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THE RESIDENCY DECISION OF ELDERLY INDONESIANS: A NESTED LOGIT ANALYSIS*

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This paper is the first study of which the author is aware that examines elderly Indonesians' residency decisions. The 1993 Indonesian Family Life Survey provides detailed data on the living children of a sample of elderly individuals. This allows a nested logit to be estimated, which pays due respect to the role of children's characteristics in determining the residency outcome. The estimated [illegible]

tions to the literature. Almost all previous studies of residency in other countries, largely because of data limitations, have emphasized the role of the elderly parent. Detailed data have been available on the elderly individuals, but only limited information on their offspring. The residency decision thus has been modeled most often as determined by parental charpredicted earnings figures and other explanatory variables are related to the residency decision via the nested logit. In addition to permitting the construction of earnings figures for children for whom earnings were not reported, the use of estimated earnings figures also circumvents the likely endogeneity of actual earnings.

The results from the nested logit indicate that children's and parents' demographic characteristics play an important role in the residency decision. Parents who are not part of a couple and parents who have a physical disability are more likely to live with a child. Unmarried and younger children are more likely to live in the same household as a parent. Parents' incomes have no effect on the probability of coresidency. Parents with children who, on average, have higher incomes are less likely, however, to live with a child, but this effect is quantitatively small. Coresidency rates, other things being equal, are higher in urban than in rural areas

Both Martin (1989) and DaVanzo and Chan (1994) mentioned the need for more extensive data on the younger generation.

The work most closely related to this study is Wolf and Soldo (1988). They used data on all surviving children of a sample of elderly women in the United States to model the residency decision within a multinomial logit framework. As mentioned above, the multinomial logit imposes the assumption of the irrelevance of independent alternatives. This constrains the response elasticities to be equal across choices. If this assumption is applied inappropriately, the resultant estimates will be biased; I discuss the assumption in greater detail below. The nested logit gives the researcher the opportunity to test the appropriateness of the assumption. In contrast to this study, Wolf and Soldo were unable to control for the children's earnings potential. The observable children's characteristics were limited to the age/sex composition of the sib-

Consider an elderly individual who must decide whether she will live on her own or with one of her n children: child[1], child[2],..., child[n]. Allow V_{ji} to denote the utility associated with the jth choice, where j ranges from 0 for living alone to n. The utility obtained from living alone will depend on the characteristics of the elderly individual. Hence we can write

$$V_{i0} = \alpha_0 + \alpha_1 Y_i + \varepsilon_i, \quad (1)$$

where V_{i0} is the indirect utility obtained from living alone, Y_i is a vector of parental characteristics, and ε_i is a random error term.

The utility associated with living with each of the children will be a function of the children's characteristics. Hence

$$V_{ij} = \beta_0 + \beta_1 X_{ij} + \varepsilon_i, \quad (2)$$

where V_{ij} represents the indirect utility obtained from living with child j and X_{ij} is a vector of characteristics of the jth child of parent i.

Because the children are defined arbitrarily as child[1], child[2], … , child[n], the β coefficients are constrained to be equal across all children. The nested logit formulation can accommodate variables that reflect the characteristics of the "chooser" only if their impact is allowed to vary across options. Hence it is not possible to include the parent's charac-

equals 1 if the child is male and the parent is male. I included various interaction terms and found them to be insignificant; so they are not included in the results reported here.

The residency decision involves a comparison of the utility obtained from each option. Hence

$$P_{ij} = \text{pr}(V_{ij} > V_{ik}) \text{ for all } j \neq k, \quad (3)$$

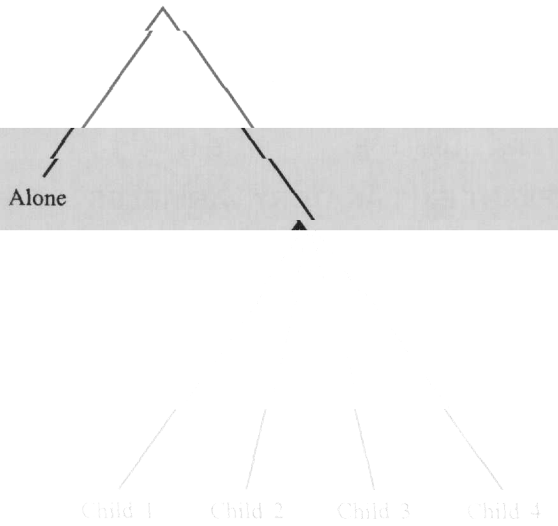
where P_{ij} is the probability of parent i making choice j. If we assume that the ε values are distributed according to the extreme value distribution, then the model can be estimated with a nested logit framework. The nested logit is a less restrictive version of the multinomial logit model: It selectively relaxes the restrictive assumption of the independence of ir-

oduction (Hoffman and Duncan 1988). One might, however, expect a greater impact on more similar alternatives. In regard to the residency choice, for instance, one might expect that having an extra child might decrease the predicted probability of living with each of the other children more than it would decrease the probability of living alone. This possibility is ruled out in a multinomial framework; for this reason I estimated a nested logit. The advantage of estimating the nested logit is that it allows one to test the appropriateness of this restriction.

The nested logit groups similar choices and (as stated above) selectively relaxes the IIA assumption. The natural hierarchical structure in the case of the residency decision is to group the choice of children, as shown in Figure 1. Note that the nested logit does not impose a sequential decision-making process. That is, it does not impose the unrealistic condition that an elderly individual first decides whether or not to live alone and only then, having decided to live with a

ture imposed is the grouping of the error terms in such a way that the IIA assumption is relaxed selectively. (For a longer discussion of nested logit models, see McFadden 1984.)

FIGURE 1. HIERARCHICAL FRAMEWORK FOR RESIDENCY DECISION



In theory, estimating a multinomial probit is another methodological option. Multinomial probits are less restrictive than multinomial logits and even less restrictive than nested logits because they completely relax the IIA assumption. These models, however, are computationally very in-

with child j, given that she is living with one of the children, is calculated according to the following equation:

$$P(\text{child } j \mid \text{with}) = \frac{\exp(V_{ij})}{\sum_{k=1}^{n} \exp(V_{ik})}. \quad (4)$$

Yet the way in which the probability of living alone is calculated, as opposed to living with one of the children, differs under the nested logit method, as follows:

$$P(\text{alone}) = \frac{\exp(V_{i0})}{\exp(V_{i0}) + \exp(\lambda * I_i)}, \quad (5)$$

where

$$I_i = \ln(\sum_{k=1}^{n} \exp(V_{ik})). \quad (6)$$

I_i is termed the "inclusive utility value." If λ = 1, then the model collapses to the standard multinomial logit. When λ is

sumption across nodes of the decision tree. The IIA assumption is imposed within the nested choices but is relaxed across them.

The probability of living with each child is thus calculated as follows:

$$P(\text{child } j) = P(\text{child } j|\text{with})(\,(1-P(\text{alone})). \qquad (7)$$

These probabilities are fed into the likelihood function and the parameters are estimated with standard maximum-likelihood techniques.[2] The parameter λ should lie between 0 and 1; a test of $\lambda = 1$ is a test of the suitability of the multinomial logit's IIA assumption.

tomary to reside with the youngest daughter. Hence the child's ordinal birth number and age are possible determinants of coresidency. As mentioned above, children's preferperson's age and gender: Wolf and Soldo (1988) suggested that elderly males may have a greater need for domestic services, whereas elderly females may be in greater need of financial services. Financial services can be provided more easily from outside the home than domestic services and care. Hence, in addition to tastes for companionship, gender may affect coresidency via the demand for domestic services. On this basis one would expect to see more single males than single females coresiding.

The affordability of living alone will also be a function of living costs. These costs are significantly higher in cities, and a number of studies have found that coresidence is more common in urban areas than in rural areas (Kim and Choe 1992; Martin 1988). This finding contrasts with the prediction that households in rural areas will reflect a more traditional lifestyle in which coresidence is more prevalent. DaVanzo and Chan (1994) explicitly included a measure of housing costs in their analysis and found that it is related positively to coresidence; inclusion of this measure reduced the positive effect of urban residence on coresidency. In this study I make no attempt to control for housing costs; thus rural/urban designation will serve as a proxy for these costs.

Earnings are potentially endogenous to the residency decision: Coresiding parents may be less likely to work than if they lived alone. Children with coresiding parents may either increase their working hours to be able to support their parent or decrease them to spend more time with the parent in the home. In the analysis below, I take the endogeneity of earnings into account by the calculation of predicted earnings figures.

Number of Children

Previous studies included a measure of the number of children as an explanatory variable: This reflects the maximum number of opportunities for coresidency. As I explain below, the nested logit approach implicitly incorporates the number of children in the likelihood function.

The above discussions can be summarized in the following list of conjectures:

1. Elderly couples may be less likely to coreside than elderly individuals who are single, because of a lesser need for companionship.
2. Single elderly men may be more likely to coreside than single elderly females because of a greater need for domestic services that can be provided by children.
3. Parents with a disability may be more likely to coreside.
4. Older parents may be more likely to coreside because of (a) a greater need for care in the home and (b) more traditional tastes.
5. Less highly educated parents may be more likely to coreside because of more traditional tastes.
6. Parents with a higher income may be less likely to coreside because of the increased ability to purchase "privacy."
7. Coresidency may be higher in urban areas because of higher living costs.
8. Children's earnings potential may affect the coresidency decision in the following ways: (a) Positively: Children with higher earnings can offer a higher level of financial benefits; (b) Negatively: children with higher earnings can afford to support their parents outside the family home.
9. Married and better-educated children may be less likely to coreside.
10. Social norms may dictate parents' preference for coresiding with younger children and for living with daughters.
11. The more children an elderly individual has, the greater the probability that he or she will live with a child.

Timing of the Residency Decision

A difficulty encountered in modeling the residency decision with cross-sectional data is the lack of information on the timing of the decision. Such timing is relevant in trying to assess who is living with whom. For instance, it is difficult to interpret a finding that parents are more likely to live with younger children. Do elderly parents move in with younger children, or are younger children still living with their parents but may move out later? We may not want to classify the latter situation as true "coresidence." Information on the ownership of the household home cannot clarify this issue entirely. Some children will remain in the parental home until and beyond their parents' death; thus at some stage they will be "coresiding" in the sense that their parents are dependent on them, even though the home officially belongs to the parents.

Another way of approaching this issue is to use the information on the household head. In the IFLS, however, the household head is defined as the person "who is responsible for satisfying the daily necessities of the household or a person who is assigned/regarded as the head of the household." Custom most likely dictates that the oldest male be accorded the position of household head regardless of earnings. The great majority of the elderly in the IFLS sample are named as household head.

In interpreting the results reported below, one must bear in mind the lack of information on the dynamics of household formation.

DATA

The IFLS, a general household survey, provides data on a random sample of 7,224 households across the Indonesian provinces in Java, Sumatra, Bali, West Nusa Tenggara, Kalimantan, and Sulawesi.[4] In this study I focus on Indonesians age 60 or over (average life expectancy in Indonesia is 63; World Bank 1995). These 7,224 households contain 2,625 individuals in this age category, or 7.94% of all household members surveyed. This figure translates to 7.03% when weighted by the appropriate sampling weights.

Information was gathered on all household members; more detailed information was gathered on selected house-

4. Sampling weights are provided to weight the data so that it is representative of the population in the 13 provinces and to correct for the within-household sampling of respondents.

holders. Those who were selected for more detailed questioning are called *respondents*. Each household contains a maximum of four respondents. These individuals were chosen specifically so that a relatively large number of elderly persons were surveyed; there are approximately 1,900 elderly IFLS respondents. The age, gender, marital status, and educational attainment of all living children of these elderly individuals are known.

In the preceding discussion I considered the coresidency decision of an elderly individual. Many elderly persons, however, are part of a couple; it is necessary to find some way of dealing with this fact in the analysis. Here I treat couples as a decision-making unit, much like individuals. Their residency decision, however, is allowed to differ from that of individuals by the inclusion of dummy variables that reflect whether an elderly decision-making unit is a couple, an elderly male, or an elderly female.

Treating couples as a unit also necessitates decisions

TABLE 1. LIVING ARRANGEMENTS OF THE INDONESIAN ELDERLY

Living Arrangement ($N = 2{,}625$)	Percentage of Elderly
Living With Adult Children	62.51
Living With Spouse and Others (Not Children)	7.60
Living With Others (Not Spouse or Children)	9.02
Living With Spouse Only	13.67
Living Alone	7.03

or other family members.[5] Of the 37.49% who do not live with children, only 4.5% have no children. Hence, approximately 33% of elderly Indonesians have children but do not live with them.

Estimating Earnings Potential

In the first stage of the estimation procedure I estimate an

$$\log(Y_i) = \beta_0 + \beta_1 AGE_i + \beta_2 AGE^2_i + \beta_3 EDUCATION_i + \beta_4 RURAL_i + \beta_5 PROVINCE_i + \beta_7 GROSSINC_i + \theta\lambda_i + \varepsilon_i \quad (8)$$

$$WORK = \alpha_0 + \alpha_1 MARRIED + \alpha_2 UNDER10 + \alpha_3 X_i + e_i \quad (9)$$

where $\log(Y_i)$ is the log of annual individual earnings in millions of rupiah (defined to include wage income and business income), *AGE* is the individual's age, *EDUCATION* is a vector of dummy variables reflecting educational attainment, *PROVINCE* is a vector of dummy variables for province, *RURAL* reflects the household [illegible]

By omitting the inverse mills ratio in Eq. (10), I obtain an estimate of earnings that is not conditional on work being the individual's main activity. Unfortunately it is not known where non-coresident children live; thus I calculate predicted earnings for *all* children (not only non-coresiding children) as follows:

$$\log(\hat{Y})_i = \hat{\beta}_0 + \hat{\beta}_1 AGE_i + \hat{\beta}_2 AGE^2{}_i + \hat{\beta}_3 EDUCATION_i \quad (11)$$

TABLE 2. NESTED LOGIT RESULTS

Variable	Coefficient	*t* Statistic
Constant	−3.51	−1.05
Elderly Individual's Characteristics		
Age	0.0001	0.00
Log predicted earnings	−0.117	−0.61
Average of children's predicted earnings	0.132	2.97
Couple	0.486	3.02
Male	0.393	1.33
Disability	−0.506	−2.20
Primary education	0.003	0.02
High school education	−0.179	−0.62
Tertiary education	−1.423	−1.66
Rural abode	0.717	5.65
Child's Characteristics		
Age	−0.667	−7.00
[illegible]	[illegible]	[illegible]

Note: Dependent variable = 1 for chosen residency option, 0 otherwise.

efficients on the children's characteristics as the marginal effect on the utility associated with living with that child. Because utility is an ordinal measure, the absolute magnitudes of the coefficients do not have an intuitive interpretation. Comparisons of the magnitudes of the coefficients on different variables signify the relative importance of the variable; in some instances discussed below, I ran simulations to furof an extra living arrangement option in the likelihood function thus implicitly incorporates the effect of an additional child on the probability of living alone.

Earnings variables. The nested logit results show that parents' earnings capacities are not a significant determinant of coresidency. The coefficient on parents' income is negative; this suggests that, on average, higher earnings capacity decreases the probability of living alone. Its effect, however, is statistically insignificant ($p = 0.54$). This finding is at odds with DaVanzo and Chan's finding for Malaysia, whereby coresidency was a positive function of a parent's ability to afford to live alone. The result reported here, however, is consistent with Rudkin's (1994) finding that coresidency is a desirable state for elderly Indonesians. If this is the case, then one would not expect higher income to be correlated with lower coresidency rates. This finding

The literature contains another, alternative reason for the higher rates of coresidency in urban areas in many Asian countries: congestion and the shortage of housing in urban centers. In rural areas, housing is not in short supply; hence it is easier to find housing. and living separately but close enough to maintain regular contact is a viable option. In cities this is much more difficult. People's lives also are generally busier, and traffic congestion makes it more difficult to move around. As a result, people may opt to live together in cities as the only way to ensure regular contact and the exchange of domestic services between family members. Young people's out-migration from rural areas is another possible explanation for lower rural coresidency rates (Andrews et al. 1986).

As mentioned above, the average of children's earnings potential has a significant impact on coresidency. The higher

DaVanzo and Chan (1994) similarly found no gender differences in Malaysia.

Having a disability was hypothesized to increase one's demand for domestic care. Accordingly a disability (measured by difficulty in standing from a sitting position, going to the bathroom, and/or dressing oneself) significantly increases the likelihood of coresidency. A parent who reports difficulty in any of the above tasks is 9.0 percentage points more likely to live with his or her adult children than a parent without such a disability. One also would expect older parents to have a greater need for domestic care. I hypothesized that this point, combined with their "traditional" values, would make them more likely to coreside. The parent's age, however, is statistically insignificant.

I also conjectured that a parent with higher educational attainment might have been more exposed to a modern lifestyle and thus would be less likely to coreside. The

on average, have high earnings are more likely to live by themselves, but this effect is quantitatively small. Therefore, in regard to forecasting future patterns of coresidency in Indonesia, I find very little evidence to suggest that increases in parents' and children's incomes would cause a large movement away from the traditional family structure.

Income is the most obvious indicator that changes with development. Other variables also change, however. Health improvements, for instance, may have consequences for coresidency. The results reported here suggest that increased survival of spouses, and hence a greater proportion of

APPENDIX. DEFINITIONS OF VARIABLES

Omitted category variables are shown in italics.

Parental Characteristics

Couple = 1 if the elderly decision maker is a couple, 0 otherwise.

Male = 1 if the elderly decision maker is a single male, 0 otherwise.

Female = 1 if the elderly decision maker is a single female, 0 otherwise.

Age = age in years of the individual (of the wife if a couple).

Log(Predicted Earnings) = log of predicted from sitting position, or going to the bathroom.

Primary School = 1 if the highest educational institution attended was primary school, 0 otherwise (of husband if a couple)

High School is defined as above, but for high school.

Tertiary is defined as above, but for tertiary education.

No Schooling = 1 if the individual/husband had never received any formal schooling, 0 otherwise.

Rural = 1 if the elderly individual/couple lives in an urban area, 0 otherwise.

Children's Characteristics

Male = 1 if the child is male, 0 otherwise.

Female = 1 if the child is female, 0 otherwise.

Age = child's age in years.

Ordinal Birth Number = 1 if first-born child, 2 if second-born, and so on.

Log(Predicted Earnings) = log of predicted rupiah earnings over the past 12 months.

Married = 1 if the child is married, 0 otherwise.

Primary School, High School, Tertiary School, *No Schooling*: defined as above.

Additional Variables From the Earnings Equations

Gross Income = 1 if the individual reported gross income rather than net income, 0 otherwise.

Under10 = the number of children the individual has under age 10.

The educational categories correspond to the highest educational institution attended, and are self-explanatory (No Schooling was the omitted category).

TABLE A1. SUMMARY STATISTICS OF VARIABLES

Variable	Mean	*SD*	Min.	Max.
Residency Choice (*N* = 6,602)	0.260	0.439	0	1
Parental Characteristics (*N* = 1,348)				
Age	61.82	9.14	34	95
Log (predicted earnings)	12.30	0.56	10.03	14.52
Log (average of children's predicted earnings)	13.91	1.49	1.64	15.77
Couple	0.583	0.493	0	1
Male	0.065	0.247	0	1
Children	4.447	2.471	1	13
Disability	0.079	0.270	0	1
Primary school	0.433	0.496	0	1
High school	0.076	0.265	0	1
Tertiary education	0.012	0.108	0	1
Rural area	0.580	0.494	0	1
Child's Characteristics (*N* = 5,254)				
Age	33.1	8.55	19	70
Ordinal birth number	3.30	2.13	1	13
Log (predicted earnings)	14.2	0.758	12.6	16.2
Male	0.507	0.500	0	1
Married	0.773	0.419	0	1
Primary school	0.464	0.499	0	1
High school	0.352	0.478	0	1
Tertiary education	0.086	0.281	0	1

Note: All log earnings figures are annual measures.

TABLE A2. EARNINGS EQUATIONS

	Female		Male	
Variables	β	t	β	t
Constant	11.81	40.46	12.89	75.14
Age	0.064	5.55	0.062	8.43
Age Squared	–0.0007	–6.01	–0.007	–9.29
Primary Education (SD)	0.332	4.84	0.314	6.63
Junior High (SMP)	0.676	5.82	0.727	11.07
Vocational SMP	0.948	4.05	0.793	7.45
Senior High (SMA)	1.316	5.82	1.030	13.67
Vocational SMA	1.627	4.05	1.144	16.73
Junior College (D1, D2)	2.166	9.29	1.997	8.30
College (D3)	1.982	13.70	1.582	11.82
University	1.963	8.70	1.588	16.10
Gross Income	0.528	7.62	0.0578	1.82
Rural	–0.589	9.30	–0.498	–14.39
λ	–0.085	0.41	–0.990	110.0
Probit				
Constant	1.51	4.91	0.185	0.57
Married	–1.01	–11.20	0.638	9.77
Under10	0.017	0.60	0.129	5.05
Age	0.029	2.54	0.054	5.59
Age squared	–0.003	–2.79	–0.0006	–5.86
Primary education (SD)	–0.021	–0.30	0.110	1.74
Junior high (SMP)	0.078	0.65	–0.0186	–0.17
Vocational SMP	0.331	1.30	0.156	0.89
Senior high (SMA)	0.370	2.10	0.073	0.29
Vocational SMA	0.809	5.15	0.187	1.10
Junior college (D1, D2)	1.220	2.82	–0.498	–0.67
College (D3)	0.764	1.66	0.335	0.31
University	0.467	1.55	–0.330	–1.02
Rural	–0.747	–11.21	–0.358	–5.29
N	3,087		4,548	

Notes: Dependent variable is log(individual earnings). "No schooling" is the omitted educational dummy variable. Provincial dummy variables were also included in both stages of the estimation.

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