An empirical test of a neo-Malthusian theory of fertility change*

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Eric Neumayer

Department of Geography and Environment and Center for Environmental Policy and Governance (CEPG), London School of Economics and Political Science, Houghton Street, London WC2A 2AE, UK.

Fax: +44-207-9557412. e.neumayer@lse.ac.uk. http://personal.lse.ac.uk/neumayer

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Abstract

Some neo-Malthusians regard fertility as being kept in check by scarcities and constraints and, conversely, as being raised by economic prosperity. Since out-migration to developed countries and the receipt of food aid from developed countries relax the constraints imposed by a country's carrying capacity, both will have a positive effect on fertility rates in developing countries. Moreover, better economic prospects will also raise fertility, all other things equal. This article provides an empirical test of these hypotheses derived from a neo-Malthusian theory of fertility change. The results fail to confirm the theory and often contradict it.

Key words: fertility, Malthusian, food aid, migration, economic prosperity, demographic transition

1. Introduction

Some neo-Malthusians have developed a theory of fertility change that is based on two fundamental and inter-related premises (see Hardin 1968, 1974; Abernethy 1993, 1999, 2002; Abernethy and Penaloza 2002; Cairns 2004).[1] First, scarcities and constraints keep fertility in check. Second, increased economic prospects or

[1] I call this 'a' rather than 'the' neo-Malthusian theory of fertility change since other neo-Malthusians from the ones cited may have different views, particularly as concerns the effect of economic prosperity on fertility.

'perceived economic opportunities' (Abernethy 2002) raise fertility. From these premises three testable hypotheses are derived, namely:

1. Food aid raises fertility rates in recipient countries.
2. Emigration from developing to developed countries raises fertility rates in the sending countries.[2]
3. Economic prosperity raises fertility rates.

When combined with another neo-Malthusian premise, namely that fertility rates are generally already higher than carrying capacity would allow for, particularly in developing countries, policy implications follow from these hypotheses. Following from the first hypothesis, the policy implication is that food aid should be either withdrawn or at least reduced. From the second hypothesis follows the call for strict limits on immigration to developed countries, possibly extended to the call for zero net migration in all countries. The policy implication following from the third hypothesis is somewhat unclear. Preventing economic prosperity is not called for. Rather, it seems that the main purpose of the third hypothesis is to warn policy makers

[2] This argument is also embraced by Daly (2004). The same is true for Ehrlich and Ehrlich (2004: 108). However, otherwise Ehrlich and Ehrlich do not subscribe to the neo-Malthusian theory of fertility change and even, by and large, embrace the demographic transition theory, which is anathema to neo-Malthusians (see below). A related and recently hotly debated issue is whether immigration to developed countries should be restricted on environmental grounds. This debate focuses mainly on the effects of immigration on the environment in developed countries, which are independent of the effects of migration on fertility rates in developing sending countries – see the forthcoming discussion forum on Migration, Globalization and the Environment in the journal Ecological Economics (Muradian, Neumayer and Røpke 2006).

that economic prosperity will not lower, and indeed will raise, fertility rates such that fertility needs to be controlled via other means.

The existing literature has discussed whether the policy implications are morally justifiable (see, for example, Griffin 1988, 1989; Fletcher 1991; Singer 1993; Ryberg 1997; Brzozowski 2003; Naess 2004). However, to my knowledge there does not exist any study attempting to test these hypotheses of fertility change empirically. If the hypotheses do not hold, then the policy implications do not follow, whether or not they are morally justifiable. The neo-Malthusians themselves mainly provide examples and casual evidence, which they regard as supportive of their hypotheses, but no rigorous test. Such a test is the objective of this short paper. In brief, the results presented here fail to confirm the hypotheses and often contradict them.

2. A neo-Malthusian theory of fertility change

Thomas Robert Malthus (1798) was not the first one to express such ideas, but his *Essay on the Principle of Population* became so famous that an entire school of thought became known as Malthusian or, in its modern version, neo-Malthusian. Malthus was convinced that the limitedness of land imposed decreasing rates of return on all other factors of production and put an absolute scarcity constraint on food production in particular. Population growth is kept in check by the scarcity constraint; if the constraint is temporarily transgressed, then famine, disease and warfare will bring population down. Population size will again increase, only to hit the absolute scarcity constraint afterwards again in an apparently endless vicious circle. Only fertility restraints such as the postponement of marriage can break the circle.

Some modern followers of Malthus have modified this view, but the idea that fertility increases and population growth are constrained by limits of the carrying

capacity of the available land is at the heart of neo-Malthusian thought. Hardin's (1968) famous "Tragedy of the Commons" and more explicitly, though less well known, his "Living on a Lifeboat" (1974) essays are probably the most radical and non-apologetic formulations of a neo-Malthusian theory of fertility change. In the latter essay he paints a picture of nation-states as individual lifeboats, the capacity of which is constrained by each nation's carrying capacity. The trouble is that, according to his view, some developing countries have gone beyond their carrying capacity. Metaphorically speaking, the high fertility rate has led to an over-loading of their lifeboats. Hence, many individuals are swimming in the water and will die if not fished out of it. Hardin argues that the only viable and morally justifiable solution is to leave these people to their fate. Taking them all into the lifeboats of the developed countries would only sink those as well, while taking a limited number in would destroy the boats' safety margins. Importantly, even if all those floating in the water could be rescued, this would not represent a long-term solution because it would entice the populations on the developing country lifeboats to grow further, such that in the future more people would be in need of assistance: 'Tragically, gifts of food that save human lives in a poor country increase human fertility where an increase is least tolerable' (Hardin 1995: 118). Providing assistance would thus only spur a vicious circle that would eventually lead to 'a catastrophe of scarcely imaginable proportions' (Hardin 1974: 564) and can only be broken if assistance is refused. It is only by making them experience the constraints of their own lifeboats' carrying capacity that they will learn how to keep their fertility in check. The two kinds of assistance that Hardin (1974) explicitly discusses are food aid, which moves food to starving people, and migration to developed countries, which moves starving people to food. Hence, he advocates severely restricting, if not abandoning, both.

Abernethy (1993, 2002) has developed the critique of demographic transition theory, that is already contained in Hardin (1974), furthest and has set up her own competing 'fertility opportunity hypothesis'. According to her, it is not economic modernization, prosperity, education and declining infant mortality that lower fertility rates, but deteriorating economic conditions (Abernethy 1993: 240). Food aid and the prospect of emigration to developed countries raise the perceived economic opportunities of populations in developing countries and thereby raise their fertility rates or, at least, prevent them from falling as much as they otherwise would.

3. An empirical test

With two exceptions, I know of no studies that provide an empirical test of the hypotheses stated above.[3] Tzougas and Tziafetas (1989) estimate the impact of international migration on fertility rates in Greece over the period 1968 to 1986. They find that a higher migration out of Greece has a negative effect on fertility that is statistically insignificant in ordinary least squares (OLS), but significant in a simultaneous equation model. The question is whether the result generalizes beyond Greece.

Abernethy and Penaloza (2002) report results from an OLS estimation with 128 observations of percentage change in the total fertility rate from different points of time in the 1990s. The explanatory variables are dummy variables for countries in Central America, South America and the "Asian Tigers" (Hong Kong, Indonesia,

[3] Many more studies have analysed the effect of internal migration, typically from rural to urban areas, on fertility, generally finding that such migration is associated with lower fertility rates – see, for example, Rowe and Rodgers (1994), Jensen and Ahlburg (2004), Kulu (2005). However, these studies are not directly relevant to the hypotheses tested here, which refer to international migration.

Japan, Malaysia, the Philippines, Singapore, South Korea, Taiwan, and Thailand), with Caribbean countries as the omitted reference category. These dummy variables are interacted with a dummy variable for the period 1997 to 1999. The only statistically significant explanatory variable in the reported estimation table is the interaction of the Asian Tiger dummy variable with the period dummy variable. Its negative sign is interpreted as the negative effect of 'the economic collapse of former "Asian tigers" in late summer, 1997' (Abernethy and Penaloza 2002: 245) on fertility rates and is therefore interpreted as evidence for the 'opportunity fertility hypothesis'. This study suffers from a number of severe shortcomings, which render the interpretation of its findings highly questionable. First, there is sample selection bias in restricting the sample to a selection of countries. Second, there is aggregation bias in lumping together countries with very different experiences of economic performance for the construction of dummy variables, both within the group of "Asian tigers" and within the remaining regional groups. Third, there is omitted variable bias by not including other explanatory variables.

To test the hypotheses more rigorously, the sample used here consists of all non-OECD countries in the world for which data are available. We exclude the Organisation of Economic Co-operation and Development (OECD) countries since the theory is explicitly about fertility change in developing countries, but results are rather similar if OECD countries are included. The dependent variable is the total fertility rate (number of births per women), defined as 'the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with prevailing age-specific fertility rates', with data taken from World Bank (2005). The main results are consistent if the natural log of fertility rates is taken as the dependent variable instead.

To test the first hypothesis, total food aid shipments in tons of cereals to a recipient country by all donors are taken from FAO (2005). This is divided by population size to create food aid per capita as the relevant measure. Data on international migration, needed to test the second hypothesis, are notoriously difficult to get. The best data exist on migration to the US, for which Clark, Hatton and Williamson (2002) have collected data over the period 1959 to 1998 for up to 180 countries. Hatton and Williamson (2002) have put together data on net international emigration rates for 80 countries for six years over the period 1972 to 1996. Finally, Docquier and Marfouk (2006) have calculated the number of nationals of the working-age population (aged 25 and over) that reside outside their home country and within one of the countries of the OECD for up to 190 countries for the years 1990 and 2000. The emigration rate variable is the number of people aged 25 and over residing in OECD countries relative to the sum of all nationals of that age group, living at home or in OECD countries. All three data sources have their respective strengths and weaknesses and also capture different aspects of international migration. For example, the migration to the US data have good availability, but capture migration to only one, if perhaps the most important, developed country in terms of immigration. The net emigration rates make no distinction between migration to developed and developing countries and measure the difference between out-migration and in-migration rather than out-migration itself. The remaining measure is only available for two points in time, but measures the stock rather than flow of emigration, thereby capturing past migration flows. Interestingly, however, all three measures lead to rather similar results as we will see below.

Testing the third hypothesis is in some sense impossible. This is because according to Abernethy (1999) what matters are subjective perceptions of prosperity and these

are of course next to impossible to measure. The recourse to subjective perceptions also makes the hypothesis almost non-falsifiable.[4] With these caveats in mind, we take the economic growth rate as our measure of economic prosperity. After all, the collapse of economic growth in many "Asian tiger" countries in the late 1990s is taken as an indication for drastically reduced perceptions of economic opportunities by Abernethy and Penaloza (2002) themselves.

As control variables we use the natural log of real gross domestic product per capita (GDP p.c.), the infant mortality rate and the female labour force participation rate, with data taken from World Bank (2005). Per capita income controls for the demographic transition that countries undergo in moving from low incomes with high fertility to high incomes with low fertility (Strulik and Sikandar 2002). Note that per capita income has not only a direct effect on fertility rates, but also an indirect one via its correlation with things such as various aspects of health care provision, for which comparable data are difficult to get for a large sample. Infant mortality captures the idea that parents aim for a certain number of surviving children rather than births and that infant mortality is positively associated with fertility rates since with high infant mortality women need to give birth to more children in order to reach their intended family size (Lee 2003).[5] Female labour force participation controls for the effect that

[4] Witness the argument in Abernethy (1999: 143) that education, health care and higher living standards are typically associated with declining fertility because they first raise and then dash hopes for real progress: 'Thus, it appears that better education and healthcare, and images of a rising standard of living – although themselves not the precipitants of the fertility decline – may set the stage for the disillusionment and disappointment that do drive down fertility.' Clearly, with recourse to such twisted logic any argument becomes almost impossible to falsify.

[5] Infant mortality has slightly better data availability than mortality below the age of five. The two are highly correlated with each other.

female empowerment might have on fertility rates (Sanderson and Dubrow 2000; Sen 2001). One could of course think of other proxy variables for female empowerment, but the labour force participation rate has the advantage of good data availability and was also found to be more strongly related to fertility rates than female education levels by McClamroch (1996). Table 1 provides summary descriptive variable statistics as well as a bivariate correlation matrix. Note that because the emigration stock rate variable is only available for two years, it is not included in the correlation matrix to prevent a massive loss of observations. It is correlated at r = .77 with the migration rate to the US and at r = 0.20 with the net out-migration rate.

< Insert Table 1 around here >

We average data over five-year periods, since both the explanatory and dependent variables are not equally well available in all years for all countries. Note, however, that the main results are consistent if we use annual data instead, in which case some countries have many more observations than others. We estimate both random- and fixed-effects models with fully panel-robust standard errors, i.e. standard errors are not only robust to heteroskedasticity, but also to autocorrelation. The inclusion of country fixed effects is justified if one or more of the explanatory variables are correlated with time-invariant factors specific to each country.[6] We also include period-specific time dummies to mitigate the possibility that our explanatory variables are merely picking up a time effect. The inclusion of control variables including

[6] Barber (2002) argues that, for a range of reasons, fertility is related to geographic latitude and winter temperatures. However, it is unclear to what extent the relationship is spurious and is down to socio-economic differences across countries that are correlated with latitude and winter temperatures.

country and time fixed effects is necessary to do justice to the theory. Food aid and migration to developed countries as well as good economic prospects might not raise fertility rates, but might prevent them from falling as much as they otherwise would. Hence, the theory would predict a positive effect of these three variables on fertility rates only contingent on the presence of other variables that can explain the downward trend in fertility rates over time.

Reverse causality of our main explanatory variables is certainly a possibility. However, if existent, it would favour the theory as countries with higher fertility rates are likely to have higher emigration rates and are perhaps more likely to receive higher food aid shipments. Since the results reported below fail to confirm the theory, potential remedies for reverse causality such as instrumental variable regression are not pursued any further.

4. Results

Table 2 presents estimation results. The control variables and the economic growth rate are always included. To these are added the migration and food aid variables in separate regressions. In columns I and II the migration rate to the U.S. is included in random- and fixed-effects estimation. Total fertility rates are positively associated with infant mortality rates and negatively with female labour force participation, per capita income and its growth rate. A higher migration rate to the US is negatively associated with fertility. The Hausman test does not suggest systematic differences between the fixed-effects and the random-effects estimation. This suggests that the random-effects estimation provides not only more efficient, but also consistent results. This holds true for the other random-effects estimations reported in table 2 as well.

Nevertheless, we also report fixed-effects estimation results since statistical tests may fail to detect inconsistency.

In columns III and IV the migration variable is the net emigration rate. In random-effects estimation, the net emigration rate, the economic growth rate and per capita income are all negatively related to fertility, whereas the opposite is the case for infant mortality. In fixed-effects estimation, only the infant mortality and the net emigration rate remain statistically significant. In columns V and VI the migration variable is the stock of emigrants aged 25 or over residing in OECD countries relative to the sum of adult nationals from a country. Note that this is a stock variable, not a flow variable like the previous ones. A higher value reflects larger migration to developed countries *in the past*. As it is only available for two years, we estimate two separate cross-sectional regressions.[7] In both estimations, a higher emigration and female labour force participation rate as well as per capita income are negatively associated with fertility, whereas the opposite is the case for infant mortality. In column VI economic growth has a statistically significantly negative effect on fertility rates, but is insignificant in column V. In columns VII and VIII, food aid per capita replaces the migration variables. It is negative and statistically significant in both random- and fixed-effects estimation. Per capita income, the economic growth and female labour force participation rate have a negative, the infant mortality rate a positive effect on fertility rates.

< Insert Table 2 around here >

[7] Note that for regression VI total fertility rates from 2002 rather than 2000 were taken due to lack of data for many countries in 2000.

In terms of robustness tests, I lagged the independent variables by one period. The reason is that migration, food aid and economic growth (as well as the other explanatory variables) could have a delayed rather than contemporaneous effect on fertility rates. The results are hardly affected. It is also possible that the effect differs across groups of countries. In particular, it could be that the effect is more in line with the tested hypotheses in very poor countries than in developing countries with somewhat higher per capita incomes. The regressions were therefore re-run for the group of low-income, lower middle-income and upper middle-income developing countries separately, using World Bank country income classifications. With one exception, none of the migration, food aid or economic growth variables became positive and statistically significantly different from zero in any of the regressions. The exception is the net out-migration rate, which became positive for the group of low-income countries, but with a t-statistics of 1.69 only. In other words, the coefficient was barely statistically significant and the result might be down to pure chance.[8]

5. Conclusion

This paper has provided an empirical test of three hypotheses that some neo-Malthusians derive from their theory of fertility change. The results clearly fail to support the theoretical predictions. Migration out of developing countries is generally associated with lower, not higher fertility rates. So are food aid and economic growth. What might explain the results? Starting with economic growth, since the 'fertility opportunity hypothesis' is set up by Abernethy (1993, 2002) in contradiction to demographic transition theory, the negative result needs no further explanation. As

[8] Detailed results of robustness tests available on request.

concerns food aid, it is quite possible that the negative link with fertility is spurious. Food aid is likely to be higher when countries experience droughts and famines. It is well established that fertility rates go down during such events (see Dyson and Ó Gráda 2002). Hence, the negative effect might be caused by the event that triggers food aid rather than by food aid itself.

On migration, one possibility is that those who leave the country have a higher fertility propensity than those who are left behind. However, there is little evidence for this and selectivity is unlikely to be a major cause (Jensen and Ahlburg 2004). Another possibility is disruption of fertility due to the physical separation of couples. Often, it is men who migrate first and are able to bring their spouses and already existing children with them only after a considerable period of time. Yet another explanation could be that countries with higher out-migration receive higher remittance payments, not necessarily captured by official per capita income figures. In as much as higher incomes are associated with lower fertility rates as demographic transition theory and most of the empirical evidence presented above would suggest, this might explain the negative effect of out-migration. Lacking data to test the various possible channels, not much more than these speculations can be offered at this point. What we do know, however, is that whatever the channel, existing evidence fails to support and even often contradicts the theory of fertility change espoused by some neo-Malthusians.

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Table 1. Descriptive variable statistics and bivariate correlation matrix.

Variable	Obs	Mean	Std. Dev.	Min	Max
Total fertility rate	499	4.636	1.934	1.104	9.800
Rate of migration to U.S.	499	0.001	0.002	0.000	0.012
Net out-migration rate	232	0.008	0.054	-0.220	0.281
Emigration stock rate (1990)	109	0.047	0.084	0	0.449
Emigration stock rate (2000)	138	0.053	0.084	0	0.474
Food aid per capita	458	0.008	0.018	0	0.171
Growth in GDP per capita	499	0.079	0.176	-0.562	1.429
GDP per capita (ln)	499	7.003	1.304	4.351	10.879
% female labour force	499	36.101	10.493	4.402	53.016
Infant mortality rate	499	73.555	48.197	3.700	225

	I	II	III	IV	V	VI	VII	VIII
I: Total fertility rate	1							
II: Rate of migration to U.S.	-0.197	1						
III: Net out-migration rate	0.085	0.394	1					
IV: Food aid per capita	0.098	0.231	0.008	1				
V: Growth in GDP per capita	-0.272	-0.038	-0.144	-0.046	1			
VI: GDP per capita (ln)	-0.650	0.192	-0.245	-0.038	0.049	1		
VII: % female labour force	-0.219	0.005	-0.083	-0.120	0.010	-0.130	1	
VIII: Infant mortality rate	0.822	-0.185	0.191	0.036	-0.182	-0.708	-0.125	1

Table 2. Estimation results (dependent variable is total fertility rate).

	I RE	II FE	III RE	IV FE	V 1990	VI 2000	VII RE	VIII FE
Rate of migration to U.S.	-86.542	-87.012						
	(3.13)***	(3.32)***						
Net out-migration rate			-2.437	-1.609				
			(2.82)***	(1.84)*				
Emigration stock rate					-2.974	-1.170		
					(2.34)**	(1.68)*		
Food aid per capita							-3.722	-3.874
							(1.77)*	(2.61)***
Growth in GDP per capita	-0.736	-0.674	-1.181	-0.661	-0.245	-7.826	-0.744	-0.630
	(4.39)***	(3.78)***	(3.32)***	(1.54)	(0.21)	(3.55)***	(4.51)***	(3.40)***
GDP per capita (ln)	-0.357	-0.308	-0.422	-0.147	-0.234	-0.148	-0.348	-0.282
	(4.61)***	(2.38)**	(4.26)***	(0.80)	(1.75)*	(1.74)*	(4.36)***	(2.08)**
% female labour force	-0.053	-0.056	-0.023	-0.007	-0.039	-0.035	-0.051	-0.054
	(5.06)***	(2.97)***	(1.65)*	(0.25)	(2.70)***	(3.39)***	(4.76)***	(2.77)***
Infant mortality rate	0.022	0.017	0.020	0.017	0.027	0.032	0.023	0.018
	(9.27)***	(5.39)***	(6.05)***	(4.06)***	(6.69)***	(10.08)***	(9.41)***	(5.00)***
Observations	499	499	232	232	109	138	472	472
Number of countries	134	134	61	61	109	138	139	139
R-squared	0.72	0.81	0.77	0.83	0.70	0.79	0.73	0.76
Hausman test (p-value)	7.71		3.43				2.99	
	(0.74)		(0.96)				(0.96)	

Notes: RE: random effects; FE: fixed effects. Period-specific time dummies included in columns I to IV and VII to VIII. Coefficients of period-dummies and constant not reported. (Panel-)robust standards errors (absolute t- and z-statistics in parentheses). Hausman test is asymptotically chi-square distributed.

* statistically significant at 10% ** at 5% *** at 1% level.