Examining the impact of natural resources scarcity and poverty on population growth in Honduras, Nepal, and Tanzania

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Abstract

This study presents an empirical analysis of the impact of natural resource scarcity and poverty on population growth via fertility in Honduras, Nepal, and Tanzania. The study applies the vicious circle argument. According to the argument natural resource scarcity coupled with poverty leads to population growth in rural areas of developing countries. The argument challenges the existing studies that largely focused on examining the impact of population growth on natural resource. This study uses recent household data from the Demographic and Health Surveys. Unlike previous studies, this study tests for and addresses the potential problem of natural resource scarcity endogeneity. The results provide support of the vicious circle argument by showing that natural resource scarcity as measured by the time taken to get to the source of drinking water and poverty measured by wealth index lead to increases in fertility for two out of the three countries examined.

Introduction

Social scientists have long debated the impact of population growth on our environment. In general there are two different and opposing perspectives on the relationship between environment and population growth. In one, which can be called neo-Malthusian, a growing population exerts pressure on the environment (Hardin, 1968; Ehrlich, 1971; Meadows, Meadows, Randers, and Behrens, 1972). The other perspective sets out a Cornucopian view, which posits that a growing population does not necessarily exert pressure on the environment (Boserup, 1976, 1981; Simon, 1980, 1981a, 1981b, 1990, 1991, 1992).

At present much of the world's population growth occurs in the developing countries. As the population continues to grow in these countries which are characterized by poverty, great pressure is being placed on the natural resources such as water and forests. The nexus of population growth, poverty and natural resources is complex and poses research challenges. Dasgupta (1995; 2000) theorizes that this complex relationship is the result of a vicious circle between the three variables (population growth, poverty and natural resources).

Since the introduction of the vicious cycle theory, only a few studies have examined it (Loughran and Pritchett, 1997; Aggarwal, Netanyahu, and Romano, 2001; Filmer and Pritchett, 2002; Sutherland, Carr and Curtis, 2004; Biddlecom, Axinn, and Barber, 2005; Ghimire and Mohai, 2005). These few studies reveal conflicting results which among others can be attributed to using inappropriate dependent variable. In majority of these studies, dependent variables used were measures of woman's fertility used as a proxy for population growth. The majority of the existing studies have used

cumulative measures of population growth such as total number of children ever born or total number of living children. The use of cumulative measure of fertility may distort the results because the covariates which in this case natural resource scarcity and poverty may not precede in time the dependent variable.

The existing studies have largely ignored the potential endogeneity problem. Endogeneity occurs when the assumption that a dependent variable is caused by exogenous variables on the right hand side of an equation and the stochastic error term is violated which may lead to biased results.

This study aims to fill the gap that was created by the previous studies, by endeavoring to examine whether natural resource scarcity and poverty lead to population growth via increases in fertility. Time taken to fetch water for domestic use will be a proxy used for natural resource scarcity. Wealth index will be used as a measure of household wealth and hence poverty. In addition, the study examines the effects of other key socioeconomic factors of fertility. Additionally, this study will contribute to the existing literature by testing for and addressing potential endogeneity of natural resource variable.

Literature Review

The empirical literature on the relationship between population growth, environmental scarcity, and poverty comes from an emerging area of research that analyzes the vicious cycle hypothesized by Dasgupta (1995, 2000). This section of the paper summarizes the empirical works that examined the vicious cycle theory.

Loughran and Pritchett (1997) used data from Nepal Living Standards Survey collected in 1996. This study used cross-sectional data to test whether variation in fuelwood and water scarcity affects fertility by altering the relative value of children in resource collection activities. Loughran and Pritchett concluded that the perception of deforestation and water scarcity by farmers in Nepal increases the perceived net cost of children, which leads to a reduction in demand for children. Their findings imply that there is no positive relationship between environmental degradation and the demand for children as suggested by the vicious cycle theory.

Aggarwal, Netanyahu, and Romano (2001) used data from the South African Integrated Household Survey (SAIHS) collected in 1993 to examine a positive link between fertility increase and environmental degradation. The authors found a positive link between wood scarcity and number of children ever born alive. The effect of water scarcity on fertility is also positive but not significant. In general, their study suggests that there is a positive feedback between environmental degradation and fertility rates.

Filmer and Pritchett (2002) used data from the 1991 Pakistan Integrated Household Survey (PIHS) to empirically detect measurable effects by indicators of environmental scarcity on fertility. They found that children (at least female children for which they have the data) are relatively specialized in collecting natural resources such as fuelwood at young ages. One of the study findings substantiates the vicious cycle theory that environmental scarcity could possibly raise the demand for children.

Sutherland, Carr, and Curtis (2004) used a cross-sectional data from the 1998/99 DHS to examine potential relationships between factors related to fertility and the access to and use of natural resources in Peten, Guatemala. Their multiple regression findings

show perception of land availability and ownership of cattle as the only two natural resource variables that are significantly associated with the number of living children. Their result shows that people who perceive land is available for their children had significantly fewer children than those who perceive land to be scarce.

Biddlecom, Axinn, and Barber (2005) used a data set collected in Western Chitwan Valley in Nepal. The focus of their study was to investigate the relationship between environmental degradation and men's and women's family size preference and subsequent reproductive behavior. Their results provide support for the vicious cycle argument that environmental degradation leads to population growth through raising fertility rates.

Ghimire and Mohai (2005) used data set collected by the Chitwan Valley Family Study from 1996 to 2000. The focus of their study was to examine the impact of environmental perceptions on contraceptive use in the rural setting of Nepal. Their results do not provide support for the vicious cycle argument. Instead their results show that environmental scarcity acts as a check on population growth. The reviewed studies reveal that there is no consensus in favor or disfavor of the vicious cycle theory.

Data and Methods

The data for this study are drawn from the Demographic and Health Surveys (DHS). This study uses cross-sectional data from surveys conducted in 2005, 2006, and 2005 for Honduras, Nepal, and Tanzania respectively. The Honduras 2005 DHS is a nationally representative sample of individual women between ages 15 and 49. The total sample for Honduras contains 19,948 individual women. The Nepal 2006 DHS

is a nationally representative sample of individual women between ages 15 and 49. The total sample for Nepal contains 10,793 individual women. The Tanzania 2004 DHS is a nationally representative sample of individual women between ages 15 and 49. The total sample for Tanzania contains 10,329 individual women. In this study the units of analysis are individual women in the childbearing years (ages 15-49) in the rural areas of the study settings.

The DHS instrument asks respondents to report retrospectively on a wide range of demographic variables. Information concerning education, family planning, family nutrition and health, and other socioeconomic variables are also collected. Although the quality of the DHS data is potentially limited by problems of recall (due to lapse of memory) and possible underreporting of certain types of behavior due to social norms, researchers view the data as highly reliable for use in demographic analysis (Ali, Cleland, and Shah, 2003). Table 1 below gives description of the variables used in this study:

Table 1 – Variables descriptions

Variables	Definitions
Dependent variables	
PB3	1 = if a woman had a birth in the last three years preceding survey 0 = otherwise
PB5	1 = if a woman had a birth in the last five years preceding survey 0 = otherwise
Key variables	
NS	An indicator of natural resource scarcity measured in minutes per trip to get to the source of drinking water
WI	Wealth index, it is an ordinal measure of household wealth (1 to 5)
Control variables	
Edup	1 = if a woman has attained primary education level 0 = otherwise
Edus	1 = if a woman has attained secondary education level 0 = otherwise
Eduh	1 = if a woman has attained higher education level 0 = otherwise
Age1924	1 = if woman is in the aged between 19 to 24 years old 0 = otherwise
Age2529	1 = if woman is in the aged between 25 to 29 years old 0 = otherwise
Age3034	1 = if woman is in the aged between 30 to 34 years old 0 = otherwise
Age3539	1 = if woman is in the aged between 35 to 39 years old 0 = otherwise
Age4044	1 = if woman is in the aged between 40 to 44 years old 0 = otherwise
Age4549	1 = if woman is in the aged between 45 to 49 years old 0 = otherwise

Knows	1 = if a woman has correct knowledge of ovulatory cycle 0 = otherwise
Sonp	1 = if a woman has indicated son preference 0 = otherwise
Emar	1 = if a woman is ever married 0 = otherwise
Cmort	1 = if a woman ever experienced infant and/or child death 0 = otherwise
Cuse	1 = if a woman used contraceptive use before first birth 0 = otherwise
Identifying variable	
Improved	1 = if the drinking water is obtained from an improved source 0 = otherwise

Analysis

Three statistical tests were applied to test potential endogeneity of natural resource scarcity. The tests reveal that endogeneity was present. However, the problem was addressed using available statistical techniques[1].

Table 2 presents Probit results for the IVPROBIT[2] model of the birth in the last three years preceding the surveys, reporting coefficients, robust standard errors, and marginal effects. For Honduras, whereas the coefficient of the variable NS is not statistically significant in the single equation model[3], in the IVPROBIT model the coefficient is positive and statistically significant at the 1% level. For Nepal, whereas the coefficient of NS variable in the single equation model is positive and statistically significant at the 5% level, in the IVPROBIT model, the level of statistical significance

[1] The diagnostic results for endogeneity problem and how it was addressed are available upon request.
[2] IVPROBIT is a two-stage Probit model that addresses endogeneity problem.
[3] The single equation model assumes that endogeneity is not present, as such did not address endogeneity. The results of the single equation model are available upon request.

increased to 1% level while maintaining its positive sign. For Tanzania, the coefficient of the NS variable is still not statistically significant even after controlling for endogeneity.

Focusing on the WI variable and other explanatory variables, it is observed that coefficients estimates are very similar for single equation and IVPROBIT models for the three countries. Worth noting here is that in all the countries the coefficient of WI is positive and statistically significant. This is consistent with the theory of vicious circle. In addition, in all the countries, the sign on each of the remaining variables is the same across the two models, and differences in magnitude are quite small. Moreover, in all the countries, the set of statistically significant variables is essentially the same for the single equation model and the IVPROBIT model.

Table 2

Probit with IV: Dependent variable - birth in the last 3 years (PB3)

	Honduras		Nepal		Tanzania	
Var	Coeff	Marginal Effect	Coeff	Marginal Effect	Coeff	Marginal Effect
Const	-1.0491		0.0845		-1.1781	
	(0.0646)		(0.1144)		(0.2064)	
NS	0.0125***	0.0042	0.0121***	0.0043	-0.0008	-0.0003
	(0.0033)		(0.0044)		(0.0030)	
WI	-0.1717***	-0.0580	-0.1189***	-0.0419	-0.0748***	-0.0297
	(0.0164)		(0.0236)		(0.0250)	
Edup	-0.1804***	-0.0624	-0.1653***	-0.0565	-0.0644	-0.0256
	(0.0466)		(0.0539)		(0.0408)	
Edus	-0.2628***	-0.0835	0.0087	0.0031	-0.2112**	-0.0827
	(0.0666)		(0.0605)		(0.0991)	
Eduh	-0.0746	-0.0246	0.1669	0.0610	-0.3411	-0.1310
	(0.1821)		(0.1709)		(0.2298)	
Age2024	0.4294***	0.1542	0.7127***	0.2687	0.9007***	0.3415
	(0.0479)		(0.0717)		(0.0666)	
Age2529	0.0816	0.0280	0.1710**	0.0618	0.6746***	0.2619
	(0.0525)		(0.0710)		(0.0715)	
Age3034	-0.2217***	-0.0711	-0.5181***	-0.1634	0.3884***	0.1538
	(0.0558)		(0.0764)		(0.0733)	
Age3539	-0.4817***	-0.1429	-0.8450***	-0.2437	0.0811	0.0323
	(0.0597)		(0.0796)		(0.0764)	
Age4044	-0.9237***	-0.2335	-1.5888***	-0.3560	-0.5352***	-0.2015
	(0.0654)		(0.0980)		(0.0807)	
Age4549	-1.7771***	-0.3173	-2.1234***	-0.3845	-1.3727***	-0.4196
	(0.0913)		(0.1325)		(0.0994)	
Knows	-0.0547	-0.0182	-0.0254	-0.0089	0.1242***	0.0494
	(0.0582)		(0.0501)		(0.0453)	
Sonp	0.0666	0.0228	0.1000**	0.0355	-0.0162	-0.0065
	(0.0366)		(0.0409)		(0.0441)	
Emar	1.5193***	0.3791			1.3667***	0.4545
	(0.0524)				(0.0643)	
Cmort	0.1827***	0.0639	0.2966***	0.1074	0.2246***	0.0893
	(0.0438)		(0.0476)		(0.0433)	
Cuse	0.0313	0.0106	-0.1384	-0.0472	-0.1131	-0.0446
	(0.0513)		(0.0840)		(0.1261)	
Number of obs	10,615		6,003		6,595	
Wald chi2(16)	2,334.45		1,455.70		1,861.85	
Prob > chi2	0.0000		0.0000		0.0000	
L.pseudolikeld	-46,258.6		-27,048.408		-39,401.202	
Wald test of exogeneity:						
chi2(1)	10.35		4.20		0.12	
Prob > chi2	0.0013		0.0404		0.7312	

***, ** represents significance at 1% and 5% respectively

Table 3 presents Probit results for the IVPROBIT model of a birth in the last five years preceding the surveys, reporting coefficients, robust standard errors, and marginal effects. For Honduras, whereas the coefficient of the variable NS is not statistically significant in the single equation model, in the IVPROBIT model the coefficient is positive and statistically significant at the 5% level. For Nepal, in the IVPROBIT model, the coefficient of NS variable is positive and statistically significant at the 5% level. The level of statistical significance is similar to what was observed in the single equation model but the magnitude of the coefficient increased in the IVPROBIT model. For Tanzania, the coefficient of the NS variable is still not statistically significant even after controlling for endogeneity. As it was for the birth in the last three years model preceding the survey, the magnitude of the NS coefficients increased for both Honduras and Nepal after controlling for endogeneity. A possible explanation for lack of statistical significance of the natural resource scarcity coefficient for Tanzania may be due to the fact that time to get to the source of drinking water is not a good proxy. This particular finding warrants further analysis that may involve using different measures of natural resource scarcity.

Focusing on the WI variable and other explanatory variables, it is observed that coefficients estimates are very similar for single equation and IVPROBIT models for the three countries. As it was the in the model of the birth in the last three years preceding the surveys, it is worth noting here is that in all the countries the coefficient of WI is positive and statistically significant. This is consistent with the theory of vicious circle. In all the countries, the sign on each of the remaining variables is the same across the two models.

Moreover, in all the countries, the set of statistically significant variables is essentially the same for the single equation model and the IVPROBIT model.

Comparatively, after addressing endogeneity of natural resource scarcity, the birth in the last three years model does better than the birth in the last five years model. Tables 2 and 3 show that using whether or not a woman had at least one birth in the last three years as the dependent variable, the level of statistical significance of the NS coefficient is at the 1% for both Honduras and Nepal where the coefficient is found to be statistically significant. This particular finding underscores the importance of using a more recent measure of fertility that precede the event, in this case the natural resource scarcity. This is contrary to what some of the existing studies that have used cumulative measure of fertility such as total number of children ever born.

Table 3

Probit with IV: Dependent variable - birth in the last 5 years (PB5)

	Honduras		Nepal		Tanzania	
Var	Coeff	Marginal Effect	Coeff	Marginal Effect	Coeff	Marginal Effect
Const	-1.0510		0.1592		-1.2878	
	(0.0664)		(0.1144)		(0.2199)	
NS	0.0079**	0.0031	0.0109**	0.0043	-0.0009	-0.0003
	(0.0035)		(0.0044)		(0.0032)	
WI	-0.1978***	-0.0776	-0.1320***	-0.0527	-0.0859***	-0.0330
	(0.0162)		(0.0233)		(0.0264)	
Edup	-0.1635***	-0.0644	-0.1643***	-0.0653	0.0232	0.0089
	(0.0475)		(0.0550)		(0.0437)	
Edus	-0.2571***	-0.0984	0.0122	0.0049	-0.1958	-0.0766
	(0.0669)		(0.0627)		(0.1030)	
Eduh	-0.1660	-0.0638	0.0267	0.0106	-0.1412	-0.0551
	(0.1774)		(0.1762)		(0.2152)	
Age2024	0.8417***	0.3253	1.2000***	0.4255	1.1988***	0.3723
	(0.0478)		(0.0765)		(0.0694)	
Age2529	0.5218***	0.2058	0.7656***	0.2912	1.1304***	0.3537
	(0.0531)		(0.0733)		(0.0770)	
Age3034	0.1216**	0.0480	-0.0020	-0.0008	0.7461***	0.2527
	(0.0555)		(0.0752)		(0.0779)	
Age3539	-0.2399***	-0.0918	-0.5447***	-0.2104	0.4012***	0.1448
	(0.0590)		(0.0776)		(0.0793)	
Age4044	-0.7424***	-0.2585	-1.0980***	-0.3852	-0.2149***	-0.0840
	(0.0629)		(0.0866)		(0.0801)	
Age4549	-1.5039***	-0.4146	-1.6569***	-0.4968	-0.9795***	-0.3727
	(0.0753)		(0.1048)		(0.0904)	
Knows	-0.0237	-0.0093	0.0237	0.0094	0.1253**	0.0475
	(0.0577)		(0.0502)		(0.0488)	
Sonp	0.0867**	0.0341	0.1037**	0.0413	0.0806	0.0307
	(0.0377)		(0.0404)		(0.0468)	
Emar	1.7557***	0.5335			1.5218***	0.5463
	(0.0501)				(0.0640)	
Cmort	0.2866***	0.1136	0.3393***	0.1345	0.3264***	0.1223
	(0.0443)		(0.0457)		(0.0471)	
Cuse	-0.0599	-0.0234	-0.2851***	-0.1122	-0.1715	-0.0670
	(0.0540)		(0.0881)		(0.1339)	
Number of obs		10,615		6,003		6,595
Wald chi2(16)		3,204.06		1,760.19		2,226.64
Prob > chi2		0.0000		0.0000		0.0000
L.pseudolikeld		-46,093.7		-27,086.9		-38,922.2
Wald test of exogeneity:						
chi2(1)		2.96		3.13		0.10
Prob > chi2		0.0855		0.0769		0.7475

***, ** represents significance at 1% and 5% respectively

Conclusion

This study presented an empirical analysis of the impact of natural resource scarcity and poverty on population growth via fertility in rural areas of Honduras, Nepal, and Tanzania. With the exception of the case of Tanzania, the findings support the vicious cycle theory. However, the relationship between fertility rates and income as measured by the wealth index is negative. This implies that reducing poverty is an important factor in controlling fertility. This is consistent to what the vicious cycle theory suggests.

Policy implications

Understanding of the impact of natural resource scarcity and poverty on fertility, and hence population growth rates is important in programming and formulating policies. This study helps to provide insights on the impact of natural resource scarcity and poverty on fertility. The findings suggest that sustainable use of natural resources is not only good for environment but also for countries or institutions that want to control population growth.

Equally important is the alleviation of poverty in reducing fertility and protecting environment. Both policy makers and international community aimed to reduce higher levels of fertility in developing countries should not only confine themselves to such factors as unmet need for contraceptives. They should incorporate other factors such as natural resource availability and household wealth in their family planning programs. For example, instead of just concentrating on the distribution of contraceptives, the governments in developing countries should also attempt to ease the burden of collecting

natural resources. This can be done by improving access to natural resources such as water as well as providing substitutes for other natural resources such as affordable electricity and efficient stoves for fuel wood.

In addition, the importance of investing in education cannot be overemphasized as revealed by the study findings. In this study and elsewhere, it has been shown that education is an important determinant of fertility. Therefore, the governments in developing countries need to target and increase investment in education at all levels if reduced fertility is a desirable outcome. Moreover, infant and child mortality need to be reduced if not eliminated completely because they still remain important factors in influencing fertility

References

Ali, Mohamed M., John Cleland, and Iqbal H. Shah. (2003). Trends in reproductive behavior among young single women in Columbia and Peru: 1985-1999. *Demography*. 40 (4): 659-673.

Aggarwal, R., Netanyahu, S., and Romano, C. (2001). Access to natural resources and the fertility decision of women: The case of South Africa. Environment and Development Economics 6(2):209-236.

Biddlecom, A., Axinn, W. G, and Barber, J. S. (2005). Environmental effects on family size preferences and subsequent reproductive behavior in Nepal. *Population and Environment* 26(3): 183-206.

Boserup, E. (1976). Environment, population, and technology in primitive societies. *Population and Development Review*, 2(1): 21-36.

Boserup, E. (1981). *Population and technological change: A study of long-term trends*, Chicago University Press.

Dasgupta, P. (1995). Population, poverty, and the local environment. *Scientific American 272*(2), 26-31.

Dasgupta, P. (2000). Population and resources: An exploration of reproductive and environmental externalities. *Population and Development Review 26*(4), 643-689.

Ehrlich, Paul R. (1971). *The population bomb*. New York: Buccaneer Books.

Filmer, D. and Pritchett, L. (2002). Environmental degradation and the demand for children; searching for the vicious cycle in Pakistan. Enviroment and development Economics 7:123-146.

Ghimire, D. & Mohai, P. (2005). Environmentalism and contraceptive use: How people in less developed settings approach environmental issues. *Population and Environment 27*(1), 29-61.

Hardin, Garrett. (1968). The tragedy of the commons, *Science* 162: 1243-1248.

Loughran, D. and Pritchett, L. (1997). Environmental scarcity, resource collection, and the demand for children in Nepal. Working paper, World Bank.

Meadows, Donella H., Meadows, Dennis L., Randers, Jorgen, & Behrens, William W. (1972). *The limits to growth: A report for the Club of Rome's Project on the Predicament of Mankind*. New York: Universe Books.

Simon, Julian L. (1980). Resource, population, environment: An oversupply of bad news. *Science*, 208(4451): 1431-1437.

Simon, Julian L. (1981a). *The ultimate resource.* NJ: Princeton University Press.

Simon, Julian L. (1981b). Environmental disruptors or environmental improvement? *Social Science Quarterly*, 62(1): 30-43.

Simon, Julian L. (1990). *Population matters: People, resources, environment, and immigration*. NJ: Transaction Publishers.

Simon, Julian L. (1991). Population growth, farmland, and the long-run standard of living. *Journal of Population Economics*, 4: 37-51.

Simon, Julian L. (1992). *Population and development in poor countries*. NJ: Princeton University Press.

Sutherland, E., Carr, D., and Curtis, S. (2004). Fertility and the environment in a natural resource dependent economy: evidence from Peten, Guatemala. Paper presented at the third international population conference of the Central American Isthmus. On-line conference paper series.