Trade and Fertility: The Impact of Exports and Export Structures

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Abstract

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JEL classifications: C33, F16, I25, J13, J24, O15, Q17

Keywords: international trade, population growth, fertility, globalization, developing countries, panel analysis

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The impact of fertility and the impact of trade are frequently discussed as two separate phenomena in the literature on economic development. However, a very recent theoretical contribution connects these two and finds that global trade has an asymmetric effect on fertility in developed and developing countries. With this contribution we provide empirical evidence of the proposed connection. Our findings generally support the proposition that trade can impact a country's fertility level both negatively and positively depending on its export structures.

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1 Introduction

Both trade and fertility are much-considered factors in the development economics debate. How does international trade affect a country's development? What are the causes and effects of fertility in the development process? A recent theoretical contribution by Galor and Mountford (2008) proposes that these two factors, trade and population development, are interrelated. The authors suggest that global trade exerts an effect on a country's fertility level in such that a modern export sector reduces fertility by providing an incentive to invest in human capital. In the tradition of unified growth models (e.g. Galor, Moav and Vollrath 2008, McDermott 2002, Doepke 2004) they incorporate both developing and developed countries and suggest that the impact of trade on fertility is a possible additional explanation for global differences in development. This is also based on certain observable trends, such as a) demographic development and b) world trade. Many countries are currently in the middle of a demographic transition.[1] Mortality rates are already low and fertility rates are declining. As a result population growth is declining. Because the demographic transition is not a uniform and simultaneous movement there are also countries at the onset (least developed countries) or at the end (advanced economies) of the transition. An additional factor that is relevant to this analysis is world trade integration, which has greatly intensified over the past decades (WTO 2006, WTO 2011).

In a stylized two-economy model Galor and Mountford propose that trade to impacts on a country's fertility development in an asymmetric manner, depending on the export sector's structure. They assume different levels of technology within an agrarian and a manufacturing (trading) sector. An increase in the level of technology that is used for production leads to an increase in demand for human capital. Also, parents optimize their own consumption and the potential income of their offspring. Naturally, skilled workers have greater income potential. Under the assumption that it is more resource intensive for parents to raise skilled offspring than unskilled offspring, they decide on the number of children and the amount of time they want to devote to raising them. This is essentially a decision on whether they wish to raise skilled or unskilled children.. As raising skilled children requires them to invest more time they will restrict themselves to a small number of children. However, if there is demand for human capital these children have greater potential income and hence there is an incentive for parents to invest in the education of their offspring. According

[1] For a detailed account of the demographic transition, theory and trends see e.g. Bloom et al. (2003) or Lee (2003).

to conventional (Ricardian) trade theory of comparative advantages there will be gains from trade resulting from relative productivity advantages. Galor and Mountford suggest that these gains are channeled differently. A skill intensive manufacturing sector will require more skilled workers (i.e. demand more human capital) than an agrarian sector and therefore fertility would be lowered. Also, in an low-tech agrarian sector parents will not devote more time to raising skilled children as the demand for human capital is low. Here fertility would not be lowered. Consequently the structure of the export sector is a significant factor in determining the impact of international trade on fertility. If the theory holds, one can pose the question whether the development of advanced economies adversely affects the development of less-developed countries (Galor and Mountford 2008), which contributes a more nuanced aspect to the debate on whether trade encourages income growth.

In another theoretical contribution, Lehmijoki and Palokangas (2009) also connect world trade with fertility decisions and thus population development in developing countries. However, while Galor and Mountford (2008) focus on the structure of the export sector, Lehmijoki and Palokangas point more to wage and income effects induced by international trade. In a family optimization model they identify two effects of trade on population growth. First, an income effect that increases population growth and then, a gender wage effect that decreases population growth in the long run. There is almost no empriical evidence of the relationship between trade and fertility, not to mention any evidence that fertility is impacted by different structures of export sectors. However, both theoretical papers contain brief empirical sections that confirm that data is consistent with the developed models.

With this paper we add to the scarce evidence concerning the relationship between trade and fertility as described mainly by Galor and Mountford (2008). Our contribution aims to provide a comprehensive empirical analysis and to emphasize the role of different export sectors as determinants of fertility. Because the theoretical advance of Galor and Mountford is built upon an asymmetric effect (fertility-enhancing or neutral impact of trade in developing countries and fertility-reducing impact of trade in developed countries) due to different structures in the export sector we use exports per capita in primary and secondary sectors.[2] Throughout we focus on panel

[2] They indicate the signalling strength a sector has to have in order to impact. However as the indicator in some cases may not reflect the structure in further tests, we control additionally for structural variables (trade openness, value added (to GDP) of the primary and secondary sector, share of manufacturing exports in total exports) and find no qualitative change in our result.

regression analysis to correctly deal with the problems inherent to cross-country studies.

Our empirical findings generally support the theory that international trade affects fertility, especially in less developed countries. In our analysis of more than 100 countries we find evidence that manufacturing exports exert a negative impact on fertility. Results are different for the export of primary goods. The primary goods sector does not negatively affect fertility. Here we rather see positive or no impacts. The remainder of this paper will be structured as follows. We introduce our data and methodology in detail in the next section and continue with the estimation results. The last section summarizes our major findings and concludes the paper.

2 Empirical Analysis

The goal of this section is to estimate the effect of the trade structure on fertility outcomes. We also hope to find an answer to the question whether trade affects fertility levels differently at different development levels. We propose a straightforward panel regression model in which we regress a fertility proxy on two trade measures. Further, we control for several factors, abstracted from the fertility literature. Based on five databases (World Development Indicators, Comtrade, Child Mortality Database, Penn World Tables and Barro and Lee's dataset on educational attainment) we create a panel of 135 countries (N) and 39 years (T) between 1970 and 2007. We limit our complete sample to this timeframe, since the data for the period before 1970 is not sufficient enough for us to perform a robust estimation. However, the precise information about the number of countries and observations is given for each individual estimation.

Methodology: The data we use is collected in cross-sections *and* time-series for our units (countries) and enables us to proceede with a panel regression. This is especially valuable because it allows us to map out a differential effect of different country groups. In the panel setting we can address this by grouping the countries into subpanels. Further, in a panel regression we can control for unobserved heterogeneity which is a common problem in OLS cross-country regressions.[3] Unobserved heterogeneity is almost by definition a potential source of bias if the sample consists of all countries for which data is available. In a regression of fertility, for example, cultural differences may be such a source of heterogeneity. In our panel setting we control for unobserved effects with

[3] For a more detailed description of the advantages of panel data over cross-section data see e.g. Hsiao (2003).

country dummies, leading us to estimate a fixed effects model. This procedure is in line with the advice of Judson and Owen (1999) who provide guidelines for macropanel estimations. Further, since we do not draw a random sample from a much larger universe of units the fixed effects model is more feasible (Baltagi 2003) than a random effects approach.

Further, we run two tests before we apply the fixed effects estimator. First, we test for heteroscedasticity across panels (groupwise heteroscedasticity) and second, we test for serial correlation within panels. The test for heteroscedasticity is based on the notion that a panel which includes all countries is very likely to show unconstant variance in the error terms of a fixed effects model estimation. The test is based on Greene (2003). We run the second test because each group is observed yearly for up to 38 times so there is a potential autocorrelation bias. We use the test proposed by Wooldridge (2002) because it has fewer assumptions than higher parameterized tests and is still robust (Drukker 2003). Since our testing indicates heteroscedasticity and serial correlation problems within the sample, we account for both in the estimation.

Model: We estimate the model

$$Y_{it} = \alpha + T_{it}\beta + X_{it}\gamma + D_i\delta + \varepsilon_{it}$$

where Y_{it} is our dependent fertility variable for country i at time t, α is a common intercept, T_{it} is our independent trade variable (for country i at time t), X_{it} is a vector of control variables, D_i is a dummy for each country i in the estimation and lastly, ε_{it} is an i.i.d. error. We proceed with this estimation in our main analysis. To obtain generally valid results we run several specifications with differing sets of control variables. This procedure ensures that we proceed in accordance with the fertility literature. A core proposition of the theory by Galor and Mountford is the differential effect of trade on fertility. This effect is primarily modeled using two different trade variables. However, we also divide our panel into different subpanels, namely high- and low-income countries and the three lower-income groups, to see whether there is a possible stronger or weaker influence. Further, within our controls we may observe different effects. We classify countries according to income and in line with the World Bank.[4]

[4] The World Bank income groups are: High-income countries, Upper middle-income countries, Lower middle-income countries, Low- income countries with 2009 GNI per capita of more than \$12 195, \$3 946-\$12 195, \$996–\$3 945 and less than \$996, respectively.

Variables:

Dependent variable: We estimate *fertility* with the total fertility rate (TFR). The TFR is a composite measure containing all age-specific fertility rates. Therefore it comprises the number of births a imaginary woman would give if she were to move fast-forward through her life (and her childbearing years). The great advantage of this is that the TFR is not influenced by age composition. The indicator is taken from the World Bank's development indicators (WDI). This indicator lets us focus directly on reproductive behaviour. We use it in levels because states that trade impacts on fertility levels. For a detailed description and potential drawbacks of the TFR see e.g. Weil (2005).

Independent variable: The trade variables we use as determinants in the equation are a) *primary exports per capita* and b) *manufacturing exports per capita*. However we do not use both variables in the same regression as they both point at a similar issue: the structure of the export sector. We use both to validate the results. Primary exports per capita refers to the value of exports (to the world) in the categories 0-4 according to the standard international trade classifications (SITC) divided by population numbers. Manufacturing exports per capita refers to the values of exports (to the world) in the SITC categories 5-8, also divided by the total population. Data on trade statistics is drawn from the trade division of the United Nations (Comtrade 2011), while data on population figures is drawn from the Penn World Tables (Heston et. al. 2009). The variable is used in levels to approximate the demand for human capital according to the theory. Exports per capita are stated in current US dollars.

Control variables: *GDP per capita*, the first control variable, is our proxy for income. The role of income as a determinant of fertility is not straightforward and the subject of an long-standing debate.[5] The impact of income on fertility strongly rises and falls depending on whether children are perceived as a productive asset or a consumption good (Drèze and Murthi 2001). If children are regarded as a consumption good the focus is on costs and the quality-quantity tradeoff. This means that rising income makes children more affordable, hence we have a positive relationship. At the same time one may observe that when parents' income increases, their opportunity costs rise as

[5] As early as 1792 Malthus proposed that income increases above subsistence levels was capable of spurring population growth (Malthus 1792).

well, showing a possible negative effect. Alternatively, if parents substitute quality for quantity the effect would also be negative. Particularly in developing countries children are more likely to be regarded as a productive asset, i.e. an inexpensive source of additional labor and old-age security. What may further confuse the relationship is the type of (additional) income: while wage increases raises opportunity costs, an increase in productive assets, e.g. land, could raise demand for children (Drèze and Murthi 2001). Due to the aforementioned complications we do not expect a particular sign for this control variable. Our data source is the Penn World Tables (Heston et. al. 2009), while GDP per capita is used in levels to comply with the mentioned possible ways of interaction. It is stated in constant 2005 US dollars.

We further control for *infant mortality*. We include this factor as it directly affects fertility decisions. To obtain a desired family size an increase in the level of child mortality will force parents to have more children. We therefore expect a strong positive relationship between infant mortality and fertility. It is suggested that especially in developing countries infant mortality may not be completely exogenous to fertility. Due to hygiene and health issues high fertility possibly leads to higher child mortality (Drèze and Murthi 2001). We will account for this in a later section (see robustness). The data is taken from the CME Info portal, a UN inter-agency group (Unicef, UN Population Division, World Bank, WHO) that produces child mortality estimates (CME 2010).

We also control for *female labor force participation* in our analysis. Especially if women are mainly occupied with child-rearing their participation in the labor force affects the number of children they have. However, in less developed, agricultural economies family duties and labor participation can possibly be more easily combined than in middle-income more industrialized societies. We therefore do not expect a uniform impact. Further, it is generally acknowledged that female labor force participation can lead to an endogeneity problem, as fertility can also be a determinant of labor force participation (Bloom et. al. 2009). We use data from the World Development Indicators (World Bank 2011). The ratio of economically active women to the total number of women aged 15 and older. "Economically active" means that they participate in the production of goods and services.

Female education. The role of education is said to have different effects on fertility. Higher education can lead to higher income and thus increase the opportunity costs of having babies. It may also be the case that more educated women, especially in developing countries, leave the agrarian sector and bear fewer children. Female education is also said to effect a woman's ability to have the desired number of children (see e.g. Kim 2010). We also control for education since Galor and Mountford's conclusion that trade in industrial goods induces investments in human capital can be interpreted in two ways. The first is the modeled channel of induced investments in the offspring's education, while the second is investment in one's own education. By including female education we control for the second effect. The level of education is approximated by the average years of schooling, with data taken from Barro and Lee (2010). The original data is provided in the shape of five-year averages. To obtain yearly time series we interpolate between the values because the series seem to follow strong trends and do not vary greatly.

Urbanization. In the analysis urbanization can impact fertility decisions because in urban settings children are less likely to be seen as a productive asset. Also, children are more difficult to supervise (Drèze and Murthi 2001) A rapid spread of modern social norms is also attributed to urban settings. We use data from the World Development Indicators on the share of population living in urban areas (World Bank 2011). We also interpolate the original five-year averages to obtain yearly time series for the same reasons as our education variable.

In the main analysis we use yearly data and refrain from averaging over years to avoid losing information contained in the series. Because the panel is not fully balanced we choose an estimator that is able to handle this. Summary statistics are given in table 1, while detailed information on data and its source is given in the appendix (table A1). All variables are used in natural logarithms.

[TABLE 1 HERE]

3 Estimation Results

Table 2 shows the estimation results for the complete sample of all countries. The columns present the estimations of different model specifications. Model 1 presents a basic model with the most important explanatory variables, namely infant mortality and GDP per capita. In models 2 to five we include more control variables. However, we are mainly interested in the behaviour of manufacuring exports per capita. Looking at the complete sample, i.e. all income groups (top panel), we find a negative significant impact of manufacturing exports on fertility. We therefore find empirical evidence of the relationship hypothesized by Galor and Mountford. Working in the manufacturing (export) sector requires, at least normally, a higher education. We hence find evidence that the availability of jobs in this sector increases demand for education and in turn, lowers fertility.

[TABLE 2 HERE]

The two panels in the middle and at the bottom divide the complete sample into high- and lower-income countries. Of the initially roughly 100 countries, around 40 are in the World Bank's income categories one (high-income) and two (high-income non-OECD), and the remainder are in categories three (upper middle-income), four (lower middle-income) and five (low-income). While the negative effect of manufacturing exports on fertility seems to disappear in high-income countries the sample of lower-income countries still shows a significant negative effect. We therefore see that the manufacturing export sector in high-income countries has a weak effect on parents' assessment of the payoff of their children's education. We interpret this result as a lack of incentive to further invest in children's education. Possibly this is because the manufacturing sector in high-income countries do not necessarily require additional schooling over and above the already high educational attainment level of workers. This also seems plausible because the "manufacturing sector" variable captures both low- and high-tech products and and the general level of education in developed countries is sufficient for producing at least low-tech products in industrialized countries. Further, in high-income countries the low fertility rates and the opportunities of women make it possible to accommodate investments in education and have children at the same time. In lower-income countries this appears to be different. With the results we can support the theoretical model where parents have fewer children in order to increase the level of education per child.

We re-run the analysis and exchange the explanatory variable of interest, i.e. we exchange manufacutring exports with primary exports. According to Galor and Mountford's theory the latter is expected to have a positive impact on fertility or at least not affect it negatively. The model proposes that in the presence of a strong primary goods export sector the incentive to invest in children's education is limited. This results in no fertility reduction.[6] The results are, to

[6] In the empirical section of Galor and Mountford's paper this impact is not explicitly tested. However, they detect a lack of influence of trade openness on fertility in low-income countries. Under the assumption that low-income countries trade mostly in primary goods this implicitly supports their theory.

conserve space, reported in table A2 in the appendix. The complete sample (in this case around 120 countries) shows no significant impact of primary exports per capita on fertility rates. However, a look at the two subsamples, high- and lower-income countries, reveals that for high-income countries in two of five models there is even a significant negative impact of primary products' exports on fertility. On the contrary, the subsample of lower-income countries shows a positive impact (in two models) as well as a positive but non-significant impact (in three models). In addition, the finding that primary exports affect fertility levels in low-income countries is consistent with the conclusion of Weil and Wilde (2009) that economic development in countries that depend heavily on income from agriculture suffers from high population growth.

We find support for the theory that exports in different categories (primary and manufacturing) affect fertility, however more so in lower-income countries. There is a slightly unexpected negative impact of the export of primary products on fertility for high-income countries , which can be explained by a factor-intensity reversal in the primary sector of high-income countries. In these countries the primary sector is capital-intensive and and there is very little demand for low-skilled workers. Also, the overall contribution to jobs is limited in this setting even though the output generated and exported is high. For these reasons the impact on fertility is almost non-existent. Overall, the results support the theory for developing countries, but here they are somewhat weaker then their counterparts in the estimation with manufacturing products (table 2).

The results indicate that the mechanism is more relevant in developing countries. Therefore, we proceed by performing estimations for further subsamples of developing countries grouped by income levels (table 3). For the impact of manufacturing exports per capita on fertility we estimate each income group seperately to identify possible different effects. The panels from top to bottom are for income groups three, four and five, respectively. Again the different model specifications show similar results, validating the general findings.

[TABLE 3 HERE]

Interestingly, we do not see the same negative impact across the subsamples. While higher and lower middle-income countries (top and middle panel) mostly show that manufacturing exports impact negatively on fertility, the bottom of the sample (low-income countries) cannot offer this connection. Even though in this case we find negative coefficients (except one in model 5), none are significant. We see that the mechanism does not work at the bottom of the development ladder.

Structures are possibly too little developed and the role of manufacturing products is marginal. We conduct a similar excercise and estimate the equations with primary exports per capita to identify the export sector's structure. The results, reported in table A3 in the appendix, show that a positive effect of exporting primary goods is mostly present in higher middle-income countries. The lower two income groups (four and five) do not show such a relationship but nevertheless have mostly positive coefficients. Overall we again have less strong estimations than the counterparts using manufacturing exports. The fact that the lower two income groups do not show the effect suggest that there are other stronger determinants of fertility decisions in the lower developed countries. However, these findings correspond to the empirical results of Galor and Mountford since the sample they used was only divided into OECD and non-OECD countries.

Besides our findings concerning the impact of trade in manufacturing products and primary products on fertility in high-, higher-, lower-middle and low-income countries it is worth pointing out the results of other included control variables as well. Child mortality, generally acknowledged as one of the main determinants of fertility, is -as expected- positively related to fertility, which is consistent with Doces (2011), Jeon and Shields (2005), Lemijoki and Palokangas (2009), and Galor and Mountford (2008). The results also show that the strength of impact varies considerably. While in low-income countries the effect is strong, it decreases as development rises, with only a very small impact in high-income countries. Intuitively, this is explained by very low child mortality rates in developed countries. This robust relationship yields an important result for policy making. If birth rates are to be brought down in low-income countries, lowering child mortality is an important target. Our "female education" variable also shows the expected sign across all estimations. There is a clear negative relationship between female education and fertility, a finding consistent with Becker et al. (2011) and Osili and Long (2008), for example. While it holds for both high- and lower-income countries (table 2) the effect is greater in countries that are further developed. In the group of low-income countries (table 3) the effect is least noticeable. The labor force participation rate of women also affects fertility negatively, a result in line with existing empirical evidence (Pampel (1993) or Jeon and Shields (2005)). However, here we cannot see any differences among the income groups except that in low-income countries it is not significantly noticeable (table 3). This makes sense because there are differences in opportunities for economically active women to rear children. A factory worker will find it more difficult to supervise her children than a woman working on a rural family-owned field, even though both of them would count as economically active. The are probably more rural workers in least developed countries. In our regression we also control for urbanization. On average we find a negative effect of urbanization on fertility. However, in high-income countries there seems to be no effect while in low-income countries (group 5) there seems to be a positive effect. Finally, we control for per capita income. The effect of income on fertility (or population development) is discussed extensively in the literature.[7] However, there are still supporters of a negative impact of income on fertility and supporters of the contrary, which is a positive impact of income on population growth. Our coefficient estimates reflect this. We find mostly insignificant relationships which can, however, indicate opposing underlying effects. Interestingly we see positive relationships in the top and the bottom income groups. That is, in high-income and low-income countries GDP per capita increases fertility levels while in between (medium-income countries) we witness a negative relation. A commonly hypothesized u-shape relationship is present that possibly depends on the substitution and income effect of children (Weil 2005).

Robustness: In case our yearly data is plagued by cyclical effects we average over five-year intervals. This creates an almost completely balanced panel of 68 countries and five five-year intervals between 1980 and 2005. We repeat our model estimations in this panel for the complete sample and the two major subsamples of high- and low-income countries. Here we refrain from estimating the low-income country groups three, four, and five separately due to severe reductions in observations. The results in tables A4-A6 in the appendix also show a negative impact of manufacturing trade on fertility for the complete sample (A4) and for the group of lower-income countries (A6) as well as a mixed (positive or non-significant) impact in high-income countries (A5). This reflects our findings in the main analysis. Also, the five-year estimations for primary exports per capita as the explanatory variable support the findings in the main analysis. Even though the results for the complete sample show a negative impact of primary exports per capita on fertility, a look at the two sub-samples indicates that this results from a strong negative influence in the group of high-income countries. In lower-income countries we find either a positive significant impact (models one and three) or no significant impact.

We perform a final validation and use a dynamic panel estimator that is capable of estimating in the presence of endogeneity. Especially child mortality, per capita GDP and the female labor

[7] For a comprehensive review see e.g. Kelley (1988).

force participation rate can be thought of as being influenced by fertility (Drèze and Murthi 2001). We employ a system GMM estimator and account for possible endogeneity of these variables. Just as in previous estimations our results for the complete sample show a significant negative effect of manufacturing exports per capita on fertility (see Table A7) and a positive impact of primary exports per capita on fertility. We do not further subdivide the sample due to a limited number of observations.

4 Conclusion

Our contribution aims to provide empirical evidence supporting Galor and Mountford's (2008) interesting proposition that trade impacts fertility. Their model, which incorporates both, developed and developing countries, exhibits an asymmetric effect of trade on fertility. The asymmetry results from different structures in the export (trade) sector. While industrialized countries have a more developed manufacturing sector, developing countries may rely on a stronger primary sector that makes intensive use of low-skilled labor. This difference in sectors is identifed as providing different incentives to invest in children's education. While the low-skilled primary sector does not provide an incentive for parents to invest in their offspring's education, the higher-skilled manufacturing sector does. The incentive to invest in education lowers fertility levels as parents favor child quality over quantity if there is the possibility to receive higher pay-offs for the investment. While former empirical extensions in theoretical studies (Lehmijoki and Palokangas (2009) and Galor and Mountford (2008)) address the export sector's structure implicitly, we do so explicitly. We regress fertility levels on exports in the two distinct sectors for primary and secondary products and find evidence of different impacts at different levels of development. In support of Galor and Mountford's (2008) theory we find that manufactures exports lower fertility levels while primary exports have a positive or no impact. Our panel regression contains yearly data from 1970 to 2007 and for 135 countries. We validate the results with average value panel regressions and a dynamic panel estimator. We find that especially in developing countries where education levels are generally lower, this relation holds. However, this connection is not present in the group of *least* developed countries. We assume that skill-intensive production does not play a strong enough role to affect fertility levels negatively.

High fertility levels are often regarded as harmful to development. A recent survey by the United Nations (World Fertility Policies 2011) underlines that many governments regard their fertility levels with concern. With the present study we conclude that fertility is also affected by world trade. On the one hand, trade integration can support the goal of lowering fertility levels in high-fertility developing countries. On the other, however, this can only be done if export structures change in favor of more manufacturing. If primary production remains predominant, fertility levels can only be brought down by other means, while economic structure may even undermine the attempt. Among other interesting and literature-consistent findings for our control variables, we point out that child mortality remains the biggest determinant of fertility levels in our analysis, especially in lower-income countries. An important policy implication is therefore that a reduction in child mortality is a strong contributor to bringing down fertility rates.

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5 Tables

Table 1: Summary statistics

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
Fertility (log)	1.217	0.528	0.077	2.09	3854
Manufacturing exports per capita (log)	4.854	2.533	-3.643	10.837	3429
Primary exports per capita (log)	5.277	1.724	0.496	10.742	3255
GDP per capita (log)	8.779	1.126	6.331	11.624	3951
Infant mortality (log)	3.382	1.06	0.642	5.263	3863
Female labor force participation (log)	3.781	0.371	2.251	4.454	2884
Female schooling (log)	1.572	0.765	-2.114	2.544	3572
Urbanization (log)	3.839	0.567	1.74	4.605	3952

Table 2: Manufacturing Exports and Fertility (Complete Sample)

	All Countries				
Model:	(1)	(2)	(3)	(4)	(5)
Man. Exp. p.c.	-0.003***	-0.004***	-0.003***	-0.003***	-0.002**
	(-3.34)	(-3.58)	(-3.43)	(-3.44)	(-2.28)
Infant Mortality	0.423***	0.355***	0.387***	0.352***	0.271***
	(74.35)	(45.07)	(56.42)	(44.21)	(31.06)
GDP p.c.	0.001	-0.001	0.000	0.000	-0.010*
	(0.20)	(-0.17)	(0.06)	(0.07)	(-1.75)
Fem.Schooling		-0.130***		-0.107***	-0.163***
		(-15.98)		(-10.30)	(-14.53)
Fem.Lab.For.Part.					-0.196***
					(-13.05)
Urbanization			-0.203***	-0.082***	-0.154***
			(-13.10)	(-3.62)	(-7.67)
Observations	3284	3047	3284	3047	2280
Countries (n)	104	94	104	94	94
Time span (years) (t)	38	38	38	38	28
	High-Income Countries (Groups 1 and 2)				
Model:	(1)	(2)	(3)	(4)	(5)
Man. Exp. p.c.	-0.001	-0.000	-0.002	-0.001	0.012**
	(-0.32)	(-0.08)	(-0.47)	(-0.27)	(2.02)
Infant Mortality	0.319***	0.160***	0.313***	0.160***	0.084***
	(25.24)	(8.16)	(22.06)	(7.83)	(3.60)
GDP p.c.	0.027*	-0.004	0.032**	-0.001	0.008
	(1.91)	(-0.31)	(2.14)	(-0.06)	(0.40)
Fem.Schooling		-0.473***		-0.478***	-0.464***
		(-10.17)		(-9.83)	(-7.23)
Fem.Lab.For.Part.					-0.110**
					(-2.36)
Urbanization			-0.058	0.014	0.012
			(-0.68)	(0.16)	(0.12)
Observations	1289	1240	1289	1240	947
Countries (n)	38	36	38	36	36
Time span (years) (t)	38	38	38	38	28
	Lower-Income Countries (Groups 3,4 and 5)				
Model:	(1)	(2)	(3)	(4)	(5)
Man. Exp. p.c.	-0.003***	-0.004***	-0.003***	-0.003***	-0.002*
	(-3.38)	(-3.67)	(-3.47)	(-3.51)	(-1.81)
Infant Mortality	0.509***	0.461***	0.473***	0.455***	0.388***
	(87.73)	(55.49)	(64.16)	(52.76)	(44.51)
GDP p.c.	0.001	-0.003	-0.002	-0.001	-0.008
	(0.10)	(-0.46)	(-0.32)	(-0.23)	(-1.38)
Fem.Schooling		-0.075***		-0.061***	-0.118***
		(-9.39)		(-5.98)	(-11.96)
Fem.Lab.For.Part.					-0.196***
					(-13.29)
Urbanization			-0.129***	-0.052**	-0.126***
			(-8.29)	(-2.23)	(-6.66)
Observations	1995	1807	1995	1807	1333
Countries (n)	66	58	66	58	58
Time span (years) (t)	38	38	38	38	28

Notes: Dependent variable in all models: TFR. All variables are used in natural logarithms.
*, ** and *** denote significance at the 10-,5- and 1% level, respectively.
T-values in parentheses.

Table 3: Manufacturing Exports and Fertility (Lower-Income Countries)

	Higher Middle Income (Group 3)				
Model:	(1)	(2)	(3)	(4)	(5)
Man. Exp. p.c.	-0.010***	-0.007***	-0.004**	-0.006**	-0.002
	(-4.04)	(-2.73)	(-2.14)	(-2.26)	(-1.07)
Infant Mortality	0.485***	0.260***	0.324***	0.248***	0.203***
	(41.04)	(16.45)	(23.64)	(15.70)	(12.30)
GDP p.c.	-0.004	-0.000	0.028**	0.016	-0.005
	(-0.30)	(-0.03)	(2.15)	(1.15)	(-0.36)
Fem.Schooling		-0.424***		-0.330***	-0.530***
		(-17.21)		(-10.52)	(-16.53)
Fem.Lab.For.Part.					-0.162***
					(-7.64)
Urbanization			-0.860***	-0.320***	0.067
			(-17.07)	(-4.84)	(1.23)
Observations	690	624	690	624	470
Countries (n)	22	19	22	19	19
Time span (years) (t)	38	38	38	38	28
	Lower Middle Income (Group 4)				
Model:	(1)	(2)	(3)	(4)	(5)
Man. Exp. p.c.	-0.003**	-0.003***	-0.002**	-0.003**	0.002
	(-2.44)	(-2.75)	(-2.29)	(-2.48)	(1.40)
Infant Mortality	0.536***	0.458***	0.458***	0.442***	0.389***
	(70.54)	(42.09)	(46.35)	(39.47)	(30.78)
GDP p.c.	-0.006	-0.010	-0.003	-0.008	-0.007
	(-0.83)	(-1.35)	(-0.41)	(-1.04)	(-0.72)
Fem.Schooling		-0.129***		-0.075***	-0.183***
		(-11.26)		(-5.67)	(-12.62)
Fem.Lab.For.Part.					-0.197***
					(-8.73)
Urbanization			-0.297***	-0.208***	-0.180***
			(-12.08)	(-6.93)	(-6.25)
Observations	901	867	901	867	647
Countries (n)	29	27	29	27	27
Time span (years) (t)	38	38	38	38	28
	Low Income (Group 5)				
Model:	(1)	(2)	(3)	(4)	(5)
Man. Exp. p.c.	-0.001	-0.000	-0.001	0.000	-0.002
	(-0.97)	(-0.10)	(-0.95)	(0.06)	(-0.62)
Infant Mortality	0.342***	0.368***	0.424***	0.561***	0.485***
	(20.69)	(11.20)	(14.54)	(11.88)	(14.20)
GDP p.c.	0.030***	0.048***	0.027***	0.042***	0.007
	(3.27)	(3.96)	(3.07)	(3.63)	(0.86)
Fem.Schooling		0.013		-0.023*	0.008
		(1.19)		(-1.88)	(0.45)
Fem.Lab.For.Part.					-0.079
					(-1.01)
Urbanization			0.079***	0.240***	-0.144***
			(3.63)	(5.89)	(-4.79)
Observations	404	316	404	316	216
Countries (n)	15	12	15	12	12
Time span (years) (t)	35	35	35	35	27

Notes: Dependent variable in all models: TFR. All variables are used in natural logarithms.
*, ** and *** denote significance at the 10-,5- and 1% level, respectively.
T-values in parentheses.

6 Appendix

Table A 1: Data Sources and Description

Variable	**Description**	**Time range**	**Source**
Fertility	Fertility is measured as the Total Fertility Rate (TFR). This is a composed measure containing all age-specific fertility rates. It comprises the number of births a imaginary woman would give if she were to move fast-forward through her life (and her childbearing years).	1970-2007	World Development Indicators (WDI)
Manufacutring exports per capita	Exports classified in groups SITC 5,6,7 and 8 in current USD divided by total population numbers.	1970-2007	United Nations Commodity Trade Database (2011)/Penn World Tables 7.0
Primary exports per capita	Exports classified in groups SITC 0,1,2,3 and 4 in current USD divided by total population numbers	1970-2007	United Nations Commodity Trade Database (2011)/Penn World Tables 7.0
GDP per capita	Gross domestic product per capita in constant USD	1970-2007	Penn World Tables 7.0
Infant mortality	Mortality rate per 1,000 live births	1970-2007	Child Mortality Database (2011)
Female labor force participation	A rate representing the share of economically active women compared to all women aged 15 and older.	1980-2007	World Development Indicators (WDI)
Female schooling	Average years of schooling among women.	1970-2007	Barro and Lee (2010)
Urbanization	Share of total population living in urban areas.	1970-2007	World Development Indicators (WDI)

Table A 2: Primary Exports and Fertility (Complete Sample)

	All Countries				
Model:	(1)	(2)	(3)	(4)	(5)
Prim. Exp. p.c.	0.001	-0.001	0.001	-0.001	-0.001
	(0.45)	(-0.58)	(1.17)	(-0.66)	(-0.42)
Infant Mortality	0.442***	0.357***	0.400***	0.356***	0.263***
	(81.60)	(50.14)	(63.93)	(50.13)	(32.83)
GDP p.c.	0.002	0.008	0.005	0.009	0.005
	(0.42)	(1.46)	(1.01)	(1.62)	(0.89)
Fem.Schooling		-0.146***		-0.145***	-0.178***
		(-22.09)		(-15.91)	(-18.88)
Fem.Lab.For.Part.					-0.179***
					(-11.77)
Urbanization			-0.232***	-0.009	-0.166***
			(-16.51)	(-0.47)	(-8.12)
Observations	3558	3244	3558	3244	2495
Countries (n)	133	115	133	115	115
Time span (years) (t)	38	38	38	38	28
	High-Income Countries (Groups 1 and 2)				
Model:	(1)	(2)	(3)	(4)	(5)
Prim. Exp. p.c.	-0.001	-0.004*	-0.001	-0.004*	-0.003
	(-0.56)	(-1.95)	(-0.44)	(-1.85)	(-0.99)
Infant Mortality	0.321***	0.141***	0.315***	0.140***	0.056***
	(27.93)	(7.64)	(24.19)	(7.29)	(2.55)
GDP p.c.	0.040*	0.006	0.047***	0.011	0.026
	(2.82)	(0.43)	(3.15)	(0.73)	(1.38)
Fem.Schooling		-0.521***		-0.527***	-0.533***
		(-11.79)		(-11.48)	(-8.63)
Fem.Lab.For.Part.					-0.130**
					(-2.89)
Urbanization			-0.087	-0.024	0.030
			(-1.03)	(-0.27)	(0.32)
Observations	1367	1322	1367	1322	1037
Countries (n)	45	43	45	43	43
Time span (years) (t)	38	38	38	38	28
	Lower-Income Countries (Groups 3,4 and 5)				
Model:	(1)	(2)	(3)	(4)	(5)
Prim. Exp. p.c.	0.002*	0.002	0.003**	0.002	0.002
	(1.76)	(1.50)	(2.24)	(1.45)	(1.47)
Infant Mortality	0.521***	0.467***	0.486***	0.465***	0.375***
	(89.63)	(58.10)	(70.18)	(57.75)	(48.25)
GDP p.c.	0.002	0.004	0.003	0.006	-0.001
	(0.41)	(0.70)	(0.59)	(0.94)	(-0.15)
Fem.Schooling		-0.088***		-0.084***	-0.128***
		(-11.98)		(-8.23)	(-14.92)
Fem.Lab.For.Part.					-0.172***
					(-11.92)
Urbanization			-0.143***	-0.012	-0.156***
			(-10.29)	(-0.60)	(-8.03)
Observations	2191	1922	2191	1922	1458
Countries (n)	88	72	88	72	72
Time span (years) (t)	38	38	38	38	28

Notes: Dependent variable in all models: TFR. All variables are used in natural logarithms.
*, ** and *** denote significance at the 10-,5- and 1% level, respectively.
T-values in parentheses.

Table A 3: Primary Exports and Fertility (Lower-Income Countries)

	Higher Middle Income (Group 3)				
Model:	(1)	(2)	(3)	(4)	(5)
Prim. Exp. p.c.	0.010**	0.011***	0.007**	0.008**	0.005
	(2.32)	(3.13)	(2.03)	(2.42)	(1.45)
Infant Mortality	0.525***	0.250***	0.321***	0.225***	0.175***
	(45.76)	(15.82)	(24.05)	(14.31)	(11.11)
GDP p.c.	0.021	0.027**	0.067***	0.043***	0.004
	(1.33)	(2.05)	(5.11)	(3.21)	(0.28)
Fem.Schooling		-0.540***		-0.405***	-0.578***
		(-22.72)		(-13.39)	(-17.46)
Fem.Lab.For.Part.					-0.119***
					(-6.25)
Urbanization			-1.053***	-0.505***	-0.097
			(-21.39)	(-7.50)	(-1.61)
Observations	823	692	823	692	534
Countries (n)	34	25	34	25	25
Time span (years) (t)	38	38	38	38	28
	Lower Middle Income (Group 4)				
Model:	(1)	(2)	(3)	(4)	(5)
Prim. Exp. p.c.	-0.001	-0.000	0.001	0.000	0.002
	(-0.79)	(-0.28)	(0.32)	(0.11)	(1.11)
Infant Mortality	0.536***	0.450***	0.471***	0.440***	0.409***
	(66.72)	(43.30)	(50.77)	(42.29)	(36.67)
GDP p.c.	-0.006	-0.011	-0.007	-0.012	-0.014
	(-0.77)	(-1.51)	(-1.01)	(-1.60)	(-1.41)
Fem.Schooling		-0.139***		-0.093***	-0.141***
		(-13.95)		(-7.67)	(-11.54)
Fem.Lab.For.Part.					-0.151***
					(-6.97)
Urbanization			-0.301***	-0.193***	-0.220***
			(-12.75)	(-6.13)	(-8.44)
Observations	914	870	914	870	658
Countries (n)	33	30	33	30	30
Time span (years) (t)	38	38	38	38	28
	Low Income (Group 5)				
Model:	(1)	(2)	(3)	(4)	(5)
Prim. Exp. p.c.	0.003	0.003	0.003	0.003	-0.005*
	(1.16)	(1.00)	(1.27)	(0.87)	(-1.68)
Infant Mortality	0.397***	0.414***	0.453***	0.434***	0.307***
	(28.85)	(14.19)	(23.45)	(14.90)	(8.63)
GDP p.c.	0.001	0.010	0.006	0.010	0.013
	(0.08)	(0.88)	(0.65)	(0.85)	(1.34)
Fem.Schooling		0.013		-0.005	0.035*
		(1.49)		(-0.43)	(-1.66)
Fem.Lab.For.Part.					0.164***
					(-2.67)
Urbanization			0.051***	0.054***	-0.222***
			(4.23)	(2.07)	(-5.71)
Observations	454	360	454	360	266
Countries (n)	21	17	21	17	17
Time span (years) (t)	35	35	35	35	27

Notes: Dependent variable in all models: TFR. All variables are used in natural logarithms.
*, ** and *** denote significance at the 10-,5- and 1% level, respectively.
T-values in parentheses.

Table A 4: Manufacturing and Primary Exports and Fertility (Complete Sample: Five-year Averages 1980 - 2005)

	All Countries				
Model:	(1)	(2)	(3)	(4)	(5)
Man. Exp. p.c.	-0.066**	-0.044***	-0.027***	-0.037***	-0.039***
	(-8.53)	(-7.24)	(-4.80)	(-4.51)	(-5.33)
Infant Mortality	0.355***	0.139***	0.319***	0.152***	0.134***
	(18.63)	(7.71)	(18.41)	(7.95)	(7.51)
GDP p.c.	0.117***	0.056***	0.115***	0.069***	0.068***
	(4.43)	(2.61)	(5.27)	(2.85)	(2.84)
Fem.Schooling		-0.543***		-0.492***	-0.477***
		(-23.41)		(-16.33)	(-14.44)
Fem.Lab.For.Part.					-0.170***
					(-5.84)
Urbanization			-0.630***	-0.184***	-0.150***
			(-16.87)	(-3.41)	(-2.97)
Observations	340	340	339	339	339
Countries (n)	68	68	68	68	68
Time span (intervals) (t)	5	5	5	5	5
Prim. Exp. p.c.	-0.013	-0.020**	-0.023**	-0.026***	-0.020**
	(-1.09)	(-2.39)	(-2.04)	(-2.64)	(-2.16)
Infant Mortality	0.433***	0.160***	0.338***	0.172***	0.152***
	(27.08)	(9.06)	(21.05)	(9.74)	(7.87)
GDP p.c.	0.049*	0.041*	0.127***	0.065***	0.052**
	(1.72)	(2.04)	(4.62)	(2.58)	(2.06)
Fem.Schooling		-0.623***		-0.488***	-0.486***
		(-23.46)		(-16.06)	(-14.51)
Fem.Lab.For.Part.					-0.183***
					(-5.50)
Urbanization			-0.713***	-0.323***	-0.277***
			(-16.96)	(-6.10)	(-5.18)
Observations	338	338	337	337	337
Countries (n)	68	68	68	68	68
Time span (intervals) (t)	5	5	5	5	5

Notes: Dependent variable in all models: TFR. All variables are used in natural logarithms.

*, ** and *** denote significance at the 10-,5- and 1% level, respectively.

T-values in parentheses.

Table A 5: Manufacturing and Primary Exports and Fertility (High-Income Countries: Five-year Averages 1980 - 2005)

	High-Income Countries (Groups 1 and 2)				
Model:	(1)	(2)	(3)	(4)	(5)
Man. Exp. p.c.	0.015	0.013	0.041	0.046**	0.059***
	(0.61)	(0.65)	(1.63)	(2.10)	(2.75)
Infant Mortality	0.203***	0.121***	0.215***	0.110***	0.103***
	(5.10)	(3.19)	(5.58)	(2.52)	(2.38)
GDP p.c.	-0.015	0.005	0.014	-0.021	-0.014
	(-0.21)	(0.08)	(0.22)	(-0.44)	(-0.28)
Fem.Schooling		-0.431***		-0.471***	-0.345***
		(-4.80)		(-5.15)	(-3.45)
Fem.Lab.For.Part.					-0.324***
					(-3.17)
Urbanization			-0.676***	-0.551***	-0.490**
			(-2.91)	(-2.80)	(-2.52)
Observations	165	165	164	164	164
Countries (n)	33	33	33	33	33
Time span (intervals) (t)	5	5	5	5	5
Prim. Exp. p.c.	-0.052***	-0.042***	-0.048***	-0.037**	-0.035**
	(-3.04)	(-3.02)	(-2.75)	(-2.32)	(-2.47)
Infant Mortality	0.174***	0.077***	0.161***	0.062	0.060
	(4.94)	(2.24)	(5.09)	(1.57)	(1.51)
GDP p.c.	0.068	0.057	0.104*	0.067	0.092*
	(1.08)	(1.05)	(1.79)	(1.19)	(1.67)
Fem.Schooling		-0.464***		-0.417***	-0.303***
		(-5.08)		(-4.15)	(-2.86)
Fem.Lab.For.Part.					-0.287***
					(-2.81)
Urbanization			-0.619***	-0.526**	0.390*
			(-2.58)	(-2.44)	(-1.88)
Observations	164	164	163	163	163
Countries (n)	33	33	33	33	33
Time span (intervals) (t)	5	5	5	5	5

Notes: Dependent variable in all models: TFR. All variables are used in natural logarithms.

*, ** and *** denote significance at the 10-,5- and 1% level, respectively.

T-values in parentheses.

Table A 6: Manufacturing and Primary Exports and Fertility (Lower-Income Countries: Five-year Averages 1980 - 2005)

	Lower-Income Countries (Groups 3, 4 and 5)				
Model:	(1)	(2)	(3)	(4)	(5)
Man. Exp. p.c.	-0.044***	-0.040***	-0.042***	-0.041***	-0.040***
	(-6.39)	(-9.65)	(-6.46)	(-9.55)	(-9.87)
Infant Mortality	0.483***	0.288***	0.430***	0.285***	0.262***
	(34.50)	(16.77)	(23.01)	(16.28)	(13.91)
GDP p.c.	0.043	0.064***	0.086***	0.064***	0.052***
	(1.44)	(3.44)	(3.08)	(3.45)	(2.80)
Fem.Schooling		-0.444***		-0.466***	-0.453***
		(-23.83)		(-16.63)	(-15.40)
Fem.Lab.For.Part.					-0.127***
					(-3.92)
Urbanization			-0.316***	0.040	0.040
			(-6.41)	(1.02)	(0.96)
Observations	175	175	175	175	175
Countries (n)	35	35	35	35	35
Time span (intervals) (t)	5	5	5	5	5
Prim. Exp. p.c.	0.031**	-0.006	0.028**	-0.006	0.017
	(2.50)	(-0.41)	(2.15)	(-0.45)	(1.23)
Infant Mortality	0.584***	0.333***	0.500***	0.333***	0.309***
	(59.26)	(15.80)	(30.03)	(15.71)	(14.64)
GDP p.c.	0.002	0.050*	0.019	0.053*	0.004
	(0.06)	(1.79)	(0.70)	(1.84)	(0.13)
Fem.Schooling		-0.504***		-0.474***	-0.461***
		(-16.75)		(-13.45)	(-12.25)
Fem.Lab.For.Part.					-0.173***
					(-5.19)
Urbanization			-0.374***	-0.069	-0.040
			(-7.15)	(-1.17)	(-0.69)
Observations	174	174	174	174	174
Countries (n)	35	35	35	35	35
Time span (intervals) (t)	5	5	5	5	5

Notes: Dependent variable in all models: TFR. All variables are used in natural logarithms.
*, ** and *** denote significance at the 10-,5- and 1% level, respectively.
T-values in parentheses.

Table A 7: Exports and Fertility (Complete Sample - System GMM Estimator)

	All Countries				
Model:	(1)	(2)	(3)	(4)	(5)
Manuf. Exp. p.c.	-0.520***	-0.315***	-0.474***	-0.316***	-0.265***
Infant Mortality	0.277	0.231	0.127	0.163	0.179
GDP p.c.	1.165**	0.780**	1.063**	0.772**	0.642***
Fem.Schooling		-0.495***		-0.482***	-0.356**
Fem.Lab.For.Part.					-0.214
Urbanization			-0.441*	-0.176	-0.152
Observations (n*t)	340	340	339	339	339
Countries (n)	68	68	68	68	68
Hansen (Prob.>X2)	0.64	0.69	0.63	0.65	0.15
Number of instruments	12	13	13	14	17
Prim. Exp. p.c.	0.559***	0.517***	0.532***	0.476***	0.356***
Infant Mortality	0.991***	0.774**	0.506	0.277	0.321*
GDP p.c.	-0.064	-0.138	-0.332	-0.477	-0.380*
Fem.Schooling		-0.352**		-0.355	-0.219
Fem.Lab.For.Part.					-0.129
Urbanization			-0.613	-0.381	-0.291
Observations (n*t)	338	338	337	337	337
Countries (n)	68	68	68	68	68
Hansen (Prob.>X2)	0.23	0.46	0.41	0.45	0.00
Number of instruments	12	13	12	13	16

Notes: Dependent variable in all models: TFR. All variables are used in natural logarithms. *, ** and *** denote significance at the 10-,5- and 1% level, respectively.