# Economic Returns to Communist Party Membership: Evidence from Chinese Twins*

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**Abstract**

This paper empirically estimates the returns to membership of the Chinese Communist Party using unique twins data that the authors collected from urban China. Our ordinary least squares estimate shows that being a Party member increases earnings by 28.1 percent, but when we use a within-twin-pair fixed-effects model, the effect of Party membership all but disappears, which suggests that much of the estimated value of Party membership that is given in the literature is due to the effects of omitted ability or family background. The findings suggest that Party members fare well not because of their special political status per se, but because of the superior ability that allowed them to pass through the strict Party membership selection process.

*JEL Classification*: J31; O15; P26

# 1 Introduction

There is growing interest among economists in measuring the value of political status or connections in both developed and developing countries (Roberts, 1990; Fisman, 2001; Agrawal and Knoeber, 2001; Johnson and Mitton, 2003; Faccio, 2004; Bertrand et al., 2004; Khwaja and Mian, 2004). In the context of China in particular, many economists and other social scientists have attempted to measure the returns to being a member of the Chinese Communist Party (Szelenyi, 1987; Nee, 1989, 1991, 1996; Rona-Tas, 1994; Walder, 1996; Morduch and Sicular, 2000; Liu, 2003).[1] Many studies have found that Party membership has had a positive value for businesses or personal incomes during China's economic transition, and that Party members have quickly turned their political advantages into economic benefits by securing high-paying jobs in monopolistic state-owned enterprises or the government.

However, despite the accumulation of large quantities of evidence on the relationship between Party membership and economic benefits, no study has succeeded in establishing causality. An ordinary least squares (OLS) estimation of the effect of Party membership on earnings cannot prove causality, because Party members may have high earnings due to their greater ability or more advantageous family background. Thus, Party membership may be correlated with the effects of unobserved ability or family background, which would make any correlation between membership and earnings spurious. Most studies of the returns to Chinese Communist Party membership, and of the value of political connections in general, give only limited information on individual characteristics, and thus unobserved heterogeneity may confound any causal inference.

In this paper, we attempt to empirically measure the value of Chinese Communist Party membership to an individual's earnings. The main innovation of this paper is that we control for the effects of omitted ability and family background by using unique twins data that two of the authors collected in urban China. As monozygotic (from the same egg) twins

[1]The Communist Party of China (CPC) was founded in 1921. Led by Mao Zedong, it won the Chinese civil war and founded the People's Republic of China in 1949. The CPC is now probably the largest party in the world, with more than 70 million members.

are genetically identical and have a similar family background, they should be subject to similar effects of unobserved ability or family background. Looking at the within-twin-pair difference will to a great extent reduce the effects of unobserved ability and family background that have caused bias in the OLS estimation of the returns to Party membership in previous studies. Intuitively, by contrasting the earnings of identical twins with and without Party membership, we can be more confident that any correlation that we observe between Party membership and earnings is not due to a correlation between Party membership and an individual's ability or family background.

Our empirical work shows that most of the effects of Party membership are actually due to the effects of unobserved ability or family background. Our OLS estimates show that being a Party member increases an individual's earnings by 28.1 percent. Although the estimated effect of Party membership is reduced by more than half when we include other measures of human capital, such as age, education, gender, and job tenure, it remains statistically significant and large in magnitude. Interestingly, once we use the within-twin-pair fixed-effects model, the effect of Party membership all but disappears, which suggests that much of the estimated returns to Party membership as found by the OLS model is due to the effects of omitted ability or family background. This finding is confirmed by generalized least squares estimations that also include the co-twin's Party membership as a covariate.

The finding that most of the effect of Party membership is due to unobserved ability or family background is not surprising given the unique way in which the Party selects its members.[2] The selection process begins with an adult individual submitting a formal application to a Party branch in their work unit to express their desire to become a member. The applicant is then monitored for at least three years, during which time they must make a continuous effort to meet all of the Party standards. Each applicant is assigned two Party member liaisons who monitor and assess the applicant's political loyalty, work performance, and social activities, and relationships with co-workers, neighbors, and other people on a

[2]See Bian et al. (2001) for the detailed selection mechanisms of the Party.

regular basis. When the Party branch believes that it is time to make a more thorough evaluation, usually about two years after application, it seeks opinions about the applicant from co-workers who are not Party members and then has a closed-door evaluation meeting that involves all of the Party members in the branch. Any serious doubt on the part of either a non-Party co-worker or a Party member could mean failure, and the applicant will be given time to improve before being considered for another closed-door evaluation. If the potential candidate passes the closed-door evaluation, then they will become a probationary Party member. Probationary Party members are then closely monitored by the Party branch for another year before becoming formal Party members.

This lengthy and extended selection procedure not only ensures the political loyalty of applicants, but also ensures the superior quality of Party members. To become a Party member, an individual needs to show great ability by outperforming co-workers, good interpersonal skills through the maintenance of good relations with co-workers, great persistence by performing well throughout the long selection process, and a positive attitude toward communist ideology, society, and work. Work ability, interpersonal skills, persistence, and a positive attitude are important qualities for the success of an individual in both their social life and their career. In fact, some sociologists (Szelenyi, 1987; Lin and Bian, 1991; Walder, 1995) view Party membership as a credential like educational qualifications.

Our further analysis suggests that the size of the earnings premium and the effect of unobserved factors differ across generations. We find that Party members on average enjoy an earnings premium among both the young and the old, although it is larger for the older generation. The earnings premium for the younger generation can be fully explained by the observed human capital variables, such as age, tenure, and education. The earnings premium for the older generation cannot be fully explained by such variables, but it can be explained by unobserved ability. The difference in the effect of unobserved ability may be due to the interruption of the education of the older generation during the Cultural Revolution. More importantly, it may also be due to the declining attractiveness of Party membership for the younger generation. Although the Communist Party still rules China, the communist ideology and role of the Party and the government in the economy have weakened after more than two and half decades of economic transition.

In addition to contributing to the growing body of literature on the value of Party membership in China, our study also contributes to the general literature that measures the value of political connections and political status. The most difficult task in such research is also to solve omitted variable bias. Because of the difficulty in directly measuring the value of political connections, Roberts (1990) and Fisman (2001) have sought to measure it indirectly by making use of special political events to solve the omitted variable bias. By using a sample of twins, we provide a method of controlling for omitted variable bias and of directly measuring the value of political status without the complication of omitted variable bias.

The structure of the paper is as follows. Section 2 describes the estimation methods that draw on the twins data. Section 3 describes the data and variables. Section 4 empirically measures the returns to Party membership, and Section 5 presents some sensitivity tests. Section 6 concludes.

# 2 Method

Our empirical work focuses on the estimation of the log earnings equation that is given as

$$y_i = X_i\alpha + \beta_1 P_i + Z_i\beta_2 + \mu_i + \epsilon_i, \tag{1}$$

where the subscript $i$ refers to individual i, $y_i$ is the logarithm of earnings, $P_i$ is the Party membership dummy, and $X_i$ is a set of observed family variables. $Z_i$ is a set of observed individual variables that affect earnings, and includes age, age squared, gender, job tenure, and years of education. $\mu_i$ represents a set of unobservables that also affect earnings, i.e., unobserved ability or family effect. $\epsilon_i$ is the disturbance term, which is assumed to be independent of $Z_i$ and $\mu_i$.

The ordinary least squares (OLS) estimate of the Party membership effect in equation

(1), $\beta_1$, is generally biased. The bias arises because normally we do not have a perfect measure of $\mu_i$, which is very likely to be correlated with $P_i$. Intuitively, the cross-sectional comparison of Party members to non-Party members will not identify the Party membership effect even if the two groups of workers are identical with respect to the observed variables. This is because Party and non-Party members may differ in other unobserved characteristics that affect income. As is discussed in the introduction, Party members may be more capable, motivated, or blessed with advantageous family backgrounds, and if these advantages are not completely accounted for then the Party membership dummy in the OLS estimations will pick up the effect of these variables. It is therefore difficult to ascertain how much of the empirical association between earnings and Party membership is due to the causal effect of Party membership and how much is due to unobserved factors that influence both earnings and Party membership. The omitted variable bias depends on $\frac{cov(P_i,\mu_i)}{var(P_i)}$, which summarizes the relationship in the sample between the excluded $\mu_i$ and the included $P_i$.

Several approaches can be taken to tackle the problem of omitted variable bias. The first approach is to seek richer datasets that can be used to control more extensively for measures of ability, family background, and such like. The main problem with this approach is that the controls inevitably remain incomplete, but nonetheless we have taken advantage of our rich dataset and include many control variables in our estimations to reduce the omitted variable bias.

A second approach is to apply the fixed-effects estimator to our twins sample. As monozygotic twins are genetically identical and have a similar family background, they should have the same $\mu_i$. Thus, taking the within-twin-pair difference will eliminate the unobservable ability and family effect $\mu_i$ that is the cause of the omitted variable bias in the OLS estimation. Intuitively, by contrasting the earnings of identical twins with different Party membership status, we can ensure that any correlation that we observe between Party membership and earnings is not due to a correlation between Party membership and a worker's ability or family background.

The fixed-effects model can be specified as follows. The earnings equations of a pair of twins are given as

$$y_{1i} = X_i\alpha + \beta_1 P_{1i} + Z_{1i}\beta_2 + \mu_i + \epsilon_{1i} \tag{2}$$

$$y_{2i} = X_i\alpha + \beta_1 P_{2i} + Z_{2i}\beta_2 + \mu_i + \epsilon_{2i}, \tag{3}$$

where $y_{ji}$ $(j = 1, 2)$ is the logarithm of the earnings of the first and second twin in the pair. $X_i$ is the set of observed variables that vary across families but not across twins, that is, the family background variables. $P_{ji}$ $(j = 1, 2)$ is the Party membership dummy for twin $j$ in family $i$, and $Z_{ji}$ $(j = 1, 2)$ is a set of variables that vary across the twins.

A within-twin-pair or fixed-effects estimator of $\beta$ for identical twins, $\beta_{fe}$ is based on the first difference between equations (2) and (3):

$$y_{1i} - y_{2i} = \beta_1(P_{1i} - P_{2i}) + (Z_{1i} - Z_{2i})\beta_2 + \epsilon_{1i} - \epsilon_{2i}. \tag{4}$$

The first difference removes both observable and unobservable family effects, or $X_i$ and $\mu_i$. As $\mu_i$ has been removed, we can apply the OLS method to Equation (4) without worrying about bias being caused by the omitted ability and family background variables.

A third approach to solving the omitted variable bias is to directly estimate both the bias and the Party effect using the approach that was developed by Ashenfelter and Krueger (1994). This approach also draws on data from monozygotic twins. In this approach, the correlation between the unobserved family effect and the observables is given as

$$\mu_i = \gamma P_{1i} + \gamma P_{2i} + Z_{1i}\theta + Z_{2i}\theta + X_i\delta + \omega_i, \tag{5}$$

where we assume that the correlations between the family effect $\mu_i$ and the Party status of each twin $P_{ji}$ $(j = 1, 2)$ and the characteristics of each twin $Z_{ji}$ $(j = 1, 2)$ are the same. We further assume that $\omega_i$ is uncorrelated with $P_{ji}$ $(j = 1, 2)$, $Z_{ji}$ $(j = 1, 2)$ and $X_i$. The coefficient $\gamma$ measures the selection effect that relates family effect to Party status, and the vector of coefficients $\theta$ measures the selection effect that relates family effect to other individual characteristics.

The reduced form for equations (2), (3), and (5) is obtained by substituting (5) into (2) and (3) and collecting the terms as follows.

$$y_{1i} = X_i(\alpha + \delta) + (\beta_1 + \gamma)P_{1i} + \gamma P_{2i} + Z_{1i}(\beta_2 + \theta) + Z_{2i}\theta + \epsilon'_{1i} \quad (6)$$

$$y_{2i} = X_i(\alpha + \delta) + (\beta_1 + \gamma)P_{2i} + \gamma P_{1i} + Z_{2i}(\beta_2 + \theta) + Z_{1i}\theta + \epsilon'_{2i}, \quad (7)$$

where $\epsilon'_{ji} = \omega_i + \epsilon_{ji}$, $(j = 1, 2)$. Equations (6) and (7) are estimated using the generalized least squares (GLS) method, which is the best estimator that allows cross-equation restrictions on the coefficients. Although both the fixed-effects and the GLS models control for ability and can produce unbiased estimates of the Party effect $\beta_1$, GLS also allows the estimation of the selection effect $\gamma$.

# 3 Data

The data that we use are derived from the Chinese Twins Survey, which was carried out by the Urban Survey Unit of the National Bureau of Statistics in June and July 2002 in five cities in China. The survey was funded by the Research Grants Council of Hong Kong. Based on twins questionnaires from the United States and elsewhere, the survey covered a wide range of socioeconomic information. The questionnaire was designed by two authors of this paper in close consultation with Mark Rosenzweig and Chinese experts at the National Bureau of Statistics. Adult twins who were aged between 18 and 65 (the 1942-1986 birth cohort) were identified by the local Bureau of Statistics through various channels, including colleagues, friends, relatives, newspaper advertising, neighborhood notices, neighborhood management committees, and household records in the public security bureau. Overall, these channels permit a roughly equal probability of contacting all of the twins in these cities, and thus the twins sample that is obtained for this study is approximately representative. (The within-twins estimation method that is used for this study controls for the first-order effects of any unobserved characteristics that might have led to the selection of pairs of twins for the sample.) The questionnaires were completed through household face-to-face personal interviews. The survey was conducted with considerable care, and several site checks were made by Junsen Zhang and experts from the National Bureau of Statistics. After appropriate discussion with Mark Rosenzweig and other experts, the data input was closely supervised and monitored by Junsen Zhang himself in July and August 2002.

This is the first socioeconomic dataset on twins in China and perhaps the first in Asia. The dataset includes detailed socioeconomic information on respondents from households in five cities: Chengdu, Chongqing, Harbin, Hefei, and Wuhan. Altogether there are 4,683 observations, of which 3,012 are from households with twins. In the twins sample, we can distinguish whether they are identical or non-identical twins. We consider a pair of twins to be identical if both twins respond that they have identical hair color, look, gender, and age. We have completed questionnaires from 3,002 individuals, of which 2,996 are twin individuals and 6 are triplet individuals. Of these 3,002 individuals, we have 914 complete pairs of identical twins (1,828 individuals), and complete information on earnings, Party membership, education, and other variables for both twins in the pair is available for 435 of these pairs (870 individuals).

For the purpose of comparison, non-twin households in the five cities were taken from regular households with whom the Urban Survey Unit conducts regular monthly surveys of their own. The Urban Survey Unit started regular monthly surveys in the 1980s. Their initial samples were random and representative, and although they have made every effort to maintain these good sampling characteristics, their samples have become less representative over time. In particular, given the increasingly high refusal rate of young people, the samples have gradually become biased toward the oversampling of old people over time. The survey of non-twin households was conducted at the same time as the twin survey using the same questionnaire.

The descriptive statistics are reported in Table 1. Although our within-twin-pair estimations control for possible sample selection, it is interesting to compare the identical twins sample to the other samples that we have. To facilitate such a comparison, we also provide the basic statistics for a large-scale survey that was conducted by the National Bureau of

Statistics as a benchmark.[3] In column 1, we report the mean of all of the variables for identical twins. Fifty-nine percent of these identical twins were male who, on average, were 34 years old, had 12 years of schooling, and their spouses also had an average of 12 years of schooling. Twenty-two percent of them were Party members who, on average, had worked for 14 years and had monthly earnings of 912 yuan, where earnings include wages, bonuses, and subsidies. The individuals in the identical twins sample were younger and earned less than those in the National Bureau of Statistics sample. Finally, the individuals in the non-twins sample (column 3) were older than both those in the National Bureau of Statistics sample and those in the twins samples.

To obtain a well performing within-twin-pair estimation of the returns to Party membership, the within-twin-pair variation of Party membership must be sufficiently large. We check the within-twin-pair variations in Party membership and education by reporting their distributions (Table 2). In 66 percent of the sets of identical twins neither twin was a Party member, in 24 percent one of the twins was a Party member, and in 10 percent both twins were Party members. The within-twin-pair variation in education is even larger. Fifty-three percent of the twin pairs had the same education, 10 percent had one year's difference in education, about 10 percent had two years' difference, and the remaining 27 percent had a difference of more than two years.

# 4 Results

In this section, we report the estimated returns to Party membership using the different samples and methods. We start with OLS regressions using the whole sample, which includes twins and non-twins, and then conduct the same OLS estimations using the monozygotic twins sample to compare the estimated coefficients to those that are estimated using the whole sample. This comparison serves as a way to check the representativeness of the monozygotic twins sample. We then conduct the within-twin-pair fixed-effects and GLS

[3]The National Bureau of Statistics has been conducting an annual survey of urban households from 226 cities (counties) in China since 1986. It is the best large-scale survey of this kind.

estimations using the twins sample, leaving the sensitivity analyses to the next section.

## 4.1 OLS Regressions Using the Whole Sample

In Table 3, we report the results of the OLS regressions using the whole sample that includes both twins and non-twins. The dependent variable is the logarithm of monthly earnings. The t-statistics are calculated using robust standard errors.

Column 1 shows a simple regression with the Party membership dummy and city dummies as independent variables. This simple regression shows that the returns to Party membership are quite large: being a Party member increases earnings by 26.2 percent, which is precisely estimated with a t-statistic of 11.36.

When we add other control variables, such as age, age squared, gender, and tenure in the second column, the correlation between the Party membership dummy and log earnings remains significant. The estimated coefficient decreases by only 2.2 percentage points, which suggests that omitting these variables only results in a small positive bias. These newly added control variables in column 2 also have the expected signs. Men have 17.4 percent higher earnings than women, and there is a concave relationship between income and age. The positive coefficient of age and the negative coefficient of age squared are both significant at least at the 10-percent level. Wage increases with age before the age of 29 and starts to drop thereafter. The turning point occurs at such a young age because we also control for job tenure, which generally increases with age. Job tenure itself has a positive effect, with an additional year in a post increasing earnings by 0.8 percent.

In column 3, we add the important human capital variable of education as a covariate. Controlling for education, the effect of Party membership is reduced by more than half. This suggests that Party members are generally better educated than non-Party members, and half of the effect of the Party membership in column 2 is in fact due to the effect of education. As expected, education itself has a positive effect on earnings. An additional year of education increases earnings by 6.3 percent, which is comparable to the estimated returns to education in previous studies that draw on Chinese data (Zhang et al., 2005).

We then test whether Party membership has a positive impact on earnings because Party members are more likely to become government officials. Morduch and Sicular (2000) find that much of the Party effect can be explained by a government official dummy in a sample from rural China. In column 4, we include a new covariate, the government official dummy, that equals one if the respondent worked in the government or Party agency, and zero otherwise. Including the government official dummy reduces the coefficient of the Party membership dummy by only 0.2 percentage points, and the government official dummy itself is not significant even at the 10-percent level. These findings suggest that becoming a government official may not be the major mechanism by which Party members earn more.

## 4.2 OLS Regressions Using the MZ Twins Sample

In this subsection, we repeat the same OLS regressions using the monozygotic twins sample. Comparing the OLS results of the whole sample with those of the MZ twins sample is a way of checking the representativeness of our twins sample. As we only use MZ twins, the sample size is reduced to 870 (or 435 pairs of twins).

The regression results that are reported in Table 4 suggest that our MZ twins sample is fairly representative in terms of the estimated coefficients, which for most of the variables are very similar to those that are reported in Table 3. This is especially true for the Party membership dummy. Note that the coefficient that is reported in column 4 is 0.112, which is only slightly different from that reported in column 4 of Table 3. Another important variable, education, also has a similar effect to that estimated using the whole sample.

To summarize, the OLS estimates of the Party membership effect are rather large even after we control many of the covariates. The remaining effect of Party membership is 0.112 in column 4 of Table 4. However, we still do not know how much of this effect is the real Party membership effect, such as political connections or the job privileges that are associated with Party membership, and how much is due to unobserved ability or family background. The finding that the government official dummy cannot explain much of the remaining Party membership effect seems to suggest that political connections or job privileges may not be that important, but we need to make further investigations to show this more rigorously.

### 4.3 Within-Twin-Pair Estimations

In Table 5, we report the results of the within-twin-pair fixed-effects estimations, or the estimations of Equation (4). As MZ twins have the same age and gender, these two variables are dropped when assessing the first difference.

The within-twin-pair estimation shows that much of the Party membership effect that is found in the OLS estimations is a result of the effects of ability or family background. Note that the within-twin-pair estimates of the Party membership dummy are all smaller than the OLS estimates that are reported in Table 4. Taking column 4 of Table 5 as an example, it can be seen that the Party effect is only 0.014, which is only one eighth of the OLS estimate using the same twins sample. This suggests that seven eighths of the OLS estimate of the Party effect is actually due to the effects of ability or family background. Moreover, none of the estimated coefficients on the Party dummy in the fixed-effects estimations is significantly different from zero, which suggests that after removing the effects of ability and family background, the pure Party membership effect is zero.[4]

It is also interesting to compare the within-twin-pair estimates of other variables to the OLS estimates. The estimated effect of job tenure remains insignificant, as in Table 4. The returns to education diminish from 0.071 to 0.024, which shows that the OLS estimate of the returns to education is also biased upward by about 200 percent. Finally, the coefficient of the government official dummy becomes larger after controlling for the effects of ability and family background, but is not significant at a conventional level.

[4]One concern is simultaneity, that is, that those with higher earnings are more likely to join (or be selected by) the Party. In terms of the within-twin-pair estimations, simultaneity means that in a given pair of twins the twin with higher earnings is more likely to join the Party. If simultaneity is important in our twins sample, then this reverse causality would lead to a positive correlation between the within-twin-pair difference in the Party membership and the within-twin-pair difference in earnings, and would cause the estimated effect of the Party membership on earnings to become biased upward. However, we find the within-twin-pair estimate of the Party effect to be zero, which suggests that any upward bias that is caused by simultaneity, even if does exist, is not very important.

## 4.4 GLS Estimations Using Twins

We next turn to the GLS estimator for Equations (6) and (7), which can directly estimate both the Party membership effect and the ability or family effect. In Table 6, we report the GLS estimates that include all of the covariates that are used in the OLS estimates. In addition to the Party membership dummy, we also include the sum of the Party membership dummies of both twins in a pair ($P_{1i} + P_{2i}$) as an independent variable. The coefficient of this new variable will be the estimated effect of ability or family background, that is, $\gamma$ in Equations (6) and (7). Similarly, we also include the sums of education, tenure and government official dummies as covariates to estimate the family effect of these variables. The GLS model is estimated by stacking Equations (6) and (7) and fitting them using the SURE model.

The GLS estimations again show that the pure Party effect is small and not significantly different from zero, whereas the effects of omitted ability and family background are large. The coefficient of an individual's Party membership is only 0.014-0.049, which is very close to the within-twin-pair estimates. In contrast, the estimated family effect, that is, the coefficient of the sum of the Party membership dummy of both twins in a pair, is much larger than the pure Party effect and is significantly different from zero in most cases. The result for education is also consistent with that of the within-twin-pair estimates. There is a large family effect for education, but education remains significant in the earnings equation even after we remove the family effect.

# 5 Sensitivity Tests

In this section, we conduct a series of sensitivity tests on the within-twin-pair estimations. We first apply a simple correlation test to examine whether the within-twin-pair estimates are less biased than the OLS estimates. We then employ the Heckman correction model to test whether our results are affected by the sample selection. Finally, we test whether the Party effect differs between the older and younger generations.

## 5.1 Potential Biases of Within-Twin-Pair Estimates

The major concern of the within-twin-pair estimate is whether it is less biased than the OLS estimate, and therefore a better estimate (Bound and Solon, 1999; Neumark, 1999). Bound and Solon (1999) examine the implications of the endogenous determination of which twin goes to school for longer, and conclude that twins-based estimations are vulnerable to the same sort of bias that affects conventional cross-sectional estimations. They argue that although taking a within-twin-pair difference removes genetic variation, or $\mu_i$, from Equation (4), this difference may still reflect the ability bias to the extent that ability consists of more than just genes. In other words, a within-twin-pair estimation may not completely eliminate the bias of the conventional cross-sectional estimation, because the within-twin-pair difference in ability may remain in $\epsilon_{1i} - \epsilon_{2i}$ in Equation (4), which may correlate with $P_{1i} - P_{2i}$. If endogenous variation in the Party membership variable comprises as large a proportion of the remaining within-twin-pair variation as it does of the cross-sectional variation, then a within-twin-pair estimation is subject to as large an endogeneity bias as the cross-sectional estimator.

Although within-twin-pair estimation cannot completely eliminate the bias of the OLS estimator, it can tighten the upper bound of the return on Party membership. Ashenfelter and Rouse (1998), Bound and Solon (1999), and Neumark (1999) have all debated the bias in the OLS and within-twin-pair estimations at length. Note that the bias in the OLS estimator depends on the fraction of variance in the Party membership that is accounted for by the variance in unobserved ability that may also affect earnings, that is, $\frac{cov(P_i,\mu_i+\epsilon_i)}{var(P_i)}$. Similarly, the bias that ability causes in the fixed-effects estimator depends on the fraction of within-twin-pair variance in the Party membership that is accounted for by the within-twin-pair variance in unobserved ability that also affects earnings, that is, $\frac{cov(\Delta P_i,\Delta\mu_i+\Delta\epsilon_i)}{var(\Delta P_i)}$. If we are confident that Party membership and the earnings error term are positively correlated both in the cross-sectional and within-twin-pair regressions, and if the endogenous variation within a family is smaller than the endogenous variation between families, then we can take it that the fixed-effects estimator is less biased than the OLS estimator. Thus, even if there is an ability bias in the within-twin-pair regressions, the fixed-effects estimator can still be regarded as an upper bound of the return on Party membership (if Party membership and ability are positively correlated). If this is the case, we can credit the within-twin-pair estimates for having tightened the upper bound of the return on Party membership. From this point of view, comparing monozygotic twins serves the purpose of reducing the bias in the estimation of returns to Party membership.

To examine whether the within-twin-pair estimate is less biased than the OLS estimate, we follow Ashenfelter and Rouse (1998) and conduct some correlation analyses. We use the correlations of average family Party membership over each pair of twins with the average family characteristics that may be correlated with ability (for example, education, tenure, marital status, spouse's education, and birth weight) to indicate the expected ability bias in a cross-sectional OLS regression. We then use the correlations of the within-twin-pair difference in Party membership and the within-twin-pair differences in these characteristics to indicate the expected ability bias in a within-twin-pair regression. If the correlations in the cross-sectional case are larger than those in the within-twin-pair case, then the ability bias in the cross-sectional OLS regressions is likely to be larger than that in the within-twin-pair regressions.

The correlation tests that are reported in Table 7 suggest that the within-twin-pair estimations of the returns to Party membership may indeed be less affected by omitted variables than the OLS estimations. Note that the between-family correlations are all larger in magnitude than the within-twin-pair correlations. For example, the correlation between average family Party membership and average family education is 0.25 (column 1, row 1) and significantly different from zero, which suggests that families with a lower average level of education have fewer Party members. This is consistent with the assumption that ability and family background positively affect Party membership status. The correlation of within-twin-pair difference in Party membership and the within-twin-pair difference in education is less than half that of the between-family correlation. This suggests that, to the extent that education measures ability, within-twin-pair differences in Party membership are less affected by the ability bias than the family-average of Party membership variable. However, this within-twin-pair correlation is still statistically significant and large in magnitude, which implies that the within-twin-pair difference cannot completely eliminate the ability bias that is embodied in education. Thus, it is necessary to control for the within-twin-pair difference in education in the within-twin-pair estimations of the returns to Party membership.

The correlations of Party membership with other variables provide even stronger evidence that the within-twin-pair estimations are subject to a smaller omitted ability bias. The between-family correlations are significant in all but one of these pairs, but none of the within-twin-pair correlations is significant. Of course, these characteristics are only an incomplete set of ability measures, but the evidence is suggestive.

## 5.2 Selection Bias

As in all studies that are concerned with earnings, there is a potential selection bias that is caused by the decision to participate. Observations had to be dropped from our analysis if there was no response on the earnings question from the interviewees, and it may be that poor people were more likely to be dropped because they would be less likely to be prepared to answer this question. If they are also less likely to be Party members, then the sample selection may lead to an underestimation of the Party membership coefficient.

To address this problem, we employ the Heckman-correction model using the dummy for reporting earnings (1 = reported, 0 = not reported) in the participation equation. For the within-twin-pair estimations to work, we need both twins to have reported their income in the questionnaire. Thus, there are two selection rules. To deal with this double selection problem, we follow Tunali (1986) and Bonjour et al. (2003) and estimate a bivariate probit model for the participation of both twins. We use age, marital status, and the number of children as additional determinants of selection. Subject to identifiability,[5] the estimations

[5]Generally speaking, it is hard to find very compelling instruments. Thus, as in other twins studies (e.g.,

that are made using the bivariate probit model to correct selection bias will yield consistent estimates of the Party effect.

Table 8 reports the within-twin-pair estimates with the Heckman corrections using the double selection model. Similar to the within-twin-pair estimates that are reported in Table 5, the estimated Party effects are all close to zero and none is significant. One of the selection terms is marginally significant in the first two regressions, but becomes insignificant once we include education and other controls in columns 3 and 4. These results therefore suggest that selection bias is not a critical issue in our twins sample.

### 5.3 Old versus Young Workers

Although the Communist Party still rules China, the communist ideology and the role of the Party and government in the economy have weakened after more than two and half decades of economic transition from a centrally planned to a market economy. The most important change in this period has been the entrance of non-state firms, including private, collective, and foreign firms, into the economy. In 2002, the non-state sector employed 70 percent of workers in China, and produced two thirds of the GDP.

These changes to the economy and the weakening of the communist ideology affect both the returns to Party membership and Party member selection. The non-state sector may not value Party membership as much as the state sector, and thus if young people are more likely to enter the non-state sector, then the returns to Party membership will be smaller for the younger generation than for the older generation. Equally, the weakening of the communist ideology and declining economic returns may have made joining the Party less attractive for the younger generation, and thus young people with a high level of ability may be less likely to join the Party than the older generation.

The unobserved ability or selection effect may also be more important for the older generation for historical reasons. As is well known, the Cultural Revolution, which occurred between 1966 and 1976, interrupted the education and career of many Chinese who were born

Bonjour et al., 2003), the Heckman-correction model may only be suggestive.

between 1950 and 1968 (aged 34-52 at the time of the survey in 2002). As a result, education and job experience may not fully pick up the ability of these people, and furthermore the political fever in this period understandably made joining the Party very rewarding for individuals with great ability.

We next test whether the returns to Party membership and the selection effect (the effect of observed and unobserved ability) differ for the older and younger generations. As our dataset is cross-sectional in nature, the best way to test this is to divide the sample into younger and older generations. The dividing point for the two generations is the median age in the sample, 34, which happens to be the cutoff age for individuals whose education was interrupted by the Cultural Revolution.

The regression results show that the younger and older generations differ only in the selection effect. In Table 9, we report the OLS and within-twin-pair estimations of the returns to Party membership using a sample of old twins. Note that the Party membership dummy is positive and significant at the one-percent level for all of the OLS specifications (columns 1-4). The magnitudes of the coefficient of all four specifications are larger than those that are estimated using twins from both the old and young generations (Table 4). Interestingly, once we take the within-twin-pair difference, almost all of the Party membership effect is gone. The coefficients of the Party membership dummy are insignificant and very small in magnitude for all the within-twin-pair estimations (columns 5-8), which suggests that Party members in the older generation tend to have a higher unobserved ability than non-party members, and there are no returns to Party membership per se.

The regression results for the young sample that are reported in Table 10 suggest a different story. Although young Party members enjoy some earnings premium, the whole premium can be explained by observed human capital variables, such as education, age, and tenure. Although the Party membership dummy is significant in the simple regression in column 1, the magnitude is much smaller than that for the old sample (0.175 versus 0.332), and becomes insignificant after we control for other variables in column 2. Once we include education as a covariate in columns 3 and 4, the coefficient of the Party membership dummy becomes almost zero, which suggests that young Party members earn more than other young people because they are more experienced, and in particular are better educated. Again, the within-twin-pair estimates of the Party membership dummy in columns 5-8 are insignificant.

Interestingly, although the old and young samples differ in unobserved ability, the returns to education and other observable human capital variables are almost the same. The returns to education for both samples are around 0.70 for the OLS estimates, and around 0.21-0.29 for the within-twin pair estimates, although only the OLS estimates are statistically significant. Comparing column 1 and column 4 in each of the two tables, we find that the coefficient of the Party membership dummy has decreased by almost the same amount (0.16) for the old and young samples when other human capital variables are controlled for. This suggests that these human capital variables, which include education, can explain the same portion of the earnings premium that is associated with Party membership, and, in the case of the young sample, the portion that is explained by these variables comprises almost the whole premium.

In summary, we find that Party members on average enjoy an earnings premium in both the older and the younger generations, although it is larger for the older generation. The earnings premium for the younger generation can be fully explained by the better observable human capital variables, such as age, tenure, and education. The earnings premium for the older generation cannot be fully explained by such variables, but it can be fully explained by unobserved ability. The difference in the effect of unobserved ability may be due to the interrupted education of the older generation or the declining attractiveness of Party membership over time.[6]

[6] An alternative explanation of the results is that the returns to the unobservables increase with age. Although we cannot exclude this explanation, we do find that the returns to observables, which include education and other human capital variables, do not differ across the young and old samples.

# 6 Conclusion

In this paper, we empirically measure the returns to membership of the Chinese Communist Party. By using twins data to control for the effects of omitted ability and family background, we find that most of the effect of Party membership is actually due to these effects. Our sensitivity analyses suggest that the within-twin-pair estimates can at least serve as the upper bound of the true returns to Party membership, and in our case this upper bound is almost zero. The estimations are also robust to models that control for selection bias. The finding that most of the effect of Party membership is due to unobserved ability or family background is not surprising, as the unique way in which the Party selects its members ensures their superior quality.

When we conduct the same analysis on the older and younger generations separately, we find that the earnings premium that is associated with Party membership for the younger generation can be fully explained by their better observable human capital variables, such as age, tenure, and education. The earnings premium for the older generation cannot be fully explained by such variables, but it can be fully explained by unobserved ability. The difference in the effect of unobserved ability may be due to the interrupted education of the older generation or the declining attractiveness of Party membership over time.

An interesting question is whether Party members have used their unique political status to exploit non-Party members and become rich during China's economic transition. Although we do not deny that this may have happened, and indeed there is some anecdotal evidence to suggest that many Party members are actually corrupt, our findings suggest that after controlling for the effects of ability and family background Party membership confers no benefit, at least in terms of tangible labor earnings. We have to admit that, like any other studies in the literature of economics, sociology, and political science, we are not able to measure intangible income, such as bribes. However, our study still provides important evidence that the literature on the returns to Communist Party membership should be re-evaluated, because it is completely based on the OLS estimates of the Party premium. We find that the whole premium is simply a premium of ability.

The survival of communism in China depends on the Party, and the survival of the Party depends on the quality of its members. Our analysis shows that Party members generally have a higher ability than non-Party members, either in the form of easily observable human capital variables or in the form of unobservables. The high quality of Party members explains why they have been able to quickly come up with and effectively implement market-based reforms, and why they are able to constantly adapt to the new environment but keep the communist ideology alive (although the ideology may have weakened in the younger generation). In this sense, the fact that its members are China's elite may be an important reason for the success of the Party and of China's economic reforms.

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Table 1: Descriptive Statistics of the Twins and Non-Twins Samples

| Variable | MZ twins | All twins | Non-twins | NBS sample |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Party membership | 0.22 | 0.20 | 0.29 | -- |
| | (0.42) | (0.40) | (0.45) | -- |
| Age | 33.99 | 34.10 | 42.22 | 40.80 |
| | (9.27) | (9.33) | (8.39) | (11.98) |
| Male | 0.59 | 0.60 | 0.47 | 0.55 |
| | (0.49) | (0.49) | (0.50) | (0.50) |
| Tenure (number of years working full time since age 16) | 14.33 | 14.33 | 21.68 | 18.45 |
| | (9.67) | (9.67) | (9.05) | (12.94) |
| Earnings (monthly wage, bonus and subsidies in RMB) | 912.06 | 877.96 | 848.47 | 1062.92 |
| | (515.79) | (573.73) | (551.08) | (840.09) |
| Years of education | 12.43 | 12.07 | 11.76 | 11.62 |
| | (2.87) | (2.92) | (3.06) | (2.83) |
| Spouse's education | 11.82 | 11.53 | 11.51 | -- |
| | (3.08) | (3.10) | (3.49) | -- |
| Government official | 0.07 | 0.07 | 0.10 | 0.09 |
| | (0.26) | (0.25) | (0.30) | (0.18) |
| Sample size | 870 | 1852 | 1260 | 23288 |

Note: Mean and standard deviation (in parentheses) are reported in the table. For the MZ twins sample, we restrict the sample to those twin pairs, (435 pairs) for which we have complete information of wages, Party membership, years of education, job tenure, and the government official status on both twins in the pair. For DZ twins and non-twins, we restrict the sample to those individuals that have complete information. The NBS sample is based on six provinces.

Table 2: Within-Twin Pair Differences in the Party Membership and Education (435 twin pairs)

| | No. of Observations | Proportion (%) |
|---|---|---|
| **Within-twin-pair difference in Party membership** | | |
| Neither twin is Party Member | 286 | 65.7 |
| Either is Party Member | 103 | 23.7 |
| Both are Party Members | 46 | 10.6 |
| Total | 435 | 100 |
| | | |
| **Within-twin-pair difference in education** | | |
| 0 | 232 | 53.3 |
| 1 | 44 | 10.1 |
| 2 | 42 | 9.7 |
| 3-8 | 117 | 26.9 |
| Total | 435 | 100 |

Table 3: OLS Estimates of the Return to the Party Membership Using the Whole Sample

| | Dependent variable: log earnings | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Party membership | 0.262*** | 0.240*** | 0.119*** | 0.117*** |
| | (11.36) | (10.20) | (5.10) | (4.96) |
| Age | | 0.020** | 0.017* | 0.017* |
| | | (2.10) | (1.95) | (1.96) |
| Age-squared | | -0.034*** | -0.029*** | -0.029*** |
| | | (3.00) | (2.74) | (2.74) |
| Male | | 0.174*** | 0.195*** | 0.195*** |
| | | (7.89) | (9.47) | (9.46) |
| Tenure | | 0.008** | 0.012*** | 0.012*** |
| | | (2.55) | (4.25) | (4.24) |
| Years of education | | | 0.063*** | 0.062*** |
| | | | (18.16) | (17.47) |
| Government official | | | | 0.023 |
| | | | | (0.64) |
| Constant | 6.600*** | 6.154*** | 5.372*** | 5.374*** |
| | (335.74) | (34.94) | (31.66) | (31.57) |
| Observations | 3112 | 3112 | 3112 | 3112 |
| R-squared | 0.06 | 0.08 | 0.18 | 0.18 |

Note: Robust t statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. All regressions include city dummies.

Table 4: OLS Estimates of the Return to the Party Membership Using the MZ twins Sample

| | Dependent variable: log earnings | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Party membership | 0.281*** | 0.251*** | 0.114** | 0.112** |
| | (6.18) | (5.19) | (2.45) | (2.38) |
| Age | | 0.074*** | 0.045** | 0.045** |
| | | (3.59) | (2.37) | (2.38) |
| Age-squared | | -0.081*** | -0.053** | -0.054** |
| | | (3.02) | (2.12) | (2.13) |
| Male | | 0.168*** | 0.192*** | 0.191*** |
| | | (3.87) | (4.86) | (4.81) |
| Tenure | | -0.011 | 0.003 | 0.003 |
| | | (1.37) | (0.52) | (0.50) |
| Years of education | | | 0.071*** | 0.071*** |
| | | | (11.48) | (11.24) |
| Government official | | | | 0.032 |
| | | | | (0.57) |
| Constant | 6.627*** | 5.190*** | 4.772*** | 4.772*** |
| | (102.49) | (14.31) | (13.96) | (13.95) |
| Twin pairs | 435 | 435 | 435 | 435 |
| Observations | 870 | 870 | 870 | 870 |
| R-squared | 0.06 | 0.11 | 0.23 | 0.23 |

Note: Robust t statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. All regressions include city dummies.

Table 5: Within-Twin-Pair Fixed-Effects Estimates of the Return to the Party Membership Using the MZ twins Sample

| | Dependent variable: log earnings | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Party membership | 0.049 | 0.046 | 0.033 | 0.014 |
| | (0.95) | (0.88) | (0.63) | (0.27) |
| Tenure | | 0.010 | 0.014 | 0.013 |
| | | (0.88) | (1.17) | (1.14) |
| Years of education | | | 0.026* | 0.024* |
| | | | (1.79) | (1.66) |
| Government official | | | | 0.136 |
| | | | | (1.64) |
| Twin pairs | 435 | 435 | 435 | 435 |
| Observations | 870 | 870 | 870 | 870 |
| R-squared | 0.00 | 0.00 | 0.02 | 0.02 |

Note: Robust t statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6: GLS Estimates of the Return to the Party Membership Using the MZ twins Sample

| | Dependent variable: log earnings | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Party membership | 0.049 | 0.045 | 0.032 | 0.014 |
| | (0.98) | (0.91) | (0.65) | (0.28) |
| Sum of Party membership dummies | 0.179*** | 0.164*** | 0.065 | 0.075* |
| | (4.47) | (4.05) | (1.64) | (1.87) |
| Age | | 0.077*** | 0.045*** | 0.045*** |
| | | (4.30) | (2.72) | (2.70) |
| Age-squared | | -0.080*** | -0.049** | -0.049** |
| | | (3.38) | (2.27) | (2.26) |
| Male | | 0.157*** | 0.189*** | 0.189*** |
| | | (3.57) | (4.76) | (4.76) |
| Tenure | | 0.011 | 0.015 | 0.014 |
| | | (1.07) | (1.42) | (1.38) |
| Years of education | | | 0.027** | 0.024** |
| | | | (2.22) | (2.02) |
| Sum of twin-pair's education | | | 0.025*** | 0.026*** |
| | | | (3.52) | (3.68) |
| Government agencies | | | | 0.135* |
| | | | | (1.73) |
| Sum of government dummies | | | | -0.079 |
| | | | | (1.33) |
| Constant | 6.582*** | 5.091*** | 4.670*** | 4.670*** |
| | (111.01) | (15.44) | (15.54) | (15.54) |
| Twin pairs | 435 | 435 | 435 | 435 |
| Observations | 870 | 870 | 870 | 870 |

Note: Absolute value of z statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. All regressions include city dummies.

Table 7: Between-Families and Within-Twin-Pair Correlations of the Party Membership and Other Variables (435 twin pairs)

| Between-family correlations | | Within-Twin-Pair Correlations | |
|---|---|---|---|
| | Party membership | | ΔParty membership |
| Education | 0.2458*** | ΔEducation | 0.1150** |
| | (<0.01) | | (0.02) |
| Tenure | 0.3347*** | ΔTenure | 0.0649 |
| | (<0.01) | | (0.18) |
| Spouse's education | 0.1816*** | ΔSpouse's education | -0.0227 |
| | (<0.01) | | (0.73) |
| Marital status | 0.2232*** | ΔMarital status | -0.0318 |
| | (<0.01) | | (0.51) |
| Birth weight | -0.0350 | ΔBirth weight | -0.0061 |
| | (0.4692) | | (0.90) |

Note: Significant level in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Between-family correlation are correlations of average family Party membership (average of the twins) with average family characteristics, and within-twin-pair correlations are correlations of the within-twin-pair differences in education with within-twin-pair differences in other characteristics

Table 8: Heckman-Corrected Fixed-Effect Model Using MZ Twins

| | Dependent variable: log earnings | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Party membership | 0.040 | 0.036 | 0.031 | 0.013 |
| | (0.79) | (0.69) | (0.61) | (0.25) |
| Tenure | | 0.013 | 0.014 | 0.013 |
| | | (1.09) | (1.15) | (1.13) |
| Years of education | | | 0.017 | 0.013 |
| | | | (0.74) | (0.62) |
| Government official | | | | 0.136 |
| | | | | (1.63) |
| Heckman selection term 1 | -0.351* | -0.378* | -0.193 | -0.206 |
| | (1.79) | (1.95) | (0.65) | (0.70) |
| Heckman selection term 2 | 0.326 | 0.354 | 0.144 | 0.161 |
| | (1.38) | (1.51) | (0.41) | (0.46) |
| Twin Pairs | 434 | 434 | 434 | 434 |
| Observations | 868 | 868 | 868 | 868 |
| R-squared | 0.01 | 0.02 | 0.02 | 0.02 |

Note: Robust t statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. We use age, marital status, and the number of children as instrumental variables for the selection equations. The Heckman model has 434 observations because the marriage variable is missing for one observation.

Table 9: OLS and Within-Twin-Pair Fixed-Effects Estimates of the Return to the Party Membership Using the Old MZ Twins Sample (age greater than the median 34)

| | Dependent variable: log earnings | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | OLS | | | | Within-twin-pair fixed-effects | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Party membership | 0.332*** | 0.339*** | 0.183*** | 0.173*** | 0.041 | 0.038 | 0.026 | -0.012 |
| | (5.97) | (5.80) | (3.29) | (3.07) | (0.51) | (0.48) | (0.33) | (0.15) |
| Age | | 0.060 | 0.031 | 0.034 | | | | |
| | | (0.65) | (0.38) | (0.41) | | | | |
| Age-squared | | -0.062 | -0.035 | -0.038 | | | | |
| | | (0.58) | (0.37) | (0.40) | | | | |
| Male | | 0.152** | 0.177*** | 0.175*** | | | | |
| | | (2.42) | (3.03) | (3.00) | | | | |
| Tenure | | -0.012 | 0.001 | 0.001 | | 0.008 | 0.012 | 0.012 |
| | | (1.17) | (0.11) | (0.08) | | (0.60) | (0.91) | (0.87) |
| Years of education | | | 0.071*** | 0.069*** | | | 0.029 | 0.025 |
| | | | (8.29) | (8.00) | | | (1.36) | (1.22) |
| Government official | | | | 0.074 | | | | 0.185* |
| | | | | (1.12) | | | | (1.71) |
| Constant | 6.609*** | 5.366*** | 5.011*** | 4.972*** | | | | |
| | (72.66) | (2.70) | (2.86) | (2.83) | | | | |
| Twin pairs | | | | | 203 | 203 | 203 | 203 |
| Observations | 406 | 406 | 406 | 406 | 406 | 406 | 406 | 406 |
| R-squared | 0.09 | 0.12 | 0.25 | 0.25 | 0.00 | 0.00 | 0.02 | 0.03 |

Note: Robust t statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. All regressions include city dummies.

Table 10: OLS and Within-Twin-Pair Fixed-Effects Estimates of the Return to the Party Membership Using the Young MZ Twins Sample (age less than the median 34)

| | Dependent variable: log earnings | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | OLS | | | | Within-twin-pair fixed-effects | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Party membership | 0.175** | 0.107 | 0.013 | 0.013 | 0.061 | 0.057 | 0.042 | 0.040 |
| | (2.12) | (1.36) | (0.17) | (0.17) | (1.19) | (1.07) | (0.77) | (0.73) |
| Age | | 0.172* | 0.062 | 0.060 | | | | |
| | | (1.71) | (0.63) | (0.61) | | | | |
| Age-squared | | -0.259 | -0.080 | -0.077 | | | | |
| | | (1.32) | (0.42) | (0.41) | | | | |
| Male | | 0.181*** | 0.204*** | 0.206*** | | | | |
| | | (2.88) | (3.55) | (3.54) | | | | |
| Tenure | | -0.007 | 0.006 | 0.006 | | 0.014 | 0.017 | 0.017 |
| | | (0.47) | (0.53) | (0.54) | | (0.65) | (0.74) | (0.74) |
| Years of education | | | 0.070*** | 0.071*** | | | 0.022 | 0.021 |
| | | | (7.82) | (7.75) | | | (1.12) | (1.08) |
| Government official | | | | -0.032 | | | | 0.062 |
| | | | | (0.36) | | | | (0.49) |
| Constant | 6.648*** | 3.898*** | 4.577*** | 4.595*** | | | | |
| | (71.63) | (3.13) | (3.72) | (3.73) | | | | |
| Twin pairs | | | | | 232 | 232 | 232 | 232 |
| Observations | 464 | 464 | 464 | 464 | 464 | 464 | 464 | 464 |
| R-squared | 0.03 | 0.11 | 0.22 | 0.22 | 0.00 | 0.01 | 0.01 | 0.01 |

Note: Robust t statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. All regressions include city dummies.