Sequential Modeling of Parity Progression Ratio in Sub-Saharan Africa*

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1 Sequential Modeling of Parity Progression

Since the actual family size decision process requires successful completion of the prior level (parity) for passage into the subsequent one. a sequential decision model accurately reflects the real decision process (Yamaguchi & Ferguson. 1995; Upchurch. Lillard. & Panis. 2002). The model of family size decision used in this paper specifies the propensity of progressing to successively higher parity levels. conditional on having completed the next lower parity – a discrete sequential choice model. Apart from measured covariates. the sequential probabilities may depend on individual and decision varying covariates and unobserved heterogeneity in the propensity to continue to the next parity.

As the reasons to have a second child may differ from those to have a third child. we allow the effects on the transition propensities to vary between these two transitions (first to second. second to third). Thus. there are up to two sequential choices of whether to continue to the next level ($s = 1.2$). each conditional on having continued to the previous level. Here. $s = 1$ corresponds to transition from 1 to 2 children. and $s = 2$ corresponds to transition from 2 to 3 children.

We use a multilevel sequential probit model of individual-family (mother) choice. Family i progresses from having completed parity s to complete the

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next parity $s+1$ if its propensity to continue is positive. $I_s > 0$. The propensity of mother (family) i progressing is thus determined by the probit index function

$$I_{i_{(s)}} = \alpha_{0s} + \alpha'_{1s} X_{i(s)} + \upsilon_i + \theta_s \tag{1}$$

for $s = 1.2$. where X_s is a vector of exogenous covariates affecting family size decisions. α_{0s} and α_{1s} are decision specific intercepts and coefficients. respectively. υ_i is a residual term capturing family level unobserved heterogeneity (shared-frailty) that may affect all levels of decision on family size. and θ_s is a decision specific stochastic element (normalized to $\theta_s = 1$. for all s). Each is assumed to be normally distributed:

$$\upsilon \tilde{} N\left(0.\sigma_\upsilon^2\right). \quad \theta_s \tilde{} N\left(0.1\right).$$

The model also allows parameters to vary across decisions (hence the s subscript on the parameter vector α). In other words. we will estimate two intercepts and two sets of coefficient estimates. one set for transition to second child. and another set for transition from second to third.

Table 4 about here

In Table 4. we report results from fitting nested sequential probit models in which we allow the effects to vary across decision levels. The results in model M0 (when no covariates have been included) show that the most common transition is from single parity (one child) to parity 2 (2 children). We also note that women with higher IQ (in M1) have lower propensities to increase family size from two to three. However. any maternal IQ effect disappears once more variables are entered (in M4 and M5). Hispanic women have higher propensities of increasing family size from two to three (in M2). whereas Black women have lower propensities to have a second child. but higher propensities to have a third child (in M2). The higher propensity of having a third child disappears when mother's age at the birth of first child is entered. Women who were older at the birth of their first child (in M3) have lower propensities to increase family size. whereas those with higher incomes (in M4) have higher propensities. Finally. women with no college education (in M5) have a lower propensity to have a third child compared to those with some college. when all variables are included in the model.

Fertility studies generally find negative (or no) relationships between socioeconomic status indicators and family size in Western countries (e.g. Lawson and Mace. 2010). Our analyses. although restricted to families with at

most three children. show some positive effects of income and education when we control for maternal IQ. maternal race. and maternal age of first child. These results partly support findings of Weeden et al. (2006) who reported that male income (or income of spouse of female) may have a positive effect on family size.

2 Preliminary Results

Table 1: Estimated effects on log-odds of transition to various parities across covariates: Eritrea

		Transition to parity						
Coviate	**Levels**	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
Moth Educ	Primary	0.374	-0.097	-0.078	-0.125	-0.021	-0.294	0.280
	Secondary+	0.793	-0.099	-0.414	-0.284	-0.507	-0.585	-0.392
Residence	Rural	0.196	0.447	0.339	0.114	-0.027	-0.368	0.144
Birth Cohort	1971-75	1.626	1.810	1.721	*20.181*	*Ref*	*Ref*	-
	1966-70	2.855	3.369	3.359	*21.252*	*1.456*	*20.884*	*Ref*
	1961-65	3.699	4.550	4.417	*22.464*	*2.413*	*21.686*	*0.782*
	1956-60	4.301	5.274	5.216	*23.346*	*3.291*	*22.575*	*2.032*
	1951-55	4.079	5.851	5.448	*23.841*	*4.226*	*22.951*	*2.569*
	1946-50	5.080	5.486	5.533	*23.777*	*4.065*	*23.342*	*2.831*
AgeMar	20-24	-1.336	-1.280	-0.863	-0.891	-0.539	-0.959	-0.684
	25+	-2.520	-2.547	-1.988	-1.475	-1.644	-1.688	-1.957

Table 2: Estimated effects on log-odds of transition to various parities across covariates: Ghana

		Transition to parity						
Coviate	**Levels**	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
Moth Educ	Primary	0.132	-0.054	-0.406	-0.022	-0.022	0.021	-0.175
	Secondary+	-0.179	-0.566	-0.936	-0.624	-0.624	-0.716	-0.385
Residence	Rural	0.570	0.446	0.524	0.692	0.692	0.438	0.667
Birth Cohort	1971-75	1.632	2.487	*19.990*	*Ref*	*Ref*	*Ref*	-
	1966-70	3.495	4.194	*21.611*	*0.747*	*0.747*	*20.740*	*Ref*
	1961-65	4.389	5.620	*23.200*	*2.078*	*2.078*	*21.350*	*1.050*
	1956-60	5.367	6.347	*24.205*	*2.909*	*2.909*	*22.440*	*1.876*
	1951-55	6.410	6.716	*24.547*	*3.633*	*3.633*	*23.078*	*2.765*
	1946-50	5.610	7.129	*24.971*	*3.814*	*3.814*	*23.042*	*3.108*
AgeMar	20-24	-2.021	-1.255	-1.287	-0.953	-0.953	-0.737	-0.749
	25+	-3.840	-2.677	-2.399	-1.736	-1.736	-1.122	-1.717

Table 3: Estimated effects on log-odds of transition to various parities across covariates: Kenya (

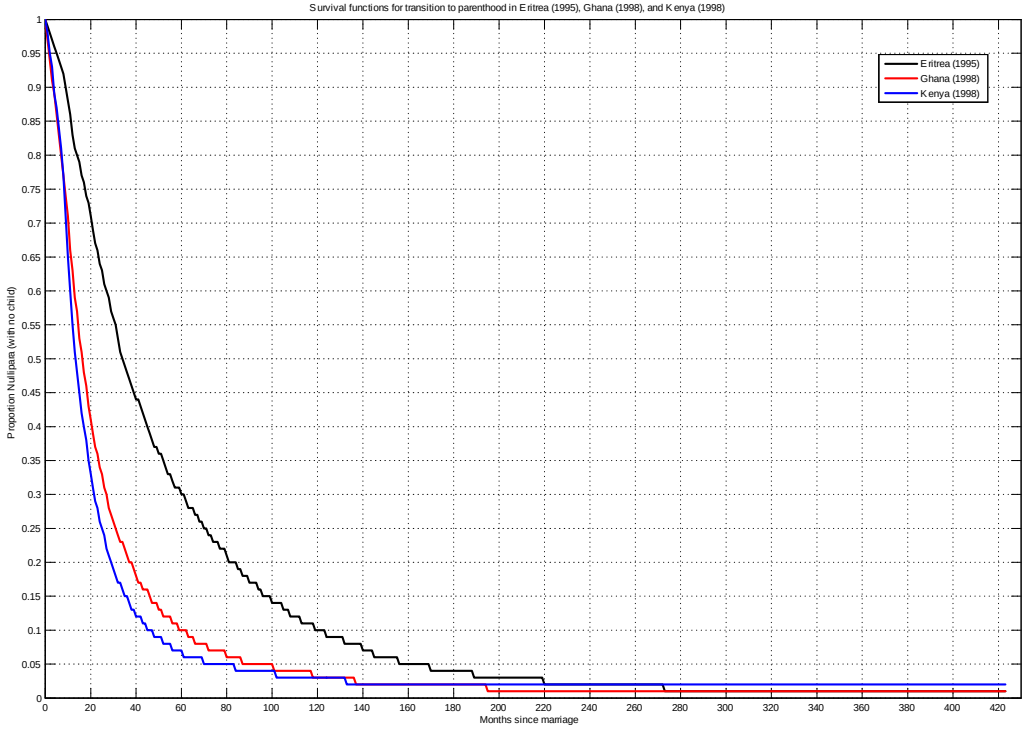
		Transition to parity						
Coviate	**Levels**	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
Moth Educ	Primary	0.774	-0.082	-0.088	-0.191	-0.160	-0.323	-0.321
	Secondary+	0.902	-0.464	-0.550	-0.887	-0.548	-0.626	-1.062
Residence	Rural	0.671	0.462	0.697	1.012	1.197	0.744	0.362
Birth Cohort	1971-75	1.845	1.663	3.499	*19.456*	*Ref*	*Ref*	*Ref*
	1966-70	3.677	3.805	4.931	*21.275*	*0.638*	*0.824*	*20.522*
	1961-65	4.482	5.457	6.527	*22.463*	*1.668*	*1.778*	*21.413*
	1956-60	3.995	5.709	7.336	*23.261*	*2.543*	*2.733*	*22.261*
	1951-55	4.636	5.857	7.898	*23.483*	*3.014*	*3.584*	*22.892*
	1946-50	4.294	5.539	7.815	*24.147*	*3.696*	*3.848*	*23.239*
AgeMar	20-24	-1.712	-1.563	-1.536	-1.028	-1.010	-1.061	-0.493
	25+	-3.204	-3.048	-2.352	-2.428	-1.608	-1.550	-3.910

Table 4: Estimated effects on log-odds of **transition to various parities** across covariates and

		Transition to parity 1			Transition to parity 2			Transitio
Coviate	**Levels**	**Eritrea**	**Ghana**	**Kenya**	**Eritrea**	**Ghana**	**Kenya**	**Eritrea**
Moth Educ	Primary	0.374	0.132	0.774	-0.097	-0.054	-0.082	-0.078
	Secondary+	0.793	-0.179	0.902	-0.099	-0.566	-0.464	-0.414
Residence	Rural	0.196	0.570	0.671	0.447	0.446	0.462	0.339
Age at Int	20-24	1.626	1.632	1.845	1.810	2.487	1.663	1.721
	25-29	2.855	3.495	3.677	3.369	4.194	3.805	3.359
	30-34	3.699	4.389	4.482	4.550	5.620	5.457	4.417
	35-39	4.301	5.367	3.995	5.274	6.347	5.709	5.216
	40-44	4.079	6.410	4.636	5.851	6.716	5.857	5.448
	45-49	5.080	5.610	4.294	5.486	7.129	5.539	5.533
AgeMar	20-24	-1.336	-2.021	-1.712	-1.280	-1.255	-1.563	-0.863
	25+	-2.520	-3.840	-3.204	-2.547	-2.677	-3.048	-1.988

Table 5: Estimated effects on log-odds of **transition parities** across covariates and countries

		Transition to parity 1			Transition to parity 2		
Coviate	**Levels**	**Eritrea**	**Ghana**	**Kenya**	**Eritrea**	**Ghana**	**Kenya**
Highest Educ Level	*Primary*	0.374	0.132	0.774	-0.097	-0.054	-0.082
	Secondary+	0.793	-0.179	0.902	-0.099	-0.566	-0.464
Residence	*Rural*	0.196	0.570	0.671	0.447	0.446	0.462
Age at Interview	*20-24*	1.626	1.632	1.845	1.810	2.487	1.663
	25-29	2.855	3.495	3.677	3.369	4.194	3.805
	30-34	3.699	4.389	4.482	4.550	5.620	5.457
	35-39	4.301	5.367	3.995	5.274	6.347	5.709
	40-44	4.079	6.410	4.636	5.851	6.716	5.857
	45-49	5.080	5.610	4.294	5.486	7.129	5.539
Age at Marriage	*20-24*	-1.336	-2.021	-1.712	-1.280	-1.255	-1.563
	25+	-2.520	-3.840	-3.204	-2.547	-2.677	-3.048


Survival functions for transition to parenthood in Eritrea (1995), Ghana (1998), and Kenya (1998)
Eritrea (1995)
Ghana (1998)
Kenya (1998)
Proportion Nulliparas (with no child)
Months since marriage
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420