ : equations 8, 9 and 10 imply:

$$Y_i = \beta_0 + \beta(Z_i\hat{\gamma}) + v_i \quad (11)$$

where the residual  $v_{it}$  is given by  $v_i = e_i + u_i + \beta v_i + \beta(Z_i^f(\gamma - \hat{\gamma}))$  and is independent of other regressors.

Our estimates of the IGE are based on the estimation of equations 10 and 11 on separate samples, described in the following section.

This estimation procedure appears as a special case of the split sample instrumental variables estimator introduced in Angrist and Krueger (1995) and Arellano and Meghir (1992). As shown in these papers, it is asymptotically equivalent to the standard instrumental variables procedure if samples  $I$  and  $J$  are drawn from the same population.

At this point one should emphasize that not having direct information on father's earnings represents a minor limitation. The argument unfolds as follows. Assume we had a direct measure of fathers yearly income for a single year. As discussed in Solon (1992; 1999), the existence of transitory earnings components in yearly income would have introduced the well-known error-in-variables attenuation bias in the estimation of the IGE, had we estimated equation 8 based on this direct measure of father's earnings. To circumvent this bias, we would have been led to rely on instrumental variables estimation, as used, for instance in Dearden, Machin and Reed (1997). But the procedure we implement is exactly equivalent to standard IV estimation.<sup>2</sup>

The specification of the first-step estimation, used to predict father's income, is presented in the appendix. In short, in the first-step, yearly income is regressed on a set of education dummies interacted with birth cohort -which allows for the possibility of change over time in the returns to education. The specification also includes a control for age and allows for separate age-earnings profile by level of education.<sup>3</sup>

<sup>2</sup>For more details on the properties of IV estimates for the estimation of the IGE, see Solon (1992) and Björklund and Jäntti (1997).

<sup>3</sup>We use a fourth-order polynomial in age and drop non-significant higher order terms.

### 3.2 Life-cycle biases

The most important limitation of the data used in this paper - and in fact of almost all data sets used in the analysis of intergenerational earnings mobility<sup>4</sup> - is that it does not allow to observe permanent income but only conveys information on income earned over a short period. In our case, we only observe yearly earnings.

When estimating equation 8 using yearly income, it is crucial, especially in comparative work, to pay great attention to the life-cycle biases that can arise in the estimation of the IGE. This point has been emphasized recently in Grawe (2006). The main result of Grawe's paper is that the IGE rises with the age at which children's yearly earnings are observed. This is due to the fact that earnings growth rate, over the life-cycle, is positively correlated with permanent earnings. Hence, early in the life-cycle inequality in yearly earnings understate inequalities in permanent earnings. So using early career earnings make children appear more equal than they really are and leads to underestimate the intergenerational transmission of inequality. Or equivalently, to overestimate mobility. On the contrary, yearly earnings inequality late in the life-cycle is typically larger than permanent earnings inequality. Using late career earnings for children will consequently lead to underestimate mobility. A reversed reasoning implies that the estimated IGE falls with the age at which father's yearly earnings are observed.

For this reason, it is important that in both countries, we observe children and fathers at the same age. However, this is not enough. First, if the slope of age-earnings profiles differ in France and Japan, the life-cycle bias will differ between the two countries and estimates will not be comparable. Second, even if age-earnings profile are similar across countries, estimating model 8 using yearly earnings may come far from providing a good estimate of the permanent income IGE. The rule of thumb suggested by Grawe is to restrict the sample to children and fathers aged about 40. This corresponds roughly to the middle of the career and earnings differentials at the age of 40 can be considered representative of permanent earnings differentials. If we are willing to assume that this is true for both Japan and France, then estimates of intergenerational mobility at the age of 40 are directly comparable.

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<sup>4</sup>One of the very rare exceptions is Mazumder (2001).

Instead of restricting our sample to individuals aged 40 years, we take into account life-cycle effects in the estimation of the IGE by including an interaction term between individual age and father's earnings, as done in Lee and Solon (2006). The equation is then given by :

$$Y_{it} = \beta_0 + \beta \hat{X}_i + \sum_{j=1}^4 \gamma_j (age_i - 40)^j \quad (12)$$

$$+ \sum_{j=1}^4 \delta_j \hat{X}_i \times (age_i - 40)^j + e_{it} \quad (13)$$

where  $Y_i^c$  denotes child's log yearly earnings,  $\hat{X}_i^f = Z_i^f \hat{\gamma}$  denotes father's predicted log earnings,  $age$  denotes child's age. The fourth order interaction between age and predicted income takes into consideration the impact of children's age on the IGE. In this equation  $\beta$  measures the IGE at the age of 40 (at this age, all the interaction terms are zero).

Of course, life-cycle effects also need to be adequately dealt with in the prediction of fathers' earnings. In the estimation of 12, we use a prediction of fathers' earnings at the age of 40. This implies that  $\beta$  comes close to measure the IGE in permanent income. More details on the estimation of the first-step equation are provided in the appendix.

## 4 Data

### 4.1 Japan : the SSM surveys

Our Japanese data come from the Social Stratification and Mobility (SSM) surveys. The SSM survey has been the primary data source for studies of social and educational mobility in Japan (Ishida, 1993; Ojima, 1998; Imada, 2000). The first wave of the survey was conducted in 1955 by the Japanese Sociological Society. Since then, similar surveys were conducted at intervals of ten years by independent organizations.

The earliest waves (1955, 1965 and 1975) focused only on males. A female sample was collected since the 1985 survey. The questionnaire of the last wave of the survey (2005) has also been used for similar surveys in Korea and Taiwan. In this paper, we make use of all available waves of the SSM surveys.

The SSM samples are designed to provide a national representative sample of the population between 20 and 70 years old. Across the different waves, the size of the male sample

varies between two and three thousands individuals. The questionnaire focuses on the description of social status, educational attainment, social origin, class identification and the perception of inequality.

The most two important variables in our analysis are income and educational attainment. The income variable available in the SSM surveys is individual primary income, which includes both labor and asset income before any tax or transfer. For most individuals of working age and who actually work, the primary component of pre-fisc income is labor earnings. Income is available in all waves of the survey in bracketed form. The bounds and number of brackets vary across waves. In the regressions, we deal with these brackets using two different routes. The first one amounts to assign the mid-value of the bracket and use standard linear regression techniques; the second it to explicitly take into account the discrete nature of our income information and use interval regression.

The education classification used in the surveys varies across waves and cohort, reflecting the changes in the Japanese educational system that occurred over the last century. For older cohorts, the classification distinguishes between five educational levels : elementary school (6 years of formal schooling), upper elementary (8 years), middle School (11 years), college (14 years) and university (17 years). For more recent cohorts, the five educational levels are : junior high school (9 years), high School (12 years), junior college (14 years), university (16 years) and graduate school (18 years). Given sample size and to assure cross-year consistency of the education classification, we used a reduced classification that distinguishes between three educational levels : lower secondary education (or lower), upper secondary education and tertiary education. This corresponds, for instance, to the classification used in Kondo (2000).

For each individual, the survey also reports his/her father's education and occupation. These items are reported *ex post* by the survey respondents.

## 4.2 France : the FQP surveys

Our French data are taken from the Formation-Qualification-Profession (FQP - Education-Training-Occupation) surveys conducted by the French National Statistical Agency (INSEE). We use all six waves of the survey (1964, 1970, 1977, 1985, 1993 and 2003). Each

wave offers a representative sample of the French population of working age.<sup>5</sup> The number of individuals surveyed varies across waves : 25 000 individuals in 1964, 38 000 in 1970, 1977, 1985 and 2003 and 19 000 in 1993.

This survey has been the primary data source for studies of social and intergenerational mobility in France, as well as a wide range of labor market issues. It contains detailed information on education, labor market outcomes (industry, occupation, number of months worked full- and part-time and annual earnings in the previous year). It also provides data on social origin (including both parents occupation and education).

The income variable in the survey is total labor earnings in the previous year. This information is not available for self-employed workers. It does not include other sources of income such as asset income or transfers. In 1964, annual earnings are recorded in interval form, using 9 intervals. Hence, all estimations results reported for wave 1964 are based on interval regression.

For both children and parents, a detailed (10 levels) classification of educational attainment is available that distinguishes between general and vocational education. The classification, however, changed several times over the six waves and was recoded in time-consistent way. The classification used in this paper distinguishes between the following six levels of education : higher education degree, upper secondary education degree, lower secondary education general , degree lower secondary education vocational degree, primary education degree, no degree.

### 4.3 Samples restrictions and matching

The analysis in this paper is confined to the study of intergenerational mobility between fathers and sons. There are two reasons to this. The first is that females were only sampled in the SSM data starting in 1985. This clearly prevents to analyze the impact of mothers socio-economic status on child's achievement, although it would still be possible to examine the extent of intergenerational mobility between fathers and daughters. One difficulty, though, is that the sample of women who participate in the labor force and earn labor income is not a representative sample of the female population. Solving such self-selection

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<sup>5</sup>More precisely, for all waves except the last two, the survey is based on a stratified sample of the French population. Adjusting for weights has only a minor impact on the estimates.

problems, would require to explicitly model the interplay between labor force participation, employment and earnings. For this reason, we concentrate on the male sample and leave the analysis of intergenerational mobility between father and daughter to future research.

In the main samples used in this paper to estimate both the first- and the second-step equation, we exclude self-employed and those without positive earnings in the year preceding the survey. This restriction is imposed to assure the comparability of the populations studied in both countries, since in France, we do not observe earnings for self-employed workers. Given the prevalence of self-employment in the father's cohorts, in both countries, it is however crucial to assess the incidence of this sample restriction. We discuss this point below and show that this incidence is, as much as we can tell, limited.

The sample used in the estimation of the first-step equation draws on most available survey waves, for both countries : 1955, 1965, 1975, 1985 and 1995 in Japan; 1964, 1970, 1977, 1985, 1993 and 2003 in France. In the Japanese case, the sample is restricted to individuals aged 25 to 54 years old. The main reason for excluding individuals older than 55, is that this used to be the common retirement age in private companies in Japan, in the fathers' cohorts. In France, the estimation is based on individuals aged 25 to 60 years. The only reason for considering a wider age range is that the oldest wave available in France is 1964, against 1955 of Japan. Hence, it is necessary to include older workers in the analysis to estimate earnings differentials among older cohorts.

Second-step estimations are based on the three most recent waves in both countries (1985, 1995 and 2005 for Japan; 1985, 1993, 2003 for France). For reasons already discussed, the sample is restricted to individuals aged between 30 and 50 years old, i.e. close to the middle of their working career. For each individual in the second-step sample, we form a prediction of his father's earnings using estimates of the first-step equation. The prediction is based on reported father's education, as well as father's cohort. In most cases, individual in the second-step sample report their father's birth year. In this case, we use the relevant cohort-specific returns to education to predict father's income. When information on father's birth year is not available, the matching procedure used is the following. Based on individual birth year and available information, we compute the distribution of father's birth cohort. The prediction of father's income is then the weighted average of

cohort-specific income for the father's education level, where the weights are given by the distribution of father's birth cohort.

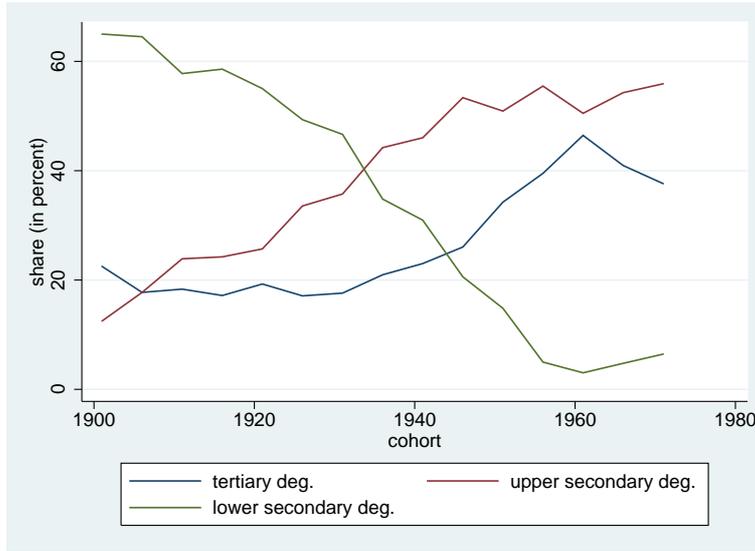
## 5 Results

### 5.1 First-step estimation

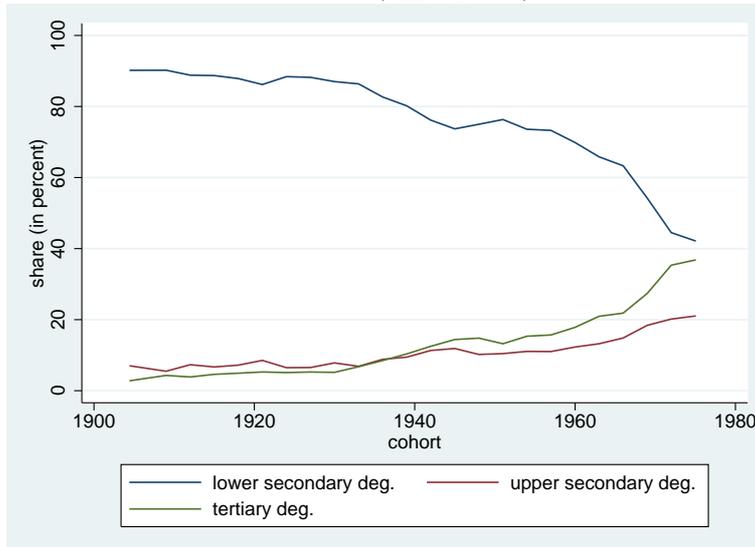
We first discuss the results of the first-step equation used in the prediction of father's earnings. Figure 1 presents the evolution over time of educational attainment in both countries, by birth cohort. In Japan, at the beginning of the century, the educational attainment of the vast majority of the male population (more than 60%) is lower secondary education or less. In fact, a significant fraction of this group only received elementary education. The rest of the population is shared evenly among the two other educational levels (upper secondary education and tertiary education). Throughout the twentieth century, three main periods need to be distinguished. The first period starts at the beginning of the century and ends in the early 1930's. It witnesses a fall in the share of the population with a lower secondary education or lower and a rise in the share of individuals with an upper secondary education. In the meantime, the share of individuals with a tertiary education remains constant. The second period corresponds to the period of fast economic development that occurred after world war II, i.e. cohorts born between the mid-1930's and 1960. This period sees an acceleration of the fall in the share of the population with a lower secondary education, a continuation of the rise of upper secondary education and take-off in the share of the population with access to university. The third period corresponds to cohorts born in the 1960's and after. During this period, the distribution of education remains roughly constant : about 40% of the population access university; a little less than 60% reach upper secondary education and very small percentage of the population has lower secondary education or less.

The evolution of the educational distribution in France is in many respects similar to Japan, although the share of each education category differ, both initial and in the final period. Panel B of figure 1 provides the composition by education using an aggregated classification similar to the one used in Japan; panel C provides the detailed composition.

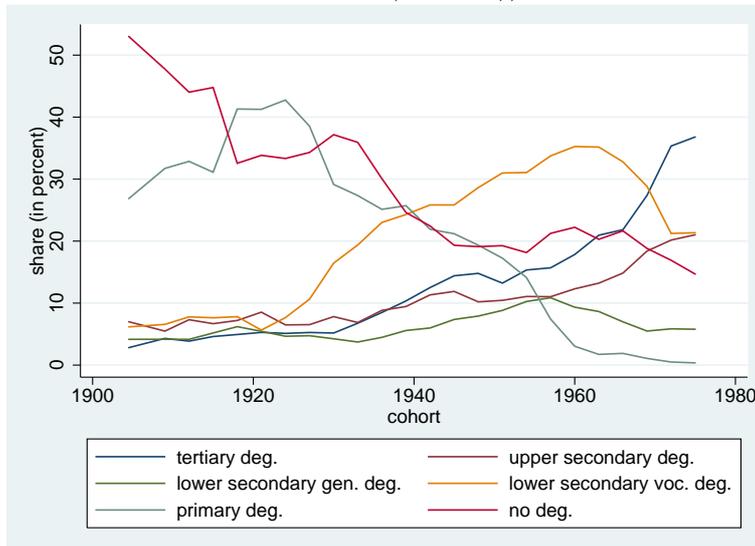
Figure 1: Distribution of education by birth cohort  
A- Japan



B- France (aggregated)



C- France (detailed)



Among cohorts born at the beginning of the century, more than 70% of the population has a primary education degree or lower. And about 80% of the population has a level of education equal to or lower than lower secondary education. Again, the beginning of the century is period of rise in access to education and this rise accelerates around the middle of the century. However, while trends are somewhat similar, educational attainment is, throughout the period, markedly lower in France than in Japan. For instance, at the end of our period, the overall educational attainment in France remains lower than in Japan : only about 35% of the population obtain a higher education degree and 20% reach the level of upper secondary education.

Figure 2 presents the evolution over time of the earnings structure, by level of education. The earnings differentials reported here are predicted earnings differentials at age 40, based on the first step regression. The experience of both countries in this respect strongly differ. Earnings differentials by level of education in Japan appear roughly constant over the entire period. Only in the case of the earliest cohorts, do earnings differentials seem more compressed than for most other cohorts.<sup>6</sup> However, it is worth emphasizing that for all cohorts, Wald tests confirm the hypothesis that earnings differentials are constant. This echoes the results in Kanomata (1998) indicating that earnings inequality has remained fairly stable in Japan in the second part of the century.

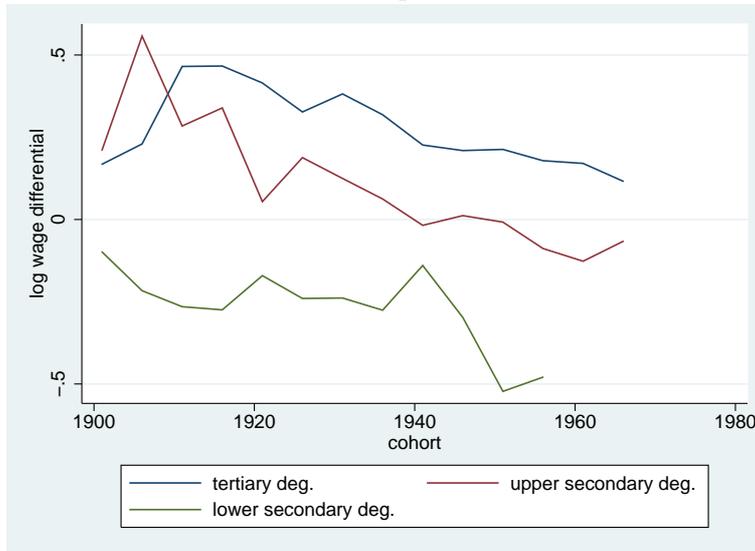
On the contrary, France experiences a marked decline in the returns to education. The largest fall occurs between cohorts born at the beginning of the century and early baby-boomers born around 1940. Two main factors account for this fall in returns to education. The first one is the massive wage compression that occurred at the end of the 1960 (in particular in 1968, after the 1/3 rise in the minimum wage) and in the early 1970's. The second one is the competitive wage adjustment that followed the massive rise in the supply of highly educated workers, as discussed in Goux and Maurin (2000).

Besides these discrepant evolutions, one should also stress that the Japanese earnings structure appears very compressed, throughout the period. On the contrary, earnings differentials are much stronger, in France, at the beginning of the period. In particular, one should underscore here that the scale used on the vertical axis differ between panels

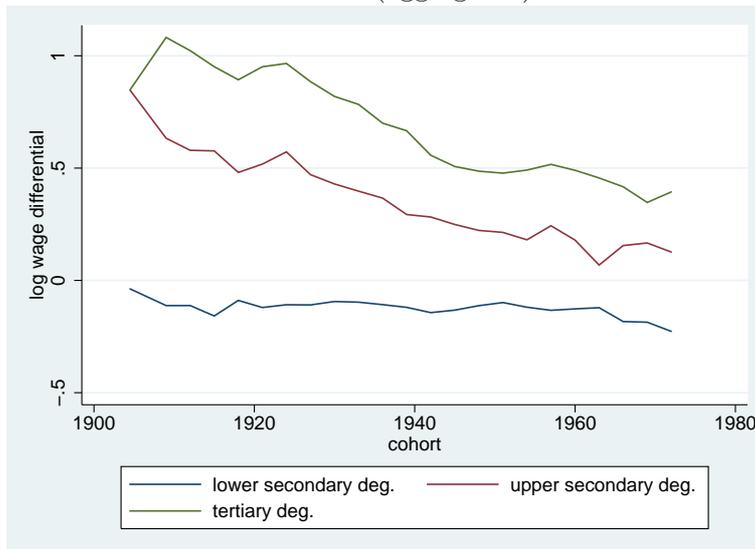
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<sup>6</sup>For the last two cohorts, we do not report the estimated earnings for the lowest group of education, given the very small number of observations in this category

Figure 2: Returns to education by birth cohort  
A- Japan



B- France (aggregated)



C- France (detailed)

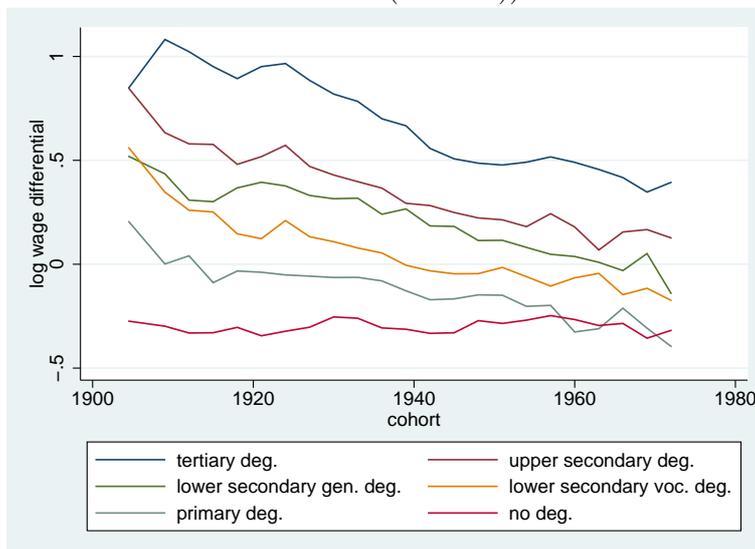


Table 1: Intergenerational earnings elasticity

	A- Japan, linear regression on interval midpoints		B - France, linear regression	
log(father's Income)	0.251	0.224	0.462	0.473
	(4.63)	(2.86)	(35.3)	(24.54)
log(father's Income)		0.009		0.007
* (age-40)		(0.01)		(3.38)
log(father's Income)		0.001		0.000
* (age-40) <sup>2</sup>		(0.48)		(-0.64)
n	987	987	13487	13487
R <sup>2</sup>	0.185	0.186	0.170	0.171

Notes : dependant variable is the logarithm of son's annual earnings; T statistics in parenthesis. For Japan, earnings are reported in brackets. For France, the exact value is reported. Interval regression is estimated by maximum likelihood under the assumption that earnings are log-normally distributed.

A and B. However, as a result of the fall in returns to education that occurred throughout the century, the returns to education in France, *at the end of the period*, appear more comparable to Japanese levels.

## 5.2 Earnings mobility

We now turn to the analysis of intergenerational earnings mobility. Table 1 presents the estimated IGE for earnings, when regressing sons' earnings on fathers' earnings predicted from the previous section's estimates.

The estimated value for Japan is .25 which represents a low value of the IGE and indicates a rather strong intergenerational mobility. Since this coefficient is an elasticity, the interpretation of this value is that, on average, only one fourth of the previous generation's economic advantage or disadvantage survive to the next generation. By contrast, the value of the IGE in France is twice as high and close to .5. If we go beyond the bilateral comparison undertaken here, the value of the IGE for Japan still appears rather low by international standards. Using the methodology implemented in this paper, Björklund and Jäntti (1997) estimated an IGE for earnings of .52 for the United-States and .28 for Sweden. Dearden, Machin et Reed (1997) report an estimate for Britain based on a procedure similar to ours of .57 for sons. Evidence available for other countries and surveyed in Solon (2002)

suggest a rather high degree of intergenerational mobility in Finland (Österbacka, 2001) and Canada (Corak and Heisz, 1999) ( $\beta$  around .2 or lower) and an intermediate degree of mobility for Germany ( $\beta=.34$ ). In the light of available evidence, it is clear that Japan stands out as a rather mobile country, from the point of view of the intergenerational transmission of income.

Estimates in table 1 also emphasize the importance of an adequate treatment of life-cycle biases when drawing international comparisons. Based on a younger age group, Lefranc and Trannoy (2005) report a value of the IGE for France around .4. Here, using a sample of individuals closer to their mid-career and adding an interaction term between father's income and son's age significantly raises the value of the IGE. On the contrary, in Japan, controlling for this interaction term tends to decrease the estimated IGE : this may be explained by the fact that individuals in the Japanese sample tend to be, on average, above the reference age of 40, at which we evaluate the IGE in the second specification reported in the table. This tends to increase the intergenerational earnings mobility gap between the two countries. We now address the contribution of educational mobility to this gap.

### 5.3 Educational mobility

The theoretical model of section 2 underlines several factors that may contribute to this gap in intergenerational earnings mobility. First, intergenerational earnings mobility may be lower because of a high correlation across generations in the level of human capital. At the same time, for a given degree of educational mobility, earnings mobility will also appear lower if the returns to education are higher.<sup>7</sup>

Table 2 evaluates the extent of intergenerational mobility in education in Japan and France. Two sets of coefficient are reported. The first coefficient is the raw correlation coefficient between son's and father's education. The second coefficient is the coefficient on father's education in the regression of son's education is regressed on cohort dummies and father's education. Hence, this last coefficient measures the intra-cohort educational mobility. Note that in both cases, the number of years of education is not directly reported

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<sup>7</sup>More precisely, this will only hold conditional on the degree of inequality in parent's earnings.

Table 2: Intergenerational educational mobility

Intergenerational correlation coefficient for years of education	Intergenerational regression coefficient for years of education
A- Japan	
0.4079	0.2878 (11.74)
B- France	
0.4856	0.4856 (72.38)

Notes : for both countries and both generations, the number of years of education is the number of formal years of schooling completed by both father and son; the regression coefficient reported is for the regression of son's years of education on father's years of education and cohort dummies; T statistics in parenthesis.

and we use the number of formal years of education completed.

Again Japan stands out as a rather mobile country. The regression coefficient for years of education is comparable to the value of the IGE for earnings, around .3. Again, this value is markedly lower than the one found in France using the same method and sample restrictions. In the latter country, the value of the intergenerational regression coefficient for education is close to .5. Hence the analysis of educational mobility entirely confirms the results obtained for earnings.

Lastly, one should emphasize that educational mobility also appears quite high when compared to other countries. For instance, Couch and Dunn (1997) report a value of the intergenerational regression coefficient for years of education of .41 for the US. The value they report for Germany is however slightly lower than what we find in Japan here : .24.

#### 5.4 Sensitivity analysis

As previously discussed in section 4, one of the limitations of the results discussed so far is that they are only based on a sample from which self-employed sons and the sons of

Table 3: Intergenerational mobility in employment status

Intergenerational mobility in employment status			
A- Japan			
father's employment status	son's employment status		
	<i>wage earner</i>	<i>self-employed</i>	<i>total</i>
<i>wage earner</i>	<b>987</b> 87.81% <i>55.79%</i>	<b>137</b> 12.19% <i>26.65%</i>	<b>1124</b>
<i>self employed</i>	<b>782</b> 67.47% <i>44.21%</i>	<b>377</b> 32.53% <i>73.35%</i>	<b>1159</b>
<i>total</i>	1769	514	2283
B- France			
father's employment status	son's employment status		
	<i>wage earner</i>	<i>self-employed</i>	<i>total</i>
<i>wage earner</i>	<b>14175</b> 75.02% <i>92.01%</i>	<b>4720</b> 24.98% <i>73.38%</i>	<b>18895</b>
<i>self employed</i>	<b>1231</b> 41.83% <i>7.99%</i>	<b>1712</b> 58.17% <i>26.62%</i>	<b>2943</b>
<i>total</i>	15406	6432	21838

Notes : numbers in bold are frequencies; normal case are row percentages and italics are column percentages.

Table 4: Intergenerational earnings elasticity - sensitivity analysis

	A- Japan, linear regression on interval midpoints		B - France, linear regression	
log(father's Income)	0.312 (7.60)	0.311 (2.86)	0.4752413 (41.3)	0.483 (28.56)
log(father's Income) *(age-40)		-0.002 (-0.34)		0.008 (4.44)
log(father's Income) *(age-40) <sup>2</sup>		0.000 (0.01)		0.000 (-0.58)
n	1769	1769	17960	17960
R <sup>2</sup>	0.209	0.209	0.174	0.175

Notes : dependant variable is the logarithm of son's annual earnings; T statistics in parenthesis. For Japan, earnings are reported in brackets. For France, the exact value is reported. Interval regression is estimated by maximum likelihood under the assumption that earnings are log-normally distributed.

Table 5: Intergenerational educational mobility - sensitivity analysis

Intergenerational correlation coefficient for years of education	Intergenerational regression coefficient for years of education
A- Japan	
0.4066	0.2895 (18.71)
B- France	
0.4742	0.4839 (82.54)

Notes : for both countries and both generations, the number of years of education is the number of formal years of schooling completed by both father and son; the regression coefficient reported is for the regression of son's years of education on father's years of education and cohort dummies; T statistics in parenthesis.

self-employed father was excluded. This limitation is first imposed by the lack of reliability of labor earnings data for self-employed workers as well as the fact that, for France, labor earnings of self-employed workers are in most cases not observed. As table 3 documents, excluding self-employed children leaves aside a still relatively small fraction of the total relevant population. On the other hand, excluding individuals whose father was self-employed ignores a sizable share of the population (between 45 and 25 %).

To assess the impact of excluding self-employed fathers, we perform the following sensitivity analysis. First, educational mobility is reassessed by estimating the correlation and regression coefficient on the sample where the restrictions on father's employment status is removed. Second, we re-estimate earnings mobility on the sample the total sample of non-self-employed sons, regardless of their father's employment status. Since for self-employed fathers earnings are not observed reliably (if at all), we predict father's earnings for this category, based on the same first step equation as in the previous section, i.e. estimated on the sample of non-self-employed fathers.

Results are presented in table 4 for earnings and table 5 for educational mobility. Including the children of self-employed workers has very little impact on estimated coefficient. The larger change is in the estimated value of the intergenerational elasticity for earnings that rises slightly in Japan, from .25 to .31. But given the precision of both estimates, the difference is not significant. In all other cases, the coefficients stay almost exactly the same.

Overall, excluding the children of self-employed workers from our sample does not affect our main conclusion. The sensitivity analysis suggests that intergenerational earnings mobility may be slightly higher than estimated in the previous section, around .3. But the main message remains. As far as the intergenerational transmission of income is concerned, Japan appears as a highly mobile country, much more so than countries such as the US, the UK or continental Europe.

## 6 Discussion and conclusion

In this paper, we have compared the extent of intergenerational earnings mobility in two industrialized societies : Japan and France. On the one hand, the labor markets of these

two countries share many features in common, in particular a high level of job protection, a large degree of on-the-job training and job-specific human capital, as well as a rather compressed wage structure. On the other hand, among other things, these two countries strongly differ in terms of the organization of their educational systems. This is particularly true of higher education. In Japan, access to higher education is often very expensive and selective, forcing family to consciously elaborate complex educational strategies and to undertake significant financial investments to support them. The extent of family investment in education in Japan has been abundantly documented. For instance families cover between 71 and 86 % of the annual expenditures of university students (Kondo, 2000, p6). Furthermore, besides tuition fees, parents often invest significant amounts in “shadow education” (Stevenson and Baker, 1992), such as cram schools and private tutoring. On the opposite, the French higher education system is, at least at face value, free and open. Of course, higher education in France is organized around a clear hierarchy, at the top of which come the elite schools (*grandes écoles*) while universities represent the least prestigious form higher education. However, it is claimed that where students end up in this hierarchical system is only based on individual merit. Which of the two countries display the greatest level of intergenerational mobility, both in terms of income and education ?

The answer to this question is, indeed, surprising. As our estimates reveal, the degree of intergenerational income mobility is much higher in Japan. Furthermore, this higher mobility in terms of income is underpinned by a lower intergenerational correlation in educational attainment.

Several factors are likely to account for the higher degree of income and educational mobility observed in Japan. The first explanation emphasizes the characteristics of the educational system in both countries. As already discussed, both countries display a marked hierarchy among higher education institutions. But the nature of this hierarchy and the allocation procedure into higher education differ greatly. The Japanese system is best understood as a continuum of higher educational institutions of differing quality (Ono, 2007). On the opposite, the most salient feature of the French system is the opposition between elite graduate schools (*grandes écoles*) on the one hand and universities on the other. This duality is more pronounced than the differences that exist among *grandes écoles*

or universities. And attending *grandes écoles* or universities have very different effects on labor market (and social) outcomes. As a result of these differences, we would expect individual outcomes to be more polarized in France than in Japan.

This is reinforced by the allocation procedure at work in both countries for access into higher education. In Japan, the type and quality of college or university student have access to is mostly determined by the results to a national exam that students take at the end of high school.<sup>8</sup> In France, all students take a national test at the end of high school (*baccalauréat*). But the results to this test are not the primary determinants of the track students will follow in the dual higher-education system. In fact, access to *grandes écoles* is determined as the result of a national entrance competition taken two years after the end of high school. But before taking this competition, students have to attend special preparatory classes for at least two years. These special classes are for the most part free of tuition but access to them is decided before the results of the national competition are known. Furthermore, access largely reflects student aspirations, teachers' recommendations and the school district of origin. In this respect we would expect family and social background to have a greater influence on student's tertiary education attainment in France than in Japan where scholastic results to a national contest plays a larger role. This corresponds to a higher value of  $\lambda$  in the model of section 2.

The second explanation for the differences in the extent of earnings and educational mobility between France and Japan lies in the low returns to education in this country. Under these circumstances, investing in one's children's human capital may not be the most profitable investment for the parents. If so, lower parental investment will lead to lower inequalities in human capital endowments and lower earnings inequality, hence more mobility.

Two stylized facts seem to contradict this simple interpretation. First, despite low returns to education, Japanese parents still devote a considerable share of their wealth to their children's education. Second, while the returns to education in Japan are low by

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<sup>8</sup>More precisely, this is the case for those born after 1960 and who applied to national (or public) universities. Most of applicants to private university take an entrance exam that is specific for each university. And the national university has its own exam. So applicants for the national university should take exams twice. In any case, allocation in the Japanese higher education system is mostly based on examination results.

international standards, there are, at least at the end of the period, comparable to the ones observed in France.

The answer to these two counter-arguments emphasize the role of earnings inequality among the parents. In the steady-state, the consequence of low returns to education is not only that investment in human capital will be little profitable. It is also that other things equal, earnings difference will be small. In this case, parents may well invest a large share of their income in their children's education, in the end, if the distribution of income is compressed, so will be the distribution of human capital in the next generation. This is confirmed by the analysis of "shadow education" undertaken in Stevenson and Baker (1992), who emphasize the following three aspects of private investment in education in Japan. First, family financial investment is high on average. Second, such investment is efficient at improving educational attainment. But third, financial investment and the use of shadow education seem to vary little with characteristics of the family background such as parental education or family income.

A similar argument may also help understand why intergenerational earnings and educational mobility in France is so low, relative to Japan, despite current low returns to education. In fact, what matters is not only the current returns but also their past value. The former define the incentives for investing in children's human capital. The latter determine the degree of inequality of income among parents, i.e. in the source of investment. Today's French adults leave in a relatively equal world, but they are the children of a much less equal world, that of post- world war II France. On the other hand, earnings inequality in Japan have been rather limited throughout the twentieth century, which leaves less room for a strong impact of parental financial investment in their children on intergenerational mobility.

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## Appendix : first-step equation

To predict father's income, we rely on a first-step equation in which yearly income is regressed on a set of education dummies interacted with birth cohort. Hence, we allow for the possibility of change over time in the returns to education. It is then possible to use father's education and birth cohort, as reported by the child, to form a prediction of his father's earnings.

In the first-step equation, we do not use father's occupation, although this information is available in our data sets. Using reported father's occupation to predict father's income raises some difficulties, given our objective, discussed in section 3 to predict father's income at age 40. Occupation typically varies over the course of a career and children report the occupation of their father at a specific point in time. For instance, occupation when the child was aged 17, may or may not correspond to occupation when the father was 40. If not, then it is difficult to use reported occupation at age 17 to assess father's earnings at age 40. There are further difficulties that differ between the French and Japanese surveys. In France, individuals are asked to report their father's occupation at the time they finished going to school : this is problematic because those who finish school later will report the occupation of their father at a later stage of the father's career. This would lead to spurious correlation between father's occupation and child's education. In Japan, the situation is different. In some cases, individuals are asked to report their father's occupation without any indication regarding the period, in the father's career. So it is unclear what occupation is precisely reported. Yet, it is likely that younger cohorts (whose parents are still active) will report current occupation of their father while older cohort will report end of career occupation. Again, there is a distortion that may affect our results. Lastly, as documented in Lefranc and Trannoy (2005) using education as the only instrument or using both education and occupation has a very limited impact on the estimated IGE.

The specification used in the first-step equation is the following :

$$X_{ict} = \alpha_t + \sum_{j=1}^{n_e} \beta_{0j}^c Ed_{ij} + \sum_{j=1}^{n_e} Ed_{ij} (\sum_{k=1}^4 \beta_{kj} (age_i - 40)^k) + \varepsilon_i$$

where  $y_{ict}$  denotes the earnings of the individual  $i$ , taken from the sample of fathers, who belongs to the cohort  $c$ , at date  $t$ ;  $\alpha_t$  is a time effect, common to all cohorts (it may for instance capture inflation, overall income growth, ...);  $Ed_{ij}$  is a dummy variable that takes the value 1 if individual  $i$  has the level of education  $j$ ;  $age_i$  is the age of individual  $i$  at time  $t$ .

This equation assumes that the returns to education at the age of 40 differ across cohorts : for instance, in some cohorts, the premium attached to higher education can be bigger than in other cohorts. In fact, there are no reason to expect that the coefficients  $\beta_{0j}^c$  will remain unchanged across cohorts. It also assumes that the effect of age on earnings varies according to the level of education. We expect that the effect is bigger for more educated people.

How to predict from the above equation the earnings at the age of 40? Note the relationship between age, time and cohort :  $age = t - c$ . So age 40 corresponds to  $t = c + 40$ . By construction, the terms  $(age_i - 40)^k$  will be zero at age 40. So for an individual of cohort  $c$ , the predicted earnings at age 40 is simply given by :

$$X_{icc+40} = \alpha_{c+40} + \sum_{j=1}^{n_e} \beta_{0j}^c Ed_{ij}$$

The problem is that for many cohorts, we won't have a snapshot of their father's

earnings exactly at age 40. And consequently, we won't be able to estimate  $\alpha_{c+40}$ , although we do estimate the values of  $\beta_{0j}^c$ . But this is of little consequence, since this term is common to all individuals of that cohort, independently of their level of education.

To be more specific, let  $\{Ed_{ij}^{father}\}_{i=1\dots n_e}$  denote a set of dummy variables characterizing the education of the father of individual  $i$ . Let  $c$  denote the cohort of father of individual  $i$ . The predicted father's income for individual  $i$  takes the form :

$$X_i = \alpha_{c+40} + \sum_{j=1}^{n_e} \beta_{0j}^c Ed_{ij}^{father}$$

The standard IGE equation is :

$$\begin{aligned} Y_i &= \beta + \gamma_0 X_i + \varepsilon_i \\ \Leftrightarrow Y_i &= \beta + \gamma_0 (\alpha_{c+40} + \sum_{j=1}^{n_e} \beta_{0j}^c Ed_{ij}^{father}) + \varepsilon_i \\ \Leftrightarrow Y_i &= (\beta + \gamma_0 \alpha_{c+40}) + \gamma_0 (\sum_{j=1}^{n_e} \beta_{0j}^c Ed_{ij}^{father}) + \varepsilon_i \end{aligned}$$

So controlling for the cohort of birth of the father (for instance, using a set of dummy variables for each cohort or a polynomial function) in the second step equation is enough to capture the term  $\beta + \gamma_0 \alpha_{c+40}$ . So we can just regress child's earnings on father's cohort and the terms  $\sum_{j=1}^{n_e} \beta_{0j}^c Ed_{ij}^{father}$  that we are able to estimate. Given child's age, we only exploit variation in earnings among fathers of the same birth cohort but with different educational level. We do not rely on differences in father's age, as a source of wage variation.

In our case, we want to estimate the IGE controlling for life-cycle effects. For simplicity, let us drop higher-order terms in age. The equation we wish to estimate is :

$$\begin{aligned} Y_i &= \beta + \gamma_0 X_i + \gamma_1 X_i \times (age_i - 40) + \varepsilon_i \\ \Leftrightarrow Y_i &= \beta + (\alpha_{c+40} + \sum_{j=1}^{n_e} \beta_{0j}^c Ed_{ij}^{father}) (\gamma_0 + \gamma_1 (age_i - 40)) + \varepsilon_i \\ \Leftrightarrow Y_i &= (\beta + \gamma_0 \alpha_{c+40} + \gamma_1 \alpha_{c+40} (age_i - 40)) + (\sum_{j=1}^{n_e} \beta_{0j}^c Ed_{ij}^{father}) (\gamma_0 + \gamma_1 (age_i - 40)) + \varepsilon_i \end{aligned}$$

Now to take care of the first parenthesis on the right-hand side, we need to account for the cohort of birth of the father (because of  $\gamma_0 \alpha_{c+40}$ ) and the age of the individual (because of  $\gamma_1 \alpha_{c+40} (age_i - 40)$ ). This can be done using dummies for father's birth cohort and polynomial for individual age. To simplify things, if we assume that  $\alpha_t$  is a smooth function of time, we can simply put a polynomial in the cohort of the father. Of course, we should put an interaction between father's cohort and child's age.

Lastly, it is important to realize that if we don't know, for each individual, the birth cohort of his/her father, we will treat all children of a given age as having fathers of the same birth cohort (in fact, a mix of different likely cohorts). In this case, it is enough to control for child's age.