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# COULD EDUCATION RETAIN FARMERS IN THE LOCAL AREA?*

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## *Abstract*

In this study, using the multinomial logit model, we investigate what factors influence farmers' choices between the alternatives of agricultural work, nonagricultural work, temporary migration, and permanent migration. We find that improving education can help local areas retain their surplus farmers, who can then work in local nonagricultural jobs or migrate permanently.

*Key Words:* Multinomial logit, education, migration
*JEL Classification:* J43, R23

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## I. *Introduction*

Unprecedented labor migration from rural to urban areas has occurred in China since the late 1980s. Recently, migration has become easier than before, with the reform of the household registration (hukou) system. However, most urbanites have negative attitudes towards migrants, because of the resulting deterioration in public security and the environment in urban areas. Greater numbers of skilled farmers are now willing to stay in their hometowns and engage in nonagricultural work, if they can earn good incomes. On the other hand, unskilled farmers are unable to find employment or must accept difficult and risky jobs in urban areas, such as jobs in the construction or catering industries.

Few studies have investigated the determinants of farmers' migration in rural China. Li and Zahniser (2002) apply a binary outcome (probit) model. They use 1995 data from the Chinese Household Income Project (CHIP 1995) to evaluate the impact of various explanatory factors on temporary migration decisions. They find that education has a significant impact on migration for both males and females. They also detect an inverted U-shaped relationship between age and the migration probability. However, a limitation is that they obtain an age threshold without considering the nonlinearity of the qualitative response model. Chen and Hamori (2009) extend the binary outcome model to multinomial selections. They use 2000 data from the China Health and Nutrition Survey (CHNS 2000) and classify the sample into three categories: agriculture, nonagriculture, and migrants. They conclude that education has a positive and significant effect on occupational-residential choice in favor of both nonagricultural and migrant work. Furthermore, they find that schooling has a slightly stronger impact on the shift from agricultural work to nonagricultural work than on the shift from farm work to migratory work.[1]

It is inappropriate to aggregate heterogeneous migrants into one category. Education should have different impacts on temporary migratory choice and permanent migratory choice. To complement existing studies, we investigate the factors influencing farmers' decisions between alternative options by using a multinomial logit (MNL) model. Age and education are key considerations. We employ a relatively new database (CHIP 2002) and the sample is classified into four categories: agriculture, nonagriculture, temporary migration, and permanent migration. The rest of the paper is organized as follows. In Section II, we describe the data and present sample summary statistics. In Section III, we present and discuss the MNL regression results. Section IV concludes the paper. In the Appendix, we describe the method used to calculate the partial effect of the quadratic form.

## II. *Data Description*

The CHIP data used in this study—relating to 2002—were collected in 2003. The survey was carried out under the direction of a team of researchers comprising scholars from the Institute of Economics at the Chinese Academy of Social Science (CASS) and researchers from other countries. The data were collected by the National Bureau of Statistics (NBS) using

[1] Zhao (1999) obtained this result earlier.

survey instruments designed by the project research team.

CHIP 2002 is more comprehensive than CHIP 1995,[2] and consists of three subdatasets: urban, rural, and migrants. Only the rural and migrant subsamples are used in this study. All the observations in this study relate to rural registrations (agricultural hukou), even those on individuals who have permanently migrated to urban areas.

Building on the 1995 survey, the CASS project team designed the 2002 survey so that it included a subsample of rural migrants living in urban areas. The CASS migrant subsample is drawn from a sampling frame based on urban addresses that is independent of place of origin and length of residence in the city, but that incorporates the restriction that individuals are registered as rural, not urban. The migrant subsample covers 12 provinces: Beijing, Shanxi, Liaoning, Jiangsu, Anhui, Henan, Hubei, Guangdong, Chongqing, Sichuan, Yunnan, and Gansu. It covers 2,005 households and 5,327 individuals.

Rural surveys include households in which the interviewee either resides at home for a substantial portion of the year (more than six months in the NBS survey) or is the primary source of income. The rural subsample covers 19 provinces: Anhui, Beijing, Gansu, Guangdong, Guizhou, Hebei, Henan, Hubei, Hunan, Liaoning, Jiangsu, Jiangxi, Jilin, Shaanxi, Shandong, Shanxi, Sichuan, Yunnan, and Zhejiang. It covers 9,200 households and 37,969 individuals. However, arguably, all households containing interviewees satisfying the above conditions should be included in the rural subsample, even if some family members have migrated to urban areas. Therefore, these family members should be considered as migrants, even though they are included in the rural subsample.

It would be cumbersome to merge the two subdatasets because of differences in detail between the two survey questionnaires. We control for individuals being aged 16-60, which is a wider range than that considered by Li and Zahniser (2002).[3] We consider only individuals whose status is employed, or unemployed but seeking a job.[4] Observations on disabled persons, students, and retirees are excluded. We classify the migrant subdataset into two categories, permanent migrants (category＝4) and temporary migrants (category＝3). Permanent migrants are those who become regular workers or long-term contract workers in enterprises or institutions after migrating. Temporary migrants are short-term or self-employed workers. The rural subdataset is more complicated and covers agricultural workers, nonagricultural workers, and migrants. Fortunately, all migrants in the rural subdataset are temporary migrants, so we merge them into category 3. Nonagriculture (category＝2) defines those who are engaged in nonagricultural jobs in their hometowns. The remainder are included in agriculture (category＝1).

Next, we define the explanatory variables. Marriage takes the value 1 for married people and 0 otherwise (unmarried, divorced, or widowed). Party＝1 for members of the Chinese Communist Party and 0 otherwise. Ethnic＝1 for members of ethnic minorities and Ethnic＝0 for the Chinese (Han) majority. Health is a discrete variable and denotes the individual's physical condition: 1 for very healthy; 2 for healthy; 3 for average; 4 for unhealthy; and 5 for sick. We use two types of variables to represent human capital. Edu-year is a continuous variable that denotes individual years of education. We also use five dummy variables to

[2] The details of CHIP 2002 and CHIP 1995 are described in Sicular et al. (2007).

[3] These authors control for individuals being aged 16-35.

[4] Farmers in agriculture are considered as employees.

TABLE 1. SUMMARY STATISTICS

| | Agriculture | | Nonagriculture | | Temporary migration | | Permanent migration | |
|---|---|---|---|---|---|---|---|---|
| | Male | Female | Male | Female | Male | Female | Male | Female |
| Obs. | 4826 | 7174 | 4542 | 1424 | 3721 | 2341 | 114 | 66 |
| Age | 38.2 | 38.2 | 40.4 | 34.9 | 32.5 | 29.5 | 34.8 | 29.6 |
| | (13.4) | (11.5) | (10.4) | (10.3) | (9.39) | (8.85) | (9.15) | (8.84) |
| Edu-year | 7.43 | 6.17 | 7.96 | 7.69 | 8.18 | 7.61 | 9.53 | 9.15 |
| | (2.42) | (2.81) | (2.37) | (2.93) | (2.39) | (2.64) | (2.78) | (3.19) |
| Edu-col | 0.009 | 0.005 | 0.018 | 0.025 | 0.018 | 0.013 | 0.008 | 0.091 |
| Edu-voa | 0.028 | 0.018 | 0.049 | 0.066 | 0.039 | 0.043 | 0.088 | 0.106 |
| Edu-hig | 0.118 | 0.066 | 0.175 | 0.135 | 0.146 | 0.086 | 0.298 | 0.197 |
| Edu-mid | 0.542 | 0.413 | 0.544 | 0.473 | 0.612 | 0.567 | 0.368 | 0.424 |
| Edu-pri | 0.246 | 0.321 | 0.172 | 0.202 | 0.139 | 0.197 | 0.123 | 0.106 |
| Illiterate | 0.057 | 0.177 | 0.042 | 0.099 | 0.046 | 0.094 | 0.035 | 0.076 |
| Marriage | 0.725 | 0.856 | 0.879 | 0.774 | 0.724 | 0.649 | 0.886 | 0.772 |
| Party | 0.091 | 0.019 | 0.19 | 0.066 | 0.046 | 0.009 | 0.105 | 0.450 |
| Ethnic | 0.193 | 0.165 | 0.089 | 0.037 | 0.094 | 0.086 | 0.105 | 0.061 |
| Health | 1.95 | 2.02 | 1.91 | 1.94 | 1.76 | 1.79 | 1.73 | 1.80 |

*Note:* The mean of each variable is presented in Table 1. Figures in brackets are standard deviations for continuous variables.

control for schooling levels: edu-col for college education; edu-voa for vocational school; edu-hig for high school; edu-mid for middle school; and edu-pri for primary school. The schooling level of the reference group is illiterate or semiliterate.

The summary statistics for males and females in each category are presented in Table 1. Interpretations of variables' means are provided in the next section, in which we also discuss MNL regression. The MNL regressions are defined as follows:

$$Category = \beta_0 + \beta_1 age + \beta_2 age^2 + \beta_3 edu - year + \beta_4 marriage + \beta_5 party + \beta_6 ethnic + \beta_7 health + u$$

$$Category = \beta_0 + \beta_1 age + \beta_2 age^2 + \beta_3 edu - col + \beta_4 edu - voa + \beta_5 edu - hig + \beta_6 edu - mid + \beta_7 edu - pri + \beta_8 marriage + \beta_9 party + \beta_{10} ethnic + \beta_{11} health + u$$

## III. *Empirical Results*

In this section, the MNL model is applied to investigate what individual characteristics influence the choice between alternatives in each category. The reference category is agriculture (category = 1). The results are presented in Tables 2 and 3. As in other nonlinear models, care is needed when interpreting the estimated parameters of the MNL model. The average partial effects (APEs) depend not only on the coefficients but also on other factors.

Most married female farmers are willing to stay in the local agricultural sector, or have a strong desire to become permanent migrants. Married male farmers are likely to leave the agricultural sector to increase their incomes.

Both male and female farmers are likely to be engaged in local nonfarming jobs, as long as they are communists. Communist Party members have better nonagricultural jobs in the local area. Ethnic minority farmers are willing to stay in the agricultural sector. Poor physical

TABLE 2. MNL REGRESSION RESULTS WITH THE CONTINUOUS MEASURE OF EDUCATION (EDU-YEAR)

| | | Male | | | Female | | |
|---|---|---|---|---|---|---|---|
| | | Coefficient | Std. err | APE | Coefficient | Std. err | APE |
| Category 2 Nonagriculture | Age | 0.253** | 0.016 | 4.98e-3 | 0.186*** | 0.025 | 1.43e-3 |
| | $Age^2$ | −3.15e-3*** | 1.99e-4 | − | −2.57e-3*** | 3.23e-4 | − |
| | Edu-year | 0.075*** | 9.42e-3 | 0.011 | 0.145*** | 0.012 | 0.014 |
| | Marriage | 0.292*** | 0.083 | 0.042 | −0.780*** | 0.118 | −0.079 |
| | Party | 0.625*** | 0.067 | 0.193 | 1.17*** | 0.150 | 0.196 |
| | Ethnic | −0.762*** | 0.066 | −0.103 | −1.64*** | 0.145 | −0.108 |
| | Health | −0.080*** | 0.031 | 3.28e-3 | 1.15e-4 | 0.045 | 4.60e-3 |
| Category 3 Temporary migration | Age | 0.269*** | 0.018 | −6.72e-3 | 0.202*** | 0.023 | −5.13e-3 |
| | $Age^2$ | −4.30e-3*** | 2.38e-4 | − | −3.76e-3*** | 3.31e-4 | − |
| | Edu-year | 0.055*** | 0.010 | 3.12e-3 | 0.068*** | 0.010 | 6.38e-3 |
| | Marriage | 0.247*** | 0.080 | 0.019 | −0.633*** | 0.092 | −0.077 |
| | Party | −0.483*** | 0.099 | −0.131 | −0.329 | 0.242 | −0.071 |
| | Ethnic | −0.849*** | 0.070 | −0.091 | −0.875*** | 0.084 | −0.084 |
| | Health | −0.230*** | 0.036 | −0.036 | −0.217*** | 0.041 | −0.031 |
| Category 4 Permanent migration | Age | 0.151* | 0.084 | −3.09e-4 | −0.074 | 0.111 | −4.73e-4 |
| | $Age^2$ | −2.64e-3** | 1.10e-3 | − | −2.89e-5 | 1.58e-3 | − |
| | Edu-year | 0.343*** | 0.042 | 1.86e-3 | 0.348*** | 0.052 | 1.09e-3 |
| | Marriage | 1.73*** | 0.393 | 6.89e-3 | 1.01** | 0.429 | 3.11e-3 |
| | Party | −0.105 | 0.322 | −1.52e-3 | 0.778 | 0.623 | 2.66e-3 |
| | Ethnic | −0.474 | 0.311 | −2.49e-4 | −1.14** | 0.521 | −2.24e-3 |
| | Health | −0.302 | 0.155 | −1.32e-3 | −0.148 | 0.210 | −3.81e-4 |
| | | LogL = −13657.5 Pseudo $R^2$ = 0.087 | | | LogL = −8931.1 Pseudo $R^2$ = 0.102 | | |

*Notes:* (a) The reference category is agriculture (category = 1) and the coefficients are normalized to zero. (b) The quadratic edu-year term was insignificant in each category. (c) All constant terms are negative and significant but are not reported here. (d) The APE for age was calculated by using the method described in the Appendix; the others were automatically computed by STATA. (e) ***, **, and * denote significance at 1%, 5%, and 10%, respectively.

condition keeps farmers in the agricultural sector.

Next, we consider the two key factors, age and education. Table 1 shows that migration probabilities for young males and females differ. The coefficients of age and its square suggest an inverted U-shaped relationship between age and the dependent variable. This result is similar to that of Li and Zahniser (2002), who make the mistake of obtaining their age threshold without considering the nonlinearity of the qualitative response model. They obtain the threshold value ($x = -b/2a$) from the quadratic form $y = ax^2 + bx + c$. Instead, we calculate the individual alternative probability for each category and plot this against age. Unlike in the linear model, the partial effect differs with the value of the explanatory variable. In addition, the APE for age is calculated by using the method described in the Appendix. We find an inverted-U relationship in all categories of male farmers. The threshold obtained from Figure 1 is more precise than that obtained by Li and Zahniser (2002). Age provides a proxy for work experience, which is approximately age minus 18. As such, it gives some indication of the earnings potential of the individual. Given that there are typically diminishing returns to experience, a quadratic formulation is appropriate. Moreover, female farmers' probabilities of being in categories 3 or 4 are slightly negatively and linearly related to age, even though the

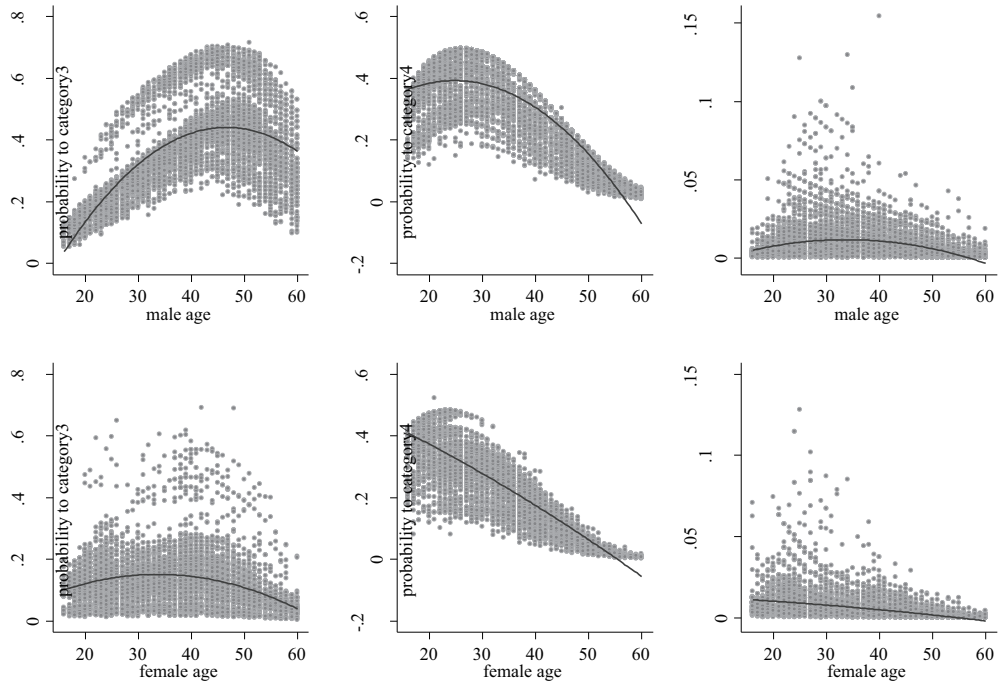
TABLE 3. MULTINOMIAL LOGIT REGRESSION RESULTS WITH DISCRETE MEASURE OF EDUCATION

| | | Male | | | Female | | |
|---|---|---|---|---|---|---|---|
| | | Coefficient | Std. err | APE | Coefficient | Std. err | APE |
| Category 2 Nonagriculture | Age | 0.251*** | 0.017 | 4.89e-3 | 0.180*** | 0.025 | 7.66e-3 |
| | $Age^2$ | −3.13e-3*** | 2.02e-4 | − | −2.59e-3*** | 3.25e-4 | − |
| | Edu-col | 0.794*** | 0.217 | 0.173 | 1.56*** | 0.269 | 0.248 |
| | Edu-voa | 0.928*** | 0.153 | 0.230 | 1.37*** | 0.175 | 0.218 |
| | Edu-hig | 0.377*** | 0.114 | 0.109 | 0.873*** | 0.130 | 0.118 |
| | Edu-mid | 0.275** | 0.103 | 0.092 | 0.347*** | 0.106 | 0.040 |
| | Edu-pri | −0.032 | 0.108 | 0.041 | 0.022 | 0.111 | 9.48e-3 |
| | Marriage | 0.316*** | 0.083 | 0.046 | −0.726*** | 0.118 | −0.071 |
| | Party | 0.604*** | 0.067 | 0.186 | 1.21*** | 0.151 | 0.203 |
| | Ethnic | −0.748*** | 0.066 | −0.100 | −1.63*** | 0.145 | −0.108 |
| | Health | −0.082** | 0.031 | 3.04e-3 | −4.04e-3 | 0.045 | 4.38e-3 |
| Category 3 Temporary migration | Age | 0.267*** | 0.018 | −6.55e-3 | 0.204*** | 0.024 | −5.58e-3 |
| | $Age^2$ | −4.31e-3*** | 2.40e-4 | − | −3.88e-3*** | 3.32e-4 | − |
| | Edu-col | 0.018 | 0.227 | −0.080 | 0.303 | 0.275 | −0.023 |
| | Edu-voa | −0.114 | 0.166 | −0.107 | 0.147 | 0.165 | −0.028 |
| | Edu-hig | −0.246** | 0.125 | −0.078 | 0.101 | 0.121 | −0.012 |
| | Edu-mid | −0.318*** | 0.113 | −0.085 | −0.080 | 0.090 | −0.018 |
| | Edu-pri | −0.582*** | 0.120 | −0.098 | −0.336*** | 0.096 | −0.045 |
| | Marriage | 0.259*** | 0.080 | −0.019 | −0.638*** | 0.092 | −0.079 |
| | Party | −0.460*** | 0.099 | −0.126 | −0.262 | 0.242 | −0.066 |
| | Ethnic | −0.850*** | 0.070 | −0.092 | −0.878*** | 0.085 | −0.084 |
| | Health | −0.231*** | 0.036 | −0.036 | −0.227*** | 0.041 | −0.032 |
| Category 4 Permanent migration | Age | 0.132 | 0.085 | −4.28e-4 | −0.068 | 0.112 | −5.56e-4 |
| | $Age^2$ | −2.58e-3** | 1.12e-3 | − | −3.92e-4 | 1.60e-3 | − |
| | Edu-col | 2.19*** | 0.634 | 0.032 | 2.70*** | 0.663 | 0.032 |
| | Edu-voa | 1.31** | 0.619 | 9.07e-3 | 1.54** | 0.630 | 8.93e-3 |
| | Edu-hig | 0.815 | 0.542 | 6.17e-3 | 1.23** | 0.545 | 6.80e-3 |
| | Edu-mid | −0.418 | 0.537 | −2.90e-3 | −0.069 | 0.511 | −3.86e-4 |
| | Edu-pri | −0.400 | 0.574 | −1.55e-3 | −0.699 | 0.595 | −2.23e-3 |
| | Marriage | 1.82*** | 0.394 | 7.60e-3 | 1.02** | 0.426 | 3.55e-3 |
| | Party | −0.154 | 0.326 | −1.84e-3 | 0.893 | 0.621 | 3.67e-3 |
| | Ethnic | −0.539* | 0.313 | −6.82e-4 | −1.13** | 0.523 | −2.53e-3 |
| | Health | −0.317** | 0.156 | −1.49e-3 | −0.150 | 0.208 | −4.34e-4 |
| | | LogL = −13636.1 Pseudo $R^2$ = 0.088 | | | LogL = −8937.4 Pseudo $R^2$ = 0.101 | | |

coefficients imply an inverted U-shaped relationship. Aging prevents female farmers from migrating.

When the continuous education variable, edu-year, is used, the results indicate that relative to those in category 1, educated female farmers are more willing to enter categories 2, 3, and 4 in turn. The APEs are 0.014, 0.006, and 0.001, respectively. When the schooling-level binary variables are used, the results indicate that most of those who have a high school degree are likely to enter categories 2 or 4. Such decisions are more prevalent among male farmers. Although the mean of edu-year increases with alternatives according to Table 1, highly educated male farmers tend not to move into category 3. By contrast, completing high school has a significantly negative effect on alternatives to category 3. Educated farmers tend to

FIG. 1. THE RELATIONSHIP BETWEEN THE CATEGORY PROBABILITIES AND AGE WHEN A CONTINOUS EDUCATION MEASURE IS USED




engage in local nonagricultural jobs, or migrate permanently.

Table 4 presents the results of investigating the effects of employer type for the primary occupation. About a fifth of males and a quarter of females are engaged in the local state-owned and co-operative sector. These proportions are significantly above the corresponding proportion for temporary migrants, but are only half the corresponding proportion for permanent migrants. Table 1 indicates that the average educational level of permanent migrants is significantly above those of others, whereas the educational level of local surplus farmers is similar to that of temporary migrants. The results indicate that the former have a stronger preference for public sector work than do temporary migrants, once their occupational-residential choices are independent of their occupation-only choices. The government should provide more public job opportunities in the rural nonagricultural sector. If the independence assumption is ruled out, the problem requires a nested logit framework. Furthermore, the descriptive statistics enable us to interpret the result as evidence of inadequate local public job opportunities, and infer that a rural resident who cannot find a job in the public sector chooses to temporarily migrate. Unfortunately, at this stage, we cannot simultaneously identify the labor supply and demand equations because of a lack of information about the labor demand side. We intend to cover these topics in future research.

TABLE 4. THE DISTRIBUTION OF OWNERSHIP IN CATEGORIES 2, 3, AND 4

| | Male | | | Female | | |
|---|---|---|---|---|---|---|
| | State-owned & co-operative | Private & foreign-owned | others | State-owned & co-operative | Private & foreign-owned | others |
| Nonagriculture | 19.3% | 44.6% | 36.1% | 25.6% | 55.5% | 18.9% |
| Temporary migration | 11.1% | 75.1% | 13.8% | 9.2% | 82.8% | 8.0% |
| Permanent migration | 48.3% | 44.7% | 7.0% | 46.2% | 46.2% | 7.6% |

## IV. *Conclusion*

In this paper, we used a multinomial logit model to investigate what factors influence farmers' choices between the alternatives of agricultural work, nonagricultural work, temporary migration, and permanent migration. Age and education were key considerations. Young male farmers are willing to leave the agricultural sector, but after peaking, their motivation decreases with age. Age has a negative effect on female farmers' migration. Better education can keep surplus farmers in their local areas by helping them get local nonagricultural jobs, or by helping them become permanent migrants. Local surplus farmers have a stronger preference for public sector work than do temporary migrants. To eliminate regional disparities, the Chinese government should develop rural education and create more public job opportunities in the rural nonagricultural sector.

## *APPENDIX*

In this appendix, we explain the method used to calculate the APE for an explanatory variable that is included in a model in quadratic form. Unlike in linear models, the partial effect of such a variable depends on the value of the explanatory variable.

According to Chapter 15 of Cameron and Trivedi (2005), the probability that individual $i$ chooses the $j$th alternative (among m choices) is:

$$P_{i,j}=\frac{e^{X_i'\beta_j+z_i'\gamma_j+z_i^{2\prime}\lambda_j}}{\sum_{l=1}^{m} e^{X_i'\beta_l+z_i'\gamma_l+z_i^{2\prime}\lambda_l}}$$

where $z$ is an explanatory variable in quadratic form. In our paper, $z=age$ and $m=4$. Partial differentiation yields the following expression for the partial effect of $z_i$ with respect to alternative $j$, from which the APE is straightforwardly obtained:

$$\frac{\partial P_{i,j}}{\partial z_i}=P_{i,j}\{(\gamma_j+2z_i\lambda_j)-\sum_{l=1}^{m}P_{i,l}(\gamma_l+2z_i\lambda_l)\}$$

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