An Econometric Analysis of the Birth Process by Racial/Ethnic Groups

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Abstract: This paper studies the birth process with seven endogenous variables: four birth inputs [maternal smoking (S), maternal drinking (D), first trimester prenatal care (PC), and maternal weight gain (WG)], and three birth outputs [gestational age (G), birth length (BL), and birth weight (BW)], and twenty-four exogenous variables. The data are taken from the NLSY. Separate analyses are performed on five racial/ethnic groups: Main Whites, Supplemental Whites, Blacks, Hispanics, and Native Americans. Across all groups, we find sizeable correlation between the disturbances in the four input and three output equations and among output disturbances.

Keywords: BAYESIAN; BIRTH LENGTH; BIRTH WEIGHT; DRINKING; GESTATION; NLSY; PRENATAL CARE; SIMULTANEITY; SMOKING; WEIGHT GAIN.

1. INTRODUCTION

In this paper we study the birth process with seven endogenous variables: four birth inputs [maternal smoking (S), maternal drinking (D), first trimester prenatal care (PC), and maternal weight gain (WG)], and three birth outputs [gestational age (G), birth length (BL), and birth weight (BW)]. The endogeneity of inputs in the three-output birth production function is the important distinguishing statistical feature between our model [see the seminal work of Grossman (1972)] and those of other social scientists and epidemiologists.

2. DATA

Our data are drawn from the National Longitudinal Survey of Youth (NLSY) merged child-mother file for 1994. Where necessary, additional variables are constructed using the data from the NLSY main file for 1994. The price indices on cigarette, alcohol, medical services and food are obtained from the consumer price index database of the Bureau of Labor Statistics.

In this paper we analyze only singleton first-born live births. There were 3,648 live singleton first births to NLSY women between 1979 and 1994. We dropped 221 births to women in the military and 28 to women no longer living in the U.S. This left 3,399 observations for our target sample. Missing observations further reduced our sample to 1,962 observations with complete data [Li and Poirier (2000, Table 1)].

Our choice of the twenty-four exogenous (conditioning) variables as shown in Table 1 is guided by the existing literature (x_1 is the intercept term). Variables x_2 - x_6 cover basic physical characteristics (the gender of the infant, the age and size of the mother) which we expect to be very important in the birth output equations. Variables x_7 - x_{12} capture regional and temporal effects plus the intelligence and family income of the mother. Variables x_{13} - x_{25} capture health insurance status and a variety of socioeconomic measures of the mother's family background. Variables x_7 - x_{25} are risk factors that causally are quite far removed from the biological event of low BW. We expect these variables to be important in the input equations, but not in the biologically based output equations. The details on the variable construction are provided in Li and Poirier (2000) Appendices A.1-A.2.

Table 1. *A List of Exogenous Variables*

x_2	Male Child	x_{14}	Missing health insurance availability
x_3	Mother's age - 23yrs.	x_{15}	Number of adults in household - 2
x_4	Body mass index - 24	x_{16}	Number of quarters worked last year - 3
x_5	Maternal height - 162cm	x_{17}	Number of maternal siblings - 4
x_6	Maternal weight - 63kg	x_{18}	Grandmother's education - 12yrs.
x_7	Northeast	x_{19}	Not on time in school at age 14
x_8	South	x_{20}	Non-urban at age 14
x_9	West	x_{21}	No employed males in household at age 14
x_{10}	Calendar time - (19)85	x_{22}	Cigarette price index
x_{11}	AFQT score/mean of same age - 1	x_{23}	Alcohol price index
x_{12}	Household income in $1000 - 25	x_{24}	Medical services price index
x_{13}	No health insurance available	x_{25}	Food price index

3. MODELING

Following the strategy outlined in Poirier (1995, Chapter 10), we choose a highly over-identified specification for our maintained hypothesis H_*, and a less restricted specification H_A as an alternative hypothesis that we expect will not lead to rejecting H_*. Our prior reflects this viewpoint. In Section 4.1 we test these overidentifying restrictions.

Consider a sample of T independent singleton first-born live births indexed by the subscript i. Let $[\mathrm{S}_i^*, \mathrm{D}_i^*, \mathrm{PC}_i^*]'$ $(i = 1, 2, ..., T)$ denote latent variables underlying the binary birth inputs $[\mathrm{S}_i, \mathrm{D}_i, \mathrm{PC}_i]' = [1(\mathrm{S}_i^*), 1(\mathrm{D}_i^*), 1(\mathrm{PC}_i^*)]'$ $(i = 1, 2, ..., T)$, where $1(\cdot)$ denotes an indicator function which equals unity if the argument is positive and equals zero otherwise. For estimation, we partition the endogenous variables into inputs z_{i1} and outputs z_{i2}: $z_{i1}^* = [\mathrm{S}_i^*, \mathrm{D}_i^*, \mathrm{PC}_i^*, \mathrm{WG}_i]'$, $z_{i1} = [\mathrm{S}_i, \mathrm{D}_i, \mathrm{PC}_i, \mathrm{WG}_i]'$, $z_{i2} = [\mathrm{G}_i, \mathrm{BL}_i, \mathrm{BW}_i]'$ $(i = 1, 2, ..., T)$. Let x_i $(i = 1, 2, ..., T)$ denote $K \times 1$ vectors of exogenous variables.

Suppose the four inputs are generated from the following specification

$$z_{i1}^* = \Delta_1' x_i + \varepsilon_{i1}, \tag{1}$$

where $\Delta_1 = [\Delta_S, \Delta_D, \Delta_{PC}, \Delta_{WG}]$ is $K \times 4$. Also suppose the three birth outputs are related to $z_{i1} = [\text{S}_i, \text{D}_i, \text{PC}_i, \text{WG}_i]'$ as follows:

$$z_{i2}'\Gamma_2 = z_{i1}'\Gamma_1 + x_i'\Delta_2 + \varepsilon_{i2}', \tag{2}$$

where $\varepsilon_i = [\varepsilon_{i1}, \varepsilon_{i2}]'|x_i \sim$ i.i.d. $N_7(0_7, \Sigma)$ $(i = 1, 2, ..., T)$, Γ_2 is nonsingular,

$$\Gamma_1 = \begin{bmatrix} \gamma_{S,G} & \gamma_{S,BL} & \gamma_{S,BW} \\ \gamma_{D,G} & \gamma_{D,BL} & \gamma_{D,BW} \\ \gamma_{PC,G} & \gamma_{PC,BL} & \gamma_{PC,BW} \\ \gamma_{WG,G} & \gamma_{WG,BL} & \gamma_{WG,BW} \end{bmatrix} = \begin{bmatrix} \gamma_G & \gamma_{BL} & \gamma_{BW} \end{bmatrix}, \tag{3}$$

$$\Gamma_2 = \begin{bmatrix} 1 & -\gamma_{G,BL} & -\gamma_{G,BW} \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}, \tag{4}$$

$$\Delta_2 = \begin{bmatrix} \delta_G & \delta_{BL} & \delta_{BW} \\ \delta_{5,G} & \delta_{5,BL} & 0 \\ \delta_{6,G} & 0 & \delta_{6,BW} \\ \Delta_{*,G} & \Delta_{*,BL} & \Delta_{*,BW} \\ 0_{13} & 0_{13} & 0_{13} \end{bmatrix}, \tag{5}$$

where $\gamma_j = [\gamma_{S,j}, \gamma_{D,j}, \gamma_{PC,j}, \gamma_{WG,j}]'$, $\delta_j = [\delta_{1,j}, \delta_{2,j}, \delta_{3,j}, \delta_{4,j}]'$, $\Delta_{*,j} = [\delta_{7,j}, ..., \delta_{12,j}]'$, $(j =$ G, BL, BW), and

$$\Sigma = \begin{bmatrix} 1 & \sigma_{S,D} & \sigma_{S,PC} & \sigma_{S,WG} & \sigma_{S,G} & \sigma_{S,BL} & \sigma_{S,BW} \\ \sigma_{S,D} & 1 & \sigma_{D,PC} & \sigma_{D,WG} & \sigma_{D,G} & \sigma_{D,BL} & \sigma_{D,BW} \\ \sigma_{S,PC} & \sigma_{D,PC} & 1 & \sigma_{PC,WG} & \sigma_{PC,G} & \sigma_{PC,BL} & \sigma_{PC,BW} \\ \sigma_{S,WG} & \sigma_{D,WG} & \sigma_{PC,WG} & \sigma_{WG}^2 & \sigma_{WG,G} & \sigma_{WG,BL} & \sigma_{WG,BW} \\ \sigma_{S,G} & \sigma_{D,G} & \sigma_{PC,G} & \sigma_{WG,G} & \sigma_G^2 & \sigma_{G,BL} & \sigma_{G,BW} \\ \sigma_{S,BL} & \sigma_{D,BL} & \sigma_{PC,BL} & \sigma_{WG,BL} & \sigma_{G,BL} & \sigma_{BL}^2 & \sigma_{BL,BW} \\ \sigma_{S,BW} & \sigma_{D,BW} & \sigma_{PC,BW} & \sigma_{WG,BW} & \sigma_{G,BW} & \sigma_{BL,BW} & \sigma_{BW}^2 \end{bmatrix}. \tag{6}$$

The coefficients in $\Delta_{*,j}$ $(j =$ G, BL, BW) are set to zero under our maintained specification H_*.

Our prior is proper, but moderately diffuse. We use the same prior for all racial/ethnic groups. The estimation of our model extends the work by Chib and Greenberg (1998) and Li (1998), and is described in Li and Poirier (2000) Appendices A.3-A.4.

4. EMPIRICAL RESULTS

4.1. *Evidence of Structure*

We investigate whether our output equations reflect a biological structure in three related ways. Firstly, the logarithmic Bayes factor in favor of our maintained specification H_*: $\Delta_{*,G} = \Delta_{*,BL} = \Delta_{*,BW} = 0_6$ versus the alternative H_A: $\Delta_{*,G} \neq 0_6$ or $\Delta_{*,BL} \neq 0_6$ or $\Delta_{*,BW} \neq 0_6$ is overwhelming for all groups [Li and Poirier (2000, Table 10)]. Secondly, the predictive densities for all endogenous variables differ little across H_* and H_A [Li and Poirier (2000, Table 11)]. Thirdly, under H_A the six additional variables x_7 - x_{12} add relatively little to the three output equations [Li and Poirier (2000, Table 12)]. Because of these results, subsequent results are conditioned upon H_*.

4.2. *System Results*

Our treatment of simultaneity, in contrast to most of the biomedical literature, is a distinguishing feature of our model. While our window imposes triangularity, it does not impose a fully recursive specification. Table 2 contains the posterior means and standard deviations for the elements in the variance-covariance matrix under our default prior. The posterior results provide strong support for the model not being fully recursive.

Table 2. *Posterior Means (Standard Deviations) of Across-Equation Correlations and Variances in Σ Under H_**

	D*	PC*	WG	G	BL	BW
			Main White			
S*	.4118	−.0710	.0469	−.2195	.1649	.0721
	(.0476)	(.0617)	(.0401)	(.1052)	(.0907)	(.1273)
D*	**1.000**	−.0760	.0927	−.3614	.2852	−.1136
	(**.0000**)	.0645	(.0435)	(.1196)	(.0953)	(.1834)
PC*		**1.000**	.0850	−.0021	−.1481	−.0751
		(**.0000**)	(.0524)	(.1248)	(.1588)	(.1459)
WG			35.26	−.0096	.0037	.1357
			(1.652)	(.0632)	(.0487)	(.1710)
G				5.096	.2546	.4068
				(.3809)	(.0579)	(.0890)
BL					11.66	.4970
					(.8482)	(.0453)
BW						.2650
						(.0272)
			Supplemental White			
S*	.2235	−.0689	.0965	.0497	.2821	.4598
	(.0937)	(.1249)	(.0685)	(.1661)	(.1379)	(.1942)
D*	**1.000**	.1392	.0846	−.2585	.4173	−.1103
	(**.0000**)	(.1186)	(.0696)	(.1432)	(.1688)	(.1526)
PC*		**1.000**	−.1012	−.1550	.1238	.0909
		(**.0000**)	(.0808)	(.1480)	(.1369)	(.1899)
WG			39.31	.0202	.0086	.3630
			(3.511)	(.0631)	(.0415)	(.1366)
G				6.256	.1893	.3909
				(.6399)	(.0702)	(.1100)
BL					13.82	.3658
					(1.489)	(.0707)
BW						.3284
						(.0577)

	D^*	PC^*	WG	G	BL	BW
			Black			
S^*	.2882	.0879	−.0792	.0319	.1078	−.0611
	(.0834)	(.0967)	(.0623)	(.1887)	(.1650)	(.2454)
D^*	**1.000**	.0996	.0276	.4467	−.2321	.1130
	(**.0000**)	(.0853)	(.0553)	(.1097)	(.1112)	(.1666)
PC^*		**1.000**	−.0156	−.4487	.0280	−.1805
		(**.0000**)	(.0557)	(.2235)	(.1147)	(.1963)
WG			48.14	.0412	−.0052	−.0473
			(3.489)	(.0544)	(.0274)	(.1471)
G				6.162	.1046	.3938
				(.8305)	(.0569)	(.1167)
BL					25.31	.3814
					(2.122)	(.0617)
BW						.3199
						(.0462)
			Hispanic			
S^*	.4854	.0401	.0436	.1158	−.0524	.0680
	(.0890)	(.1139)	(.0703)	(.1508)	(.1575)	(.1769)
D^*	**1.000**	−.0004	−.0046	.2927	−.0946	.0568
	(**.0000**)	(.0949)	(.0699)	(.2285)	(.1682)	(.2492)
PC^*		**1.000**	.0487	−.2803	.1590	−.3150
		(**.0000**)	(.0633)	(.2294)	(.1500)	(.2409)
WG			44.25	.0041	.0035	−.0757
			(3.711)	(.0563)	(.0323)	(.1473)
G				6.330	.2106	.4626
				(.7927)	(.0625)	(.1162)
BL					21.49	.3113
					(1.863)	(.0652)
BW						.3374
						(.0449)
			Native American			
S^*	.3118	−.2480	.0066	.2446	−.2017	−.2352
	(.1546)	(.1774)	(.0925)	(.2377)	(.2060)	(.2557)
D^*	**1.000**	−.3522	−.0246	.0653	.0789	−.1468
	(**.0000**)	(.1846)	(.0895)	(.1898)	(.2310)	(.2674)
PC^*		**1.000**	.0500	.1078	−.0451	.0722
		(**.0000**)	(.1011)	(.2147)	(.2270)	(.2548)
WG			64.07	−.0028	−.0012	.0755
			(11.44)	(.0447)	(.0437)	(.1736)
G				7.993	.1340	.1681
				(1.372)	(.0858)	(.1351)
BL					8.652	.4148
					(1.387)	(.0998)
BW						.4367
						(.0832)

Note: Variances for S^*, D^*, and PC^* are normalized to unity.
Off-diagonal elements are given as correlations, not covariances.

Of particular interest is the off-diagonal block of correlations between inputs and outputs. The results for Native Americans indicate that the posterior means of these correlations are fairly small relative to their posterior standard deviations. But due to the small sample of eighty-one Native American births, these posterior standard deviations are fairly large. The sample sizes for the other groups are much larger, resulting in smaller posterior standard deviations and the movement of the posterior mass clearly away from zero.

Although our prior for Σ is centered over a diagonal matrix (supporting the use of single-equation methods), the need for simultaneous equations techniques is apparent in our posterior results. The correlations between input disturbances and the BW disturbance are fairly small for most groups, this should not be interpreted as justifying simply running a regression for the BW equation. The correlation between the disturbances in the G and BW equations is sizeable. Indeed, as Li and Poirier (2000, Section 4.6) note, the ordinary least squares (OLS) results for the BW equation of Main Whites are substantially different from our posterior results.

The correlations among output disturbances are sizeable for all groups, except possibly for Native Americans. Also note that the posterior mean of the variance of the BW disturbance is noticeably smaller for the Main White group than those of all other groups.

4.3. *Output Equations*

The output equations are of prime importance. They describe how birth inputs together with the biological size of the mother are transformed into birth outputs describing the physical characteristics of the infant. We discuss each of the three equations in turn, presenting posterior results under the default prior. When discussing maternal height and weight we take into account both their effects through body mass index (BMI = weight in kg/[height in meters]^2) and their linear effects. The posterior means and standard deviations of the partial derivatives of the exogenous variable effects of maternal height and weight are reported for each output equation.

The posterior results for the G equation are reported in Table 3. The pictures regarding the effects of exogenous variables differ somewhat across groups. Although BMI, maternal height, and maternal weight do not appear to matter much individually for Main Whites, Blacks, and Hispanics, the net marginal effect of maternal weight is substantial and similar across the groups. In contrast, the same three variables appear to have separate effects for Supplemental Whites and Native Americans, which yield no net effects for Supplemental Whites, and a negative net effect of maternal height for Native Americans. The posterior effect of being male is only noticeable for Main Whites. The posterior effect of maternal age is consistently negative and noticeably shifted away from the origin for Main Whites, Blacks, and Hispanics.

Table 3. *G Equation by Group: Posterior Means (Standard Deviations) of* Γ_1 *and* Δ_2 *Under* H_*

	Prior	*Main White*	*Supp. White*	*Black*	*Hisp.*	*Native Amer.*
S	−1.000	.4480	−.3833	.2315	−.1121	−.1967
	(2.000)	(.3880)	(.6904)	(.8059)	(.7212)	(1.094)
D	.0000	1.255	.7983	−1.880	−.9589	−.7112
	(2.000)	(.4553)	(.6243)	(.5406)	(1.017)	(.9714)
PC	.0000	.2368	.4575	1.933	1.138	−.3798
	(2.000)	(.5071)	(.6929)	(.9949)	(.9766)	(1.101)
WG	.0000	.0254	.0395	.0193	−.0082	.0061
	(2.000)	(.0255)	(.0345)	(.0254)	(.0296)	(.0430)
Intercept	40.00	37.67	37.81	37.43	38.53	39.55
	(1.760)	(.5938)	(.8097)	(.7886)	(.7468)	(1.055)
Male Child	.0000	−.2455	−.1033	.2075	−.1696	.4540
	(1.760)	(.1477)	(.3206)	(.2461)	(.2810)	(.6229)
Mother's age-23yrs.	.0000	−.1058	−.0425	−.0506	−.1128	−.0178
	(12.00)	(.0213)	(.0524)	(.0340)	(.0444)	(.0844)
Body mass index-24	.0000	.0260	−.6877	.0113	−.0510	−.7709
	(12.00)	(.2369)	(.4426)	(.2333)	(.3977)	(.8177)
Maternal ht.-162cm	.0000	−.0013	−.1950	.0166	.0087	−.3070
	(12.00)	(.0685)	(.1264)	(.0720)	(.1194)	(.2579)
Maternal wt.-63kg	.0000	.0068	.2514	.0197	.0406	.2946
	(12.00)	(.0873)	(.1636)	(.0861)	(.1543)	(.3075)
Height	−.0430	−.0090	.0088	.0133	.0239	−.0786
	(12.44)	(.0135)	(.0266)	(.0185)	(.0259)	(.0556)
Weight	.1599	.0167	−.0106	.0240	.0212	.0008
	(13.03)	(.0074)	(.0164)	(.0103)	(.0154)	(.0264)

Table 4. *BL Equation by Group: Posterior Means (Standard Deviations) of* Γ_1, Γ_2 *and* Δ_2 *Under* H_*

	Prior	*Main White*	*Supp. White*	*Black*	*Hisp.*	*Native Amer.*
S	.0000	−1.581	−1.810	−.4231	−1.055	−.1968
	(3.000)	(.5443)	(.9062)	(1.541)	(1.435)	(1.086)
D	.0000	−1.283	−1.385	1.341	1.201	−.8107
	(3.000)	(.5805)	(1.100)	(1.106)	(1.398)	(1.202)
PC	.0000	1.442	−1.828	.2599	−1.129	.1126
	(3.000)	(1.011)	(1.017)	(1.077)	(1.235)	(1.319)
WG	.1000	.0605	.0980	.1325	.0336	.1026
	(1.000)	(.0342)	(.0431)	(.0412)	(.0465)	(.0456)
G	.0500	.0884	.1338	.0069	.0936	.0726
	(1.000)	(.0527)	(.0532)	(.0529)	(.0545)	(.0555)
Intercept	48.00	46.69	47.11	47.39	46.79	47.35
	(1.760)	(1.787)	(1.714)	(1.749)	(1.756)	(1.705)
Male Child	.1000	.7303	.9287	.8529	1.120	.4028
	(1.760)	(.2283)	(.4716)	(.4873)	(.5107)	(.6407)
Mother's age-23yrs.	.0000	−.0933	.0770	.0991	−.0440	−.0429
	(12.00)	(.0326)	(.0772)	(.0664)	(.0816)	(.0893)
Body mass index-24	.0000	.0535	−.0024	.0351	.0441	.0625
	(12.00)	(.0277)	(.0620)	(.0527)	(.0704)	(.0706)
Maternal ht.-162cm	.0000	.0854	.0941	.0455	.1294	.0387
	(12.00)	(.0185)	(.0355)	(.0353)	(.0448)	(.0532)
Height	−.4611	.0696	.0948	.0351	.1163	.0202
	(12.22)	(.0196)	(.0388)	(.0362)	(.0468)	(.0569)
Weight	.0928	.0204	−.0009	.0134	.0168	.0238
	(4.543)	(.0105)	(.0236)	(.0201)	(.0268)	(.0269)

The posterior mean effects of the three endogenous binary inputs vary in sign and magnitude across the groups. Of the fifteen (3×5) cases, a posterior mean is more than twice its standard deviation only twice. There is more consistency in the effects of WG on G across the groups, and in most cases the effects of WG are small.

The posterior results for the BL equation are reported in Table 4. Similar pictures emerge regarding the effects of exogenous variables across the groups, except for the large standard deviations in the small sample of Native Americans. Clearly, male infants are on average longer. The net marginal effect of maternal height on BL is noticeable but small in magnitude. The net marginal effect of maternal weight is noticeable only for Main Whites.

The posterior mean effects of the three endogenous binary inputs are more similar across the groups in the BL equation than they are in the G equation. The posterior mean effect of S on BL is consistently negative across the groups, and larger than its standard deviation for Main and Supplemental Whites. The posterior mean effects of D and PC on BL vary across the groups. Both WG and G have positive mean effects on BL, which are quite consistent across the groups.

Table 5. *BW Equation by Group: Posterior Means (Standard Deviations) of* Γ_1, Γ_2 *and* Δ_2 *Under* H_*

	Prior	*Main White*	*Supp. White*	*Black*	*Hisp.*	*Native Amer.*
S	−.3500 (1.000)	−.2887 (.1008)	−.6074 (.1859)	−.0482 (.2442)	−.1299 (.2045)	−.1136 (.2908)
D	.0000 (1.000)	.1239 (.1418)	.1536 (.1435)	−.1448 (.1684)	−.0763 (.2531)	.0268 (.3135)
PC	.1000 (1.000)	.1192 (.1443)	−.0424 (.1906)	.2244 (.2074)	.3977 (.2448)	−.0015 (.3246)
WG	.1000 (1.000)	.0009 (.0155)	−.0222 (.0137)	.0182 (.0125)	.0070 (.0133)	.0036 (.0167)
G	.0100 (1.000)	.0363 (.0210)	.0471 (.0241)	.0226 (.0244)	.0296 (.0224)	.0362 (.0231)
Intercept	2.000 (.8800)	1.820 (.7927)	1.843 (.8940)	1.930 (.9033)	1.806 (.8472)	1.857 (.8496)
Male Child	.1000 (.8800)	.0920 (.0351)	.2065 (.0758)	.1117 (.0579)	−.0124 (.0657)	.0765 (.1531)
Mother's age-23yrs.	.0000 (6.000)	−.0186 (.0055)	−.0194 (.0128)	.0014 (.0079)	−.0137 (.0108)	−.0066 (.0209)
Body mass index-24	.0000 (6.000)	−.0353 (.0117)	−.0192 (.0208)	−.0126 (.0139)	−.0477 (.0208)	−.0005 (.0409)
Maternal wt.-63kg	.0000 (6.000)	.0207 (.0044)	.0135 (.0071)	.0083 (.0052)	.0241 (.0080)	.0191 (.0144)
Height	.0003 (1.797)	.0105 (.0035)	.0057 (.0062)	.0037 (.0041)	.0141 (.0062)	.0001 (.0121)
Weight	−.0923 (6.443)	.0072 (.0017)	.0062 (.0037)	.0035 (.0025)	.0059 (.0036)	.0189 (.0062)

The posterior results for the BW equation are reported in Table 5. Similar pictures emerge regarding the effects of exogenous variables across the groups, except for the large standard deviations in the small sample of Native Americans. Clearly, male infants are on average heavier, except in the case of Hispanics. The net marginal effect of maternal height on BW is noticeable for Main Whites and Hispanics. The net marginal effect of maternal weight on BW is noticeable, and consistent across the groups.

Like in the BL equation, the posterior mean effects of the three endogenous binary inputs are more similar across the groups in the BW equation than they are in the G equation. The posterior mean effect of S on BW is consistently negative across the groups, and larger than its standard deviation for Main and Supplemental Whites. The posterior mean effects of D and PC on BW vary across the groups, and are generally small. WG has a small positive mean effect on BW for all groups except Supplemental Whites in which case it is negative and larger in absolute value than its posterior standard deviation. The posterior mean effect of G on BW is positive and fairly comparable across the groups.

Finally, we also compute goodness-of-fit measures for the three output equations. The measures of correlation are developed by Carter and Nagar (1977) and are for use with a single equation within a simultaneous system. The Carter-Nagar measure has the same interpretation as the familiar coefficient of determination used with the classical linear model and at the same time it explicitly includes all the restrictions that serve to identify the structural equation. For the G equation, the Carter-Nagar single equation R^2 for Main Whites, Supplemental Whites, Blacks, Hispanics, and Native Americans are .0534, .0371, .0503, .0539, and .0863, respectively; for the BL equation, the single equation R^2 for Main Whites, Supplemental Whites, Blacks, Hispanics, and Native Americans are .0475, .1419, .0499, .0565, and .1054, respectively; and for the BW equation, the R^2 for Main Whites, Supplemental Whites, Blacks, Hispanics, and Native Americans are .0759, .1172, .0512, .0661, and .2058, respectively.

5. DISCUSSION

The literature is filled with attempts to account for the differences in the marginal distributions of birth outcomes like BW across racial/ethnic groups [Poirier (1998)]. So far, we have used a common window and prior in our analysis, but we deal with each group separately. While some idea regarding the pooling of different groups emerges from the results reported in this paper, further pooling of groups is examined in Li and Poirier (2000). In this paper, we focus on explaining the birth outcomes such as gestation, BL, and BW using a simultaneous equations approach. From a society viewpoint, the more interesting and ultimately relevant question to ask, is what factors affect children's attainment later in life. We conjecture that BW and related birth measurements are the intervening variables in explaining children's development later in life, and we plan to investigate further in future work.

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