GLOBAL INSTITUTIONAL NETWORKS AND CONTEMPORARY FERTILITY TRANSITIONS

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Abstract

The rise of the global network of nation-states has precipitated social transformations throughout the world. Global institution-building has introduced new channels of social interaction, including bilateral trade, intergovernmental organizations (IGOs), and regional trade blocs, and these channels in turn have affected the direction and speed of the flow of materials, information, and ideas impinging on fertility. This paper explores the role of these modern global institutions in driving fertility change in the time period 1960-2009. I estimate an autoregressive dyadic diffusion model to examine the impact of global institution-building on fertility change. I find that all three of the aforementioned forms of institution-building—increased bilateral trade, regional integration via trade blocs, and IGO formation—have had a significant impact on the diffusion of fertility behaviors through normative influence. In particular, participation in free trade agreements, engagement in bilateral trade with rich countries, and entry into IGOs like the UN and WHO that enforce global scripts all mediate cross-national interaction and produce convergence in total fertility rates between pairs of nation-states. The most efficient channel of diffusion is bilateral trade with rich countries.

Global Institutional Networks and Contemporary Fertility Transitions

Introduction

The past half century produced massive changes in global organization, including rapid growth in international trade, regional integration, and participation of nation-states in intergovernmental organizations (IGOs) and agreements. Globalization forged links between individuals, communities, and nation-states, which in turn increased the cross-border flows of goods, services, information, technologies, and people. These new connections generated social change by bringing communities on opposite ends of the global network into contact with foreign concepts and cultures. This intensification of cross-national exchange led to the diffusion of many beliefs and practices, including the adoption of international standards (Guler, Guillén, and Macpherson 2002), democracy (Torfason and Ingram 2010; Wejnert 2005), cultural practices (Kaufman and Patterson 2005), higher education (Schofer and Meyer 2005), and market-oriented reforms (Henisz, Zelner, and Guillén 2005).

Over this same time period, we also witnessed dramatic changes in fertility, with the majority of developing nations undergoing transitions from high to low fertility. Whereas women used to give birth to five or six children, they now give birth to two or three (McNicoll 1992). These twin phenomena of fertility transitions and institution-building were accompanied by an increased capacity for the transmission of ideas and information, and it is likely that all three of these trends are causally linked. Fertility scholars have long noted the role of information in influencing childbearing (e.g., Watkins 1986), and have recently started to empirically explore how network structures give rise to the diffusion of contraceptive use and fertility ideals (Behrman, Kohler, and Watkins 2001; Montgomery and Casterline 1993; Tolnay 1995). In a parallel development, they have begun to study the function of national and local institutions in driving, enabling, or constraining fertility-related behaviors (McDonald 2000; McNicoll 1980; Portes 2006). However, researchers have not yet examined the impact of global institutions on fertility.

Much of the research on cross-national diffusion of fertility-related behaviors has been at the theoretical or descriptive level, and the majority of empirical fertility diffusion research has focused on small communities or individual countries. Few recent empirical studies have explored fertility change as a global phenomenon. This is surprising, given that much of the variation in fertility occurs between rather than within countries. I argue that in addition to national and local structures, we should consider global institutions when thinking about diffusion and the role of information, since it is often the global institutional structure that sets the terms of cross-societal interaction and information flow. To that end, this paper combines the institutional and diffusion approaches in an empirical analysis of how the global institutional network mediates the cross-national diffusion of fertility. This article take a broader view than previous studies by analyzing fertility change at the nation-state level and linking it back to the change in global organization. In both the theoretical framing and empirical analyses, I adopt the recently developed Theory of Conjunctural Action perspective introduced by Johnson-Hanks, Bachrach, Morgan, and Kohler (2011). I employ a novel empirical approach that exploits variation in global network structure across time and countries to identify the extent to which global institutional change leads to the diffusion of fertility. This article also explores the extent to which this isomorphism is normative. The findings suggest that contemporary fertility change is partly driven by the normative diffusion of schematic and material structures through the global network of international trade and organizations. Bilateral trade, IGO ties, and regional trade blocs, three institutional arrangements seemingly irrelevant for fertility, thus structure fertility diffusion across countries. These results address the broader sociological question of how new organizational forms can result in the unexpected exchange and uptake of ideas. This article also reinforces the importance of the interplay between ideation and structure in driving global social change.

Fertility and Global Institutional Structure

Following the Second World War, nation-states throughout the world began to experience unforeseen fertility declines. While developed Western countries had long since begun their fertility transitions, this was a new phenomenon for non-Western European countries and what we now call the developing world (Bongaarts and Watkins 1996). Demographers, sociologists, and economists were quick to notice the declines and theorized that the standard set of demographic transition theories offered the most likely explanation: these countries were modernizing and developing economically, and this transition to modernity in turn led to fertility declines (Notestein 1945). The 1970s and 1980s, however, introduced doubt. Fertility scholars began to suspect that the intersection of ideational and structural variables played a bigger role than previously thought (Caldwell 1976; Mauldin and Berelson 1978). The general consensus among fertility scholars today is that classical socioeconomic and rational choice theories of fertility failed to account for the onset of fertility declines, producing inconsistent results at best (see Cleland and Wilson 1987; Mason 1997). Variables indexing development explained only part of the fertility declines. New theoretical frameworks stressed the role of ideational factors in explaining family change.

The dominant paradigm of contemporary fertility research is diffusion theory, which is closely coupled with frameworks of ideational fertility and social interaction (Bongaarts and Watkins 1996; Knodel and van de Walle 1979). These theories hold that individuals, communities, and nation-states interact with each other, thus spreading information, ideas, and technology regarding contraception and fertility ideals. Diffused ideas and technologies are received and reinterpreted, gaining new meaning in different contexts and impelling or constraining actions pertaining to fertility choice. New research has stressed the role of information and mass media in shaping thoughts regarding family limitation (Montgomery and Chung 1994; Potter et al. 1998; Westoff and Koffman 2011).

Recently, these frameworks were unified by Johnson-Hanks et al. (2011) in their Theory of Conjunctural Action (TCA). TCA explains variation in fertility and family variables by considering the intersection of virtual and perceptible structures. The primary building blocks of TCA are “schemas” and “materials.” Schemas are unobserved mental maps or scripts, defined as “ways of perceiving and acting through which we make sense of the world and motivate our actions” (Johnson-Hanks et al. 2011: 2). They are created and altered over time through interaction, perception, and comprehension in a path-dependent process. Schemas thus reflect the social, psychological, and physical environments in which individuals and populations are embedded. Materials are “the objects, performances, and organizations that sediment schemas in the perceptible world” (p. 8). They instantiate schemas by introducing and enforcing them in the realm of social action. Structure is thus formed and reshaped by the interaction of existing schemas with the introduction of new material elements.

In the context of global fertility change, schemas are macro structures that emerge at the nation-state level. Nation-states are the domain of national culture and institution-building, so schemas reflect the symbolic elements, beliefs, and institutions of the nation-state. While schemas have a tendency to remain stable over time, they can change in the course of social interaction. Throughout the latter half of the twentieth century, nation-states were confronted with a series of conjunctures wherein they faced the prospect of increased interaction with other countries. Nation-states interact on the global stage through exposure to material elements like consumer goods, media, and national institutional arrangements. These material elements may directly affect family size, as in the case of contraceptive technology and family planning programs. But material exchange can also affect family size through its impact on schematic structures. One example is the importation of foreign films and advertisements which depict two-child families. While these media may not directly cause people to have a certain family size, they can act through normative change to affect how people perceive family structure. Thus, in societies where family size was not a conscious consideration (i.e., it was "left up to God"), material exchange can reshape how people think about fertility and family limitation (van de Walle 1992).

Global institutions are the primary links between nation-states and thus are prime candidates for channels of social interaction and schematic diffusion. The global network refers to the set of nation-states, which are nodes in the network, connected to each other through various institutions and organizations embodying these institutions, including trade, regional blocs, and intergovernmental organizations and agreements. There is also a spatial aspect to the network—countries with similar structural and cultural characteristics like national income or shared language are considered to be closer to each other. One can think of the global network as being embedded in a multidimensional space of characteristics of the countries (see Berry, Guillén, and Hendi 2012 for a more in-depth development of this concept). Participation in global institutions and the structural properties of nation-states are constantly evolving, path-dependent, and mutually dependent. Increasing connectedness in the global network can result in greater exchange of materials and schemas that impinge on fertility. For example, Figure 1 plots the total fertility rate and trade as a percentage of GDP for the whole world over the past half century, showing that not only do the two variables follow similar trajectories, but also that the concavities of the two graphs change at similar points in time. Changes in the intensity of trade occur at roughly the same times as changes in the intensity of the global fertility decline.

For the global network to play a role, one-shot adoption of a practice or the short-term transfer of information may not be enough to permanently or even semi-permanently change fertility behaviors and ideals. The channels of social interaction must be expanded or at least sustained (Palloni 1996). Global institutions are one way diffusion can be sustained. The logic of global capitalism and globalization more broadly have sustained interaction between nation-states built in, so diffusion of schemas through globalization is understood to be a long-term phenomenon and not a one-shot, temporary outcome. Thus, as nation-states become increasingly connected to the global network, their fertility rates become more similar to those of nation-states to which they are connected.

In addition to examining whether globalization produced convergence in fertility rates, it is important to understand the isomorphic mechanism underlying the potential convergence. Increasing similarity in fertility rates across nation-states can be driven by mimesis, coercion, cohesion (normative pressures), or competition (DiMaggio and Powell 1983). While prior empirical work on fertility has described the velocity and patterning of fertility change, there has not been a focus on which of these mechanisms, if any, underlies contemporary fertility transitions. TCA allows for a number of possibilities but puts the most weight on normative influence as the main driver of fertility change. This article thus argues that global institutional networks drive fertility transitions through normative change.

Trade, IGOs, and Regional Trade Blocs

One specific vehicle for material exchange at the nation-state level is bilateral trade (Bongaarts and Watkins 1996). Bilateral trade is the exchange of goods and services across national borders. Modern macroeconomic theories predict that trade results in increasing fertility differentials between countries. Galor and Mountford (2006), for example, argue that countries respond to gains from trade differently, with some reinvesting in human capital and economic growth and others in population growth. This results in a delayed demographic transition for the latter group, thus producing divergence in fertility rates between the two types of countries. This theory does not allow for trade to act as anything other than a driver of economic growth—it has no social meaning.

By contrast, the TCA perspective would argue that beyond its pure economic effects, trade is a vehicle for the transmission of schematic structures embodied in material elements. Foreign goods and services often carry with them <u>normative</u> implications. A television show produced in a foreign country, for example, may depict families with two children or with mothers who work in the formal sector. A dubbed television program is therefore not only a form of entertainment—it can sometimes serve as a model of social, economic, or demographic behavior. Goods are not acultural. They come embedded with ideas which get reinterpreted in the receiving country context (McCracken 1986). These ideas embodied in materials need not be directly related to fertility. Images of mass consumption may have few direct connections with fertility, but in a developing country context they may produce fertility reductions because of incompatibilities between high fertility and consumption of luxury goods. These indirect effects can eventually feed back to shape schemas. Even seemingly innocuous forms of trade might have an effect on fertility. Johnson-Hanks et al. (2011) provide the example of a sedan that can only accept two child car seats. Importing sedans may decrease the likelihood of a family having more than two children because of the limit to the number of children that can be seated in a sedan. In turn, this material element may fuel a feedback effect through normative change, causing transformations in national schemas that impinge on fertility. TCA thus produces the following generic prediction:

> Hypothesis 1: Increased trade between two nation-states results in decreased differences in their fertility rates.

This generic prediction, however, can be refined. Not all social interaction resulting from trade is created equally—interaction with more powerful or authoritative actors may produce greater adoption of schemas than interaction with weaker actors (Johnson-Hanks et al 2011). This proposition has its origins in observations of elites made by demographers in the 1970s (Caldwell 2001; Mauldin and Berelson 1978; Nortman 1972). Elites have become more connected to and cognizant of the global network over the past half-century, and have thus adopted the goals and broad policies associated with socioeconomic development. To a great extent, elites control the construal of schemas within nation-states. They live in globally-connected cities, consume and produce images and stories in the mass media, control or manage industries, and are generally at the top of their countries' status hierarchies. In addition to pressuring the state and broader society for the enactment of prescriptions like the adoption of democracy and capitalism, national elites actively pursue fertility reduction as a mode of development. Fertility reductions are seen as necessary for gaining legitimacy on the world stage and for transitioning from being less to more developed. The specific actions of elites, including increasing access to education and healthcare services, supporting family planning programs, and influencing media content, may differ across contexts, but what is relevant is the desire to reduce fertility and any type of action effecting this change. Globalization in the form of greater trade increases the relevance of actors and actions external to the nation-state by amplifying their effect on national elites. From this perspective, as nation-states become increasingly connected to the global network through trade, they adopt the schemas and institutional forms of their rich and powerful trading partners. Once again, this is a form of normative isomorphism at the global level.[1] This refinement thus predicts:

> Hypothesis 2: If a non-rich nation-state increases its imports from a rich nation-state, its fertility rate will move closer to the fertility rate of the rich nation-state.

Regional trade blocs are organizations consisting of geographically proximate countries and are formed to increase trade and mutual understanding among member states. Trade blocs reduce tariffs and barriers to capital and labor flow among member states. In effect, they can divert trade by incentivizing trade with bloc members above trade with states outside of the bloc (Krugman 1991).[2] This results in social interaction becoming concentrated within the trade bloc relative to social interaction with nation-states outside of the bloc. From the perspective of TCA, trade bloc formation would lead to increased material exchange and diffusion of fertility-related schemas within the bloc, thus reducing the differences in fertility rates between member countries. Global institution-building in the form of trade bloc formation results not only in increased within-bloc trade, but also in greater integration of policies relating to national economies. For example, trade blocs in Europe, the Caribbean, West and Central Africa, South America, Arabia, Southeast Asia, and Central America all allow for some form of visa-free travel, resulting in greater movement of people and ideas. Many of these blocs also instituted agreements that called for joint bargaining in global forums on matters of trade and defense. Trade blocs today are not only attempts to enhance trade, but they are also often efforts to increase solidarity and enforce regional scripts. They impose cohesion through normative influence. The third hypothesis is thus:

> Hypothesis 3: If a nation-state joins a trade bloc, its fertility will move closer to the fertility of the members of the bloc.

Similar to how the effect of trade on schematic change is asymmetric, some types of trade blocs may be more effective at promoting schematic diffusion than others. Trade blocs differ qualitatively from one another. Some blocs are free trade areas and allow for the free flow of goods and services, while common markets may additionally allow for the free movement of capital and labor. Still other trade blocs form monetary unions, sharing the same currency and monetary policy across member countries. One implication of TCA and theories of ideational fertility is that institutional structures that allow for greater material exchange have greater potential for affecting schemas. Free trade is thus the property of trade blocs most likely to result in schematic diffusion. While allowing for the free flow of labor and capital has the potential to intensify communication between labor migrants and their host countries, ethnographic and historical accounts have shown otherwise (Castles and Miller 2009; Piore 1979). In practice, common markets act as attractors for cheap, unskilled labor, where the labor migrants tend to be exploited and segregated from the native population. Thus common markets would not add much to schematic exchange, and may even lead to the opposite: divergence driven by reinforcement of current schemas. Common currencies and monetary policies also are not theorized to substantially increase schematic exchange. One possibility is that shared currency may help to culturally unify members of the bloc, leading to greater uniformity in the types of goods consumed. Together, these arguments lead to the following prediction:

> Hypothesis 4: Free trade is the most important trade bloc property for producing uniformity in fertility rates within regional trade blocs. Common markets and monetary unions will have weaker or no effects on uniformity of fertility within blocs.

A third mechanism for the diffusion of fertility-related behaviors is communication through intergovernmental organizations, or IGOs. One key element of TCA is identity, or the perpetuation of a self-narrative, and its development through social interaction. Meyer (2000) describes identity and models of actorhood in the global system of nation-states. From this perspective, IGOs help to construct and communicate a common world culture among member states. Actors in this approach are nation-states. The rise of the global network was accompanied by widespread acceptance of global scripts for different dimensions of social, political, and economic life. Pressure from individuals and organizations both internal and external to the nation-state is theorized to compel actors to adopt legitimated models of actorhood, thus leading to conformity along cultural and policy dimensions. In the context of fertility, positive assessments of low fertility are derived from "common models of socioeconomic development" in which limiting population growth is perceived as a necessary part of the path to development. Barrett (1995) describes the role of population experts who act through organizations like the United Nations (UN) to actively pursue fertility reductions in pre-transition societies. Fertility management is one of the UN Population Fund's key goals (UN Population Fund 2012). IGOs have sponsored major conferences—Bucharest in 1974, Mexico City in 1984, and Cairo in 1994—all built on the idea that population growth and high fertility are impediments to development. These fertility and population growth goals were later coded as goals for female empowerment. One emphasis of the world society perspective is a decoupling between purpose on the one hand and actions and outcomes on the other. Thus, while the adopted models of actorhood may not correspond directly to actions aimed at achieving the outcome of lower fertility, fertility declines may still occur through associated mechanisms precipitated by the broader acceptance of these models. For example, models of later marriage or higher education may lead to delayed age at first birth, which in turn would drive down total fertility. We therefore expect nation-states that are connected to each other through common membership in IGOs to participate in greater material and schematic exchange, thus producing isomorphism through normative change. Fertility convergence directly follows. This sets up the final hypothesis:

> Hypothesis 5: The formation of IGO connections between a pair of nation-states will result in a lesser difference between the two countries' fertility rates.

Data

The empirical analysis in this paper uses panel data consisting of country-year pairs to generate dyadic network data. There are approximately 170 countries under analysis annually from 1960 to 2009. The unit of analysis is thus the dyad-year, representing two countries in a given year. The outcome variable of interest is fertility, and it is measured using the period total fertility rate (TFR) for each country in each year. The period TFR can be interpreted as the number of children a woman could expect to have over her lifetime if current rates of childbearing prevailed and if she survived through the end of her reproductive years. These TFRs are taken from the World Bank's World Development Indicators database (WDI). TFR is a commonly used measure of fertility and is preferred to other measures because it has an intuitive interpretation and it is age-standardized. Period fertility is the appropriate measure since the mechanism at play (schematic and material exchange) is theorized to operate in a period fashion. Furthermore, Ní Bhrolcháin (1992) showed that fertility declines within societies are simultaneously experienced by women of all childbearing ages. This period character of fertility decline implies that period TFR (as opposed to cohort TFR) is the more apt measure to use in studying fertility change. Data on countries' GDP per capita (in constant 2000 US Dollars) and total trade as a percentage of GDP also come from the WDI. A country's trade partner is designated as rich if the trade partner has a GDP per capita of at least $12,500 in constant 2000 US Dollars.

The analysis also employs data on dyadic network relations relating to bilateral trade and participation in global institutions. I obtained data from the Correlates of War (COW) project on participation in bilateral trade (version 3.0, Barbieri and Keshk 2012; Barbieri, Keshk, and Pollins 2009) and intergovernmental organizations (version 2.3, Pevehouse, Nordstrom, and Warnke 2004). These data contain entries that correspond to dyad-year pairs—that is, each case in the dataset corresponds to a pair of countries in a given year (e.g., US-India 1982). Some of the entries included countries that no longer exist because of mergers with other countries or because of dissolution. The latter were listwise deleted. This should have minimal impact since only two countries posed this problem. Mergers, as in the case of East and West Germany, were handled by combining the constituent countries for pre-merger years. For example, total trade for the constructed Germany before merger would simply be the sum of total trade for East and West Germany. The final variable used in the regression analysis was constructed using the bilateral trade data and is equal to the percentage of total imports coming from each trade partner. This can be thought of as a "trade portfolio" variable.

Six IGOs were selected for the analysis based on their size and capacity to effect global change: the World Bank; the World Trade Organization (WTO); the United Nations (UN); the UN Educational, Scientific, and Cultural Organization (UNESCO); the International Monetary Fund (IMF); and the World Health Organization (WHO). Eighteen major trade blocs recognized by the WTO and COW are included and are categorized into free trade agreements (FTAs), common markets, or monetary unions according to their stated policies (see Appendix Table A1). Indicators for single markets and political unions are excluded because these types of organizations are still relatively rare. Descriptive statistics for all variables used in this analysis are presented in Table 1.

Missing data was not a severe problem with this dataset—the IGO and bilateral trade data were missing for relatively few cases. Fertility data was also near complete (less than 6% missingness). The TFRs are measured on a five-year basis and interpolated by the World Bank for years between measurements. Because fertility tends to move fairly smoothly and because this analysis is focused on trends, interpolation is unlikely to change the direction of regression coefficients and thus should not bias inference. GDP per capita and trade as a percentage of GDP are missing for some countries in earlier years (closer to 1960) and for some less developed countries (less than 13% missingness). Given the relatively small number of missing cases, any observations with missing data were listwise deleted in this analysis.

Methods

I estimate the effect of the global network structure on the diffusion of fertility by employing an autoregressive dyadic diffusion model. Rather than using the country-year as the unit of analysis, this model focuses on dyad-years—that is, the primary unit of analysis is a pair of countries in a given year. Diffusion is often conceptualized as a process through which goods, people, institutions, and ideas flow from one place to another, so measuring network relationships at the dyadic level is a natural choice. In this analysis, diffusion of fertility is modeled as a function of structural variables, network ties, and country and dyad-specific fixed effects. This statistical model therefore explicitly takes into account the theoretical model described above.

Diffusion is a dynamic phenomenon, and as such it is easy to incorrectly specify the ordering of events in the theoretical model and thus mistake the direction of causality in the statistical model. One way to overcome this potential misspecification problem is to estimate effects at different time lags and thus trace out the full dynamic response of fertility. This strategy, while theoretically appealing, is limiting when the time range of data is not exceptionally long. Instead, I adopt a lagged dependent variable (LDV) specification. The LDV, coupled with country and dyad fixed effects, allows us to interpret the estimated coefficients as the effect of changes in the independent variables—that is, the effect of new shocks to the structural and network variables. This is desirable since it effectively precludes the ordering issues discussed above, allowing for interpretation of the parameters as effects of the independent variables on the dependent variable and not vice versa.

According to the theoretical model and hypotheses, the difference between any two countries' fertility rates in a given year is determined as a function of the extent of bilateral trade and common membership in trade blocs and intergovernmental organizations (conditional on other factors). Rather than focusing only on year t variables, we can assume that all past lags of all variables affect the outcome. In other words, we must explicitly take into account the entire history of dyadic network ties and control variables in the model. I assume that the relative importance of each variable changes in the same fashion over time. Formally, the statistical model is specified as follows:

$$\begin{aligned}|y_{i,t} - y_{j,t}| = \delta_0 &+ \gamma_1(\omega_0\tau_{ij1,t}n_{ij1,t} + \omega_1\tau_{ij1,t-1}n_{ij1,t-1} + \omega_2\tau_{ij1,t-2}n_{ij1,t-2} + \cdots) + \cdots \\ &+ \gamma_K(\omega_0\tau_{ijK,t}n_{ijK,t} + \omega_1\tau_{ijK,t-1}n_{ijK,t-1} + \omega_2\tau_{ijK,t-2}n_{ijK,t-2} + \cdots) \\ &+ \beta_1(\omega_0 x_{1i,t} + \omega_1 x_{1i,t-1} + \cdots) + \cdots + \beta_M(\omega_0 x_{Mi,t} + \omega_1 x_{Mi,t-1} + \cdots) + f_{ij} + u_{ijt}\end{aligned}$$

where i refers to country i, j refers to country j, and t is the year. The outcome is the absolute difference between $y_{i,t}$ and $y_{j,t}$, which are country i and j's respective total fertility rates in year t. Since material and schematic diffusion reduce differences in countries' fertility rates, this is the appropriate outcome measure indicated by the theoretical model. The k^{th} dyadic network tie is represented by $n_{i,j,k,t}$, which equals 1 if countries i and j share the tie in year t and zero otherwise. For example, a given network tie variable may represent whether countries i and j are connected through a free trade agreement or through common membership in the World Health Organization (WHO). $\tau_{i,j,k,t}$ is a measure of the strength of network tie k between countries i and j at time t. For membership in common organizations, the tie strength is standardized to equal 1. For dyadic relations where tie strength varies, $\tau_{i,j,k,t}$ is a measure of the volume or magnitude of the tie. For bilateral trade, for example, $\tau_{i,j,k,t}$ would be the proportion of country i's total imports coming from country j. The $x_{mi,t}$ variables are controls specific to country i (e.g., GDP per capita). f_{ij} is a placeholder variable representing the sum of country i, country j, and dyad i,j fixed effects (note that this is the more general derivation, and fixed effects can be omitted or replaced with random effects without effect on the rest of the mathematics). u_{ijt} is a stochastic error term that is mean zero with constant variance and is uncorrelated across time and dyads. The ω_s terms (where $s = 0, \ldots, \infty$) are weight parameters (between 0 and 1) indicating the relative importance of the s^{th} lag of the variables. This expression can be written more compactly as

$$\left|y_{i,t}-y_{j,t}\right| = \delta_0 + \sum_{k=1}^{K}\gamma_k\sum_{s=0}^{\infty}\omega_s\tau_{ijk,t-s} + \sum_{m=1}^{M}\beta_m\sum_{s=0}^{\infty}\omega_s x_{mi,t-s} + f_{ij} + u_{ijt}$$

where k is an index for network ties that ranges from 1 to K, since there are K different network ties under consideration (bilateral trade, common membership in a regional bloc, common membership in an IGO, etc).

This model has an infinite number of parameters and thus is not parametrically identified. I impose the following restriction to reduce the dimensionality of the parameter space: $\omega_s = \omega^s$, where $\omega \in (0,1)$ is a one-dimensional parameter. This is one way to formalize the implicit assumption that older lags of variables are less important in explaining current outcomes (that is, more recent variables are given greater weight). Using the lag operator L (the operator such that for any time series $\{X_t\}$ and any nonnegative integer s, $L^s X_t = X_{t-s}$), we can now write the model as:

$$\left|y_{i,t}-y_{j,t}\right| = \delta_0 + \sum_{k=1}^{K}\gamma_k\frac{1}{1-\omega L}\tau_{ijk,t}\cdot n_{ijk,t} + \sum_{m=1}^{M}\beta_m\frac{1}{1-\omega L}x_{mi,t} + f_{ij} + u_{ijt}$$

where $\frac{1}{1-\omega L}$ represents the infinite-order lag polynomial $\sum_{s=0}^{\infty}\omega^s L^s$. Multiplying the equation by $1-\omega L$ and rearranging terms yields:

$$\left|y_{i,t}-y_{j,t}\right| = \delta_0(1-\omega) + \omega\cdot\left|y_{i,t-1}-y_{j,t-1}\right| + \sum_{k=1}^{K}\gamma_k\tau_{ijk,t}\cdot n_{ijk,t} + \sum_{m=1}^{M}\beta_m x_{mi,t} + (1-\omega)f_{ij}$$
$$+ (u_{ijt} - \omega\cdot u_{ij,t-1}).$$

Finally, we can rewrite this equation as:

$$\left|y_{i,t}-y_{j,t}\right| = \alpha + \omega \cdot \left|y_{i,t-1}-y_{j,t-1}\right| + \boldsymbol{x}_{\boldsymbol{i,t}}'\boldsymbol{\beta} + \sum_k \gamma_k \cdot \tau_{i,j,k,t} \cdot n_{i,j,k,t} + \mu_i + \mu_j + \mu_{i,j} + \varepsilon_{i,j,t}$$

where $\boldsymbol{x}_{\boldsymbol{i,t}}$ is an M-dimensional vector of control variables specific to country i. The μ terms are fixed effects for country i, country j, and dyad i, j respectively. They subsume time-invariant factors of both countries and dyads, including variables like geographic adjacency, pre-1960 colonial history, and climate. The stochastic error term $\varepsilon_{i,j,t}$ is mean zero with constant variance and exhibits first-order autocorrelation.

The main parameters of interest from the model are the γ_k's, which measure the direction and magnitude of the effect of network ties on the diffusion of fertility. These parameters can be interpreted as the one-year effect of strengthening the network tie by one unit. A negative sign indicates that the tie contributes to diffusion and thus convergence in fertility levels.

This model is preferred to models based on country-year units of analysis because it takes dyadic network relationships into account, and dyadic ties are the theoretical objects of interest. By incorporating the lagged dependent variable, this model also prevents incorrect inference about the ordering of fertility changes and global institutional change. This feature is helpful since it is unclear *a priori* whether globalization begets fertility change or fertility change begets globalization. The estimator for the parameters is a variant of the fixed-effects estimator. This estimator thus sweeps out any time-invariant linearly additive effects that are specific to either country within the dyad or to the dyad itself. This novel regression design has not been used before to study global fertility change. One difficulty of this setup is that the estimator may be biased in small samples because of correlation between the lagged dependent variable and the error term. An instrumental variable strategy is presented in the Robustness of Results section of this article to overcome this potential bias.

Results

Tables 2 and 3 array the estimates of the autoregressive dyadic diffusion model described in the Methods section. Each of the numbered columns (1 and 2 in Table 2; 1 through 4 in Table 3) represents a different regression specification. GDP per capita and trade openness are included as controls in all regressions. The first row of each table contains estimates for the lagged dependent variable (LDV) coefficient. The second row in Table 2 shows the effect of bilateral trade ties on absolute TFR differences. In Table 3, the second and third rows decompose estimates for the effect of bilateral trade on the outcome into effects of trade with non-rich vs. rich countries (from the importing country's perspective), respectively.[3] Rows four through six in Table 3 show the coefficient estimates for variables representing different types of trade blocs. Finally, the last six rows in Table 3 contain estimates that describe the effect of common IGO membership on the outcome. Sample sizes (N) are displayed at the bottom of the table for each regression. Coefficient estimates for trade from the rich country perspective are not shown, but are positive and statistically significant. Coefficient estimates for country-specific controls for GDP per capita and trade openness are not shown but are both negative and statistically significant in almost all regressions.

The first hypothesis predicted that bilateral trade is a form of social interaction—it acts as a vehicle for the diffusion of fertility, so increased trade between two countries would produce convergence in fertility. Furthermore, hypothesis 2 stated that this effect is highly asymmetric: rich countries exert convergent pressures on their non-rich trade partners' TFRs whereas non-rich countries do not exert convergent pressures on non-rich countries. The effect of trade ties on rich countries is unspecified.

Regression two in Table 2 shows a negative and statistically significant effect of trade (imports from country j as a percentage of country i's total imports) on dyad-specific absolute differences in fertility. Positive bilateral trade between two countries is therefore associated with convergence in their TFRs. Thus there appears to be support for the generic hypothesis 1, since increased trade relations appear to drive countries closer together in terms of their fertility rates (however, see the Robustness of Results section where this finding is shown to be sensitive to the model specification).

I find strong evidence in support of hypothesis 2. Including an interaction between bilateral trade and a dummy for whether the trade partner is rich shows that increased trade with a rich country results in convergence fertility (Table 3, regressions 1 and 4). Increased trade with a non-rich country does not result in diffusion. The estimates in column 4 of Table 3 indicate that a unit increase in the trade variable is associated with a year-over-year decrease in the difference between the two countries' TFRs of 0.22 children per woman. This is a fairly sizable effect of diffusion. Many less-developed countries (LDCs) currently have TFRs in the range of 4 children per woman, so a 0.22 children per woman decrease in the TFR corresponds to a decrease of roughly 12% of the difference between a contemporary LDC's TFR and replacement level fertility.[4] Bilateral trade has the largest effect of all network ties investigated in this study. In summary, I find strong evidence in support of the hypothesis that bilateral trade with rich countries exerts convergent pressure on non-rich countries' fertility rates.

Hypothesis 3 predicted that trade bloc participation, an institutionalized form of regional integration, is another channel of social interaction that facilitates fertility convergence. Furthermore, hypothesis 4 stated that free trade is the most important property of trade blocs in reducing differences in fertility across co-members of trade blocs. I analyzed three properties of trade blocs: whether or not the bloc supports free trade, whether it includes a common market agreement, and whether it is a monetary union. Of these, free trade is predicted to result in the greatest extent of diffusion because it incorporates a deeper level of material exchange than the other two properties. Monetary unions, which introduce common policies relating to currency, are expected to exert the next greatest amount of diffusion. Monetary coordination can be accompanied by increased uniformity in the types of goods and services consumed by member countries of the monetary union. However, the effect of this type of coordination on fertility should be sufficiently weaker than allowing for free trade. Common markets, which allow for the free flow of labor and capital, are theorized to be the weakest of these three types of agreements (where the metric is whether policies support fertility diffusion). While the free flow of labor may result in some diffusion, migrant workers in common market blocs tend not to be well-integrated into the receiving economies (Castles and Miller 2009; Piore 1979), and thus are less likely to spread information, materials, and ideas regarding fertility to the host population.

The regression estimates from Table 3 provide support for hypotheses 3 and 4. Regressions 2 and 4 both show basically the same result: free trade agreements result in the greatest degree of convergence, while common markets result in fertility divergence. Monetary unions lie somewhere in between and yield divergence. While the relative ranking of these three types of blocs matches with the hypotheses, the direction of the effects is somewhat surprising. All of the regressions indicate that common markets and, to a lesser extent, monetary unions result in a divergence of fertility levels between the two countries in the dyad. Taken together, these findings indicate that while regional integration can result in fertility diffusion, distortive trade and labor policies may act against the free trade effect and hinder diffusion. If one country in a dyad under common market policies is experiencing fertility declines, then restricting ideational diffusion in this manner may produce divergence in TFRs between the two countries. Joint monetary policies do not appear to produce convergence. These result underlines the importance of material exchange in driving fertility convergence, since free trade policies are the only properties of trade blocs examined in this analysis that produce convergence.

The last set of network ties I examine are common memberships in intergovernmental organizations. The third and fourth regressions in Table 3 show that of the six IGO ties analyzed, two result in reduction of fertility differences between countries. Bilateral ties through the United Nations (UN) and the UN Educational, Scientific, and Cultural Organization (UNESCO) both produce within-dyad convergence over time in TFRs. The UN, in particular, produces convergence at a quicker rate. In contrast to the other IGOs, the World Bank and the World Trade Organization, both of which are sometimes considered more coercive in terms of the interactions they promote, fail to engender diffusion and in fact produce divergence. While joint participation in the WHO is associated with divergence, the magnitude of the effect is quite small. These results indicate that normative isomorphic pressures are likely at play (as opposed to coercive influence) at the global level.

Because of the dynamic nature of the estimated model, we can simulate fertility trajectories using stylized data and the estimates from Table 3 (regression 4). Figure 2 presents four trajectories of absolute TFR differences simulated using various trade scenarios. Each trajectory is based on an imaginary country with a GDP per capita in 1960 of $300 which grows at an annual geometric rate of 6%. It joins the World Bank in 1967, the UN in 1962, the WHO in 1965, the IMF in 1980, the WTO in 1990, and the UNESCO in 1963. It joins a free trade agreement with a rich country in 1985. This made-up country starts with a fertility of 5.5 in 1960 and begins to engage in a trade relationship with a rich country in the same year. The rich country has a TFR in 1960 of 2.1 children per woman, which can roughly be considered "replacement level" fertility. The absolute fertility difference between the two countries is allowed to change endogenously. There are four separate bilateral trade scenarios. The first (labeled T1 in Figure 2) is that the country linearly increases its imports from the rich country from 1% to 30% of total imports between 1960 and 2009. In scenario T2, it increases its imports from 1% to 20%. In T3, imports with the rich country increase from 1% to 10%. Finally, in trade trajectory T4, the made-up country never engages in trade with a rich country (i.e., imports from a rich country are zero for the entire 50 year period). T1 thus represents the greatest trade with a rich country scenario, whereas T4 represents the baseline case of no trade with a rich country.

Figure 2 plots the absolute TFR differences between the imaginary country and the rich country according to each trade scenario. The T1 trajectory shows the greatest amount of convergence between the made-up country and the rich country. The absolute TFR difference starts at 3.4 children per woman in 1960 and declines to 0.20 children per woman by 2009. If we decrease the amount of trade with rich countries over time to only 10% (trajectory T3), the absolute fertility difference decreases from 3.4 children per woman to 1.2 children per woman. While this is smaller than the decline in the T1 trajectory, it still indicates a great degree of convergence: a decline in the absolute TFR difference of roughly 2.2 children per woman. If we restrict bilateral trade so that the made-up country doesn't trade with a rich country at all, then we still see fertility convergence but not to as great a degree. The absolute TFR difference between the made-up country and the rich country decreases from 3.4 to 1.8 children per woman. This confirms the idea that trade is an important channel of social interaction that can lead to fertility changes. In the T3 and T1 scenarios (i.e., the lower and higher trade variants) bilateral trade accounts for roughly 26% and 50% of the convergence in fertility, respectively. The T4 results also underscore the fact that while trade and globalization are vital to understanding contemporary fertility transitions, they do not explain the entirety of fertility declines.

Robustness of Results

These results can be interpreted as showing that global institutional change in its many forms is an important channel of social interaction that drives fertility diffusion. Of all the global institutions under consideration, bilateral trade with rich countries promoted the greatest extent of fertility diffusion.

There are other possible interpretations. One might argue that these results tell us that free market orientation is what matters, not necessarily trade itself. Countries that are more free market-oriented, as the argument goes, are also more likely to adopt lower fertility. While this is certainly a possibility, I have controlled for trade as a percentage of GDP, which is a measure of trade openness and free market orientation. Another possible explanation is that ideational diffusion isn't occurring at all—rather, as trade expands, populations are exposed to a greater number of luxury goods and consumption of these luxury goods is incompatible with high fertility. If the trade variables employed in this analysis were in absolute terms, this would certainly be a possible explanation. However, the bilateral trade variables are defined as a percentage of total trade, so they only contain information on the relative strength of trade ties with a particular country. This same logic precludes the explanation that fertility change might be occurring alongside trade because expanded trade allows for changes in labor demand, which in turn would drive fertility change. A fourth possible explanation for these results is that they don't measure the effect of social interaction at all, and that they actually measure the effect of socioeconomic development. While development has shown to be a strong correlate of fertility in prior research, the model specification adjusts for GDP per capita, which is the most commonly-used measure of development. It is therefore unlikely that the trade and IGO results are being driven by trends in development or free market orientation. Finally, as stated above, globalization is not the only factor that drives global fertility change but should be recognized as part of the process.

While the diffusion model estimates shown in Table 3 indicate that certain types of global network ties produce convergence in fertility, they must be interpreted with caution. These estimates are sensitive to the model specification, and thus are only correct insofar as the assumed model is correct. One potential problem is that the error terms in the dyadic diffusion model may be correlated over time. I account for this possibility by estimating heteroskedasticity and autocorrelation consistent (HAC) standard errors based on a lag length of 3 years (Newey and West 1987). All standard errors in Tables 2 through 5 and Appendix Tables A2 through A5 are thus adjusted for potential serial correlation.

Another difficulty is the possibility that there are unobserved factors influencing the dependent variable. If these unobserved variables are correlated with the other explanatory variables, then the pooled OLS estimates in Tables 2 and 3 may be biased. While it is possible that important variables have been omitted from this analysis,[5] I employ dyad and country-specific fixed effects to sweep out any of these variables that are time-invariant. These variables include such factors as colonial history, geographic proximity, linguistic similarity, and time-invariant cultural affinities. The fixed-effects estimates for the autoregressive dyadic diffusion model are shown in column 2 of Tables 4 and 5 (see Appendix Tables A2 and A3 for details). The fixed effects estimates do not differ substantially from the pooled OLS estimates, indicating that the pooled OLS results are robust.

The fixed effects model, however, may introduce bias since the lagged dependent variable is correlated with the error term. I account for this possibility by estimating an instrumental variable (IV) fixed effects model, where lagged values of the explanatory variables act as instruments for the LDV. These estimates are shown in column 3 of Tables 4 and 5 (see Appendix Tables A4 and A5 for details). Two differences between the IV-fixed effects and the pooled OLS estimates are that in the former, the effects of joint participation in the WHO and the IMF change signs. Joint participation in WHO now results in convergence, whereas joint participation in the IMF no longer has a statistically significant effect. This strengthens the finding that coercive isomorphism is not at play in driving fertility convergence at the global level. Another major difference is shown in Table 4: the effect of generic bilateral trade ties now results in divergence as opposed to convergence. The effect of trade thus leads in general to divergence, and only produces convergence when a non-rich country imports from a rich country. We therefore find mixed evidence for hypothesis 1, but strong evidence in favor of hypothesis 2. The remaining parameter estimates (in particular, the effect of bilateral trade with a rich country) match closely with the pooled OLS estimates and thus increase our confidence in these results.

Because nation-states came into and went out of existence between 1960 and 2009, country mergers and dissolutions were dealt with through combination of data and listwise deletion, respectively. Since the number of mergers and dissolutions was small, the decision about how to treat these events is unlikely to affect the results. Nevertheless, as a robustness check for mergers, any countries that eventually merged with each other (e.g., East and West Germany) were listwise deleted, showing no qualitative difference from the combined data results (i.e., the results based on collapsing East and West Germany into one country prior to German reunification). For dissolutions, keeping former nation-states in the analysis (subject to data availability) did not have any appreciable effect on the results.

One final potential issue with this analysis is the arbitrary cutoff for what value of GDP per capita defines a country as "rich." The cutoff used in this article is $12,500, but it is arguable whether this value is too high or too low. As a robustness check, I explore higher and lower cutoffs (ranging between $9,266 and $20,000) for whether or not a country is rich and find that the results are robust to this cutoff specification.

Discussion and Conclusion

This article employs a novel methodology and dataset to highlight the importance of new global institutions in mediating schematic and material exchange at the global level, thus driving change in nation-states' fertility rates through normative influence. Trade and economic change do matter—just not in the way we thought they did. Classical theories of fertility decline emphasized countries' transitions to modernity and the role of economic growth and development in driving fertility change (Notestein 1945). Recent work has moved in another direction, offering up the hypothesis that ideational diffusion is what really matters (Bongaarts and Watkins 1996; Cleland and Wilson 1987). This article confirms that elements of both are true: beyond its pure economic effects, global institution-building is a social process. It is a form of social interaction, and it embodies material and schematic diffusion. People, states, and societies take cues from materials circulated through trade and global institutions and reshape their schemas that impinge on fertility accordingly. Even after controlling for path dependence in fertility differences, socioeconomic development, colonial history, geographic proximity, trade openness, and participation in global organizations, we find that increased bilateral trade with a rich country still leads to reduced fertility differences between the two trade partners. The trade effect is asymmetric, with non-rich nation-states converging to rich nation-states in the global network.

Entry into IGOs like the UN and WHO that enforce global scripts yields convergence in fertility rates, whereas entry into more coercive IGOs like the WTO and World Bank results in the opposite effect. Free trade agreements lead to fertility convergence whereas common markets and monetary unions yield divergence. The magnitude of these effects is small relative to the trade effect. This may indicate the greater power of trade, which is a more direct form of social interaction, to effect fertility change compared to other institutions that are out of the hands of the average person. Trade is something that effects change on a much more personal level. Unlike with IGOs, people (whether knowingly or not) participate in trade daily and thus are directly exposed to this powerful channel of social interaction. One important qualification is that global network connections are not the only factors that explain fertility change; rather, the social process of trade is one factor that has played an important role in affecting schemas that impinge on fertility.

These results confirm the macro-level mechanisms theorized by Bongaarts and Watkins (1996) and Caldwell (2001), among others, who write that globalization can lead to fertility transitions through a variety of international linkages. All of the hypotheses tested in this article are consistent with the idea that normative isomorphic pressures are at work in driving fertility convergence. The above results are thus in accord with recent findings in the globalization literature on the role of normative change in driving other types of diffusion, including the spread of democracy (Torfason and Ingram 2010) and higher education (Schofer and Meyer 2005). However, these results also show that the effect of globalization on fertility and convergence more broadly is not unidirectional as predicted by a number of theories of social change (Meyer 2000; Notestein 1945). While the formation or strengthening of some types of institutional ties leads to convergence, this effect is not uniform. Ties through more coercive organizations do not appear to yield convergence.[6] Trade has varied effects depending on the nature of the trade relationship, indicating a limit to the ability of global ties to produce convergence. This article also provides support for the Theory of Conjunctural Action as a framework for studying fertility change. It helps to refine aspects of TCA: we learned that on the global level, diffusion through trade is directed, with non-rich countries adopting the fertility characteristics of rich countries, albeit through different means. Studying the relationship between globalization and fertility is important because we do not yet know whether the global fertility transition was initiated by the same forces for many countries, or if there were different mechanisms for different countries. Because the growth of the global network coincided with the worldwide fertility transition, globalization is a strong candidate as a vehicle for the spread of fertility declines internationally (Caldwell 2001).

In terms of policy, one might be tempted to interpret these results as prescribing increased trade between rich and poor countries to facilitate fertility convergence. This is a mistaken construal of the above results, since it does not take into account the fact that trade is, to a great extent, a voluntary exchange. People and nation-states are not lemmings who accept the constraints of structure willingly. Rather, they are social actors with agency who actively take part in defining their interaction on the global stage. Thus, forcing a developing country into a trade relationship is unlikely to result in fertility declines. In the language of the program evaluation literature, these results may not be externally valid. There are also numerous examples of countries that commenced fertility transitions seemingly independent of trade ties (for example, Iran in the 1980s). What these results do say is that fertility declines seem to have been partially patterned by the process of integration into the global economy and polity.

The findings presented here suggest further work should be undertaken on the linkages between globalization and demographic processes. One limitation of the present study is that it could not take into account the specifics of organizational communication or the differences in types of goods and services traded. Dollar or percentage amounts may not adequately capture the effects of global institutions on fertility. Future studies should examine the causal impact of the spread of specific materials across borders, whether through trade, IGOs, or regional trade blocs. This will help elucidate the meso and micro level mechanisms that drive schematic change throughout the world. Another limitation of this study is that it only captures first-order network effects (effects of one nation-state directly on another). There may be effects based on relationships spanning multiple degrees of separation, so that even if two countries are not directly connected they may still influence each other. Future research can extend the theoretical and methodological frameworks presented here to account for higher-order network effects. Finally, TCA emphasizes the fact that the distribution of schemas across social space is uneven. Empirical studies should therefore also consider how globalization may drive inequality in fertility outcomes within countries. Most importantly, future studies should consider the interaction of material and schematic structures rather than considering each in isolation.

ENDNOTES

[1] The mechanism of diffusion at the individual or local level is unobserved and could be of a different variety, but in the great majority of cases national fertility transitions were not of a coercive nature (Bongaarts and Sinding 2009).

[2] Note that this trade diversion need not imply stalled gains in the absolute amount of trade being conducted.

[3] These estimates are only from a non-rich country's perspective—the bilateral trade effects for rich countries are positive and statistically significant but are not shown here. These divergence results for rich countries provide further evidence that different isomorphic (or perhaps polymorphic) mechanisms are at play on the global stage.

[4] This is a crude approximation since replacement level fertility, defined as the TFR that would make the net reproductive rate (NRR) equal to 1, differs from country to country because of mortality differences. I use a TFR of 2.1 children per woman as an approximation.

[5] Note that I do not control for more proximate determinants of fertility like education, contraceptive prevalence, or family planning programs. This is by design, since the aim of this study is to understand what global factors have led to fertility convergence. The aforementioned proximate variables are mechanisms resulting from globalization, and thus lie along the causal pathway between global institutions and fertility.

[6] Note that while this interpretation is consistent with the findings in this article, more research will be needed to verify whether this is always the case. The effect of joint participation in the IMF, for example, is almost zero.

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TABLES

Table 1. Descriptive Statistics for WDI and Correlates of War Data, 1960-2009

Variable	*N*	Mean	SD	Min	Max
Total Fertility Rate	984083	4.0	2.0	1.1	9.2
Absolute TFR Difference	958012	2.1	1.6	0.0	7.9
Bilateral Trade	1016385	0.0	0.04	0.0	1.0
Rich	1016385	0.1	0.3	0.0	1.0
Common Market	1016385	0.0	0.1	0.0	1.0
Free Trade Agreement (FTA)	1016385	0.0	0.1	0.0	1.0
Monetary Union	1016385	0.0	0.1	0.0	1.0
World Bank	838137	0.8	0.4	0.0	1.0
UN	838137	0.9	0.2	0.0	1.0
WHO	838137	1.0	0.2	0.0	1.0
IMF	838137	0.9	0.3	0.0	1.0
UNESCO	838137	0.9	0.3	0.0	1.0
WTO	838137	0.9	0.4	0.0	1.0
GDP per capita (constant 2000 US$)	887817	6136.6	8800.2	57.8	108111.2
Trade Openness (trade as % of GDP)	887525	74.4	47.0	0.2	445.9

Note: All summary statistics not pertaining to the dyad refer to country i within dyad i, j, except for “Rich”, which refers to country j.

Table 2. Autoregressive Dyadic Diffusion Model Estimates for Absolute TFR Differences

	(1)	(2)
LDV	0.994***	0.994***
	(0.000117)	(0.000118)
Bilateral Trade		-0.0709***
		(0.00573)
N	801389	801389

Note: All tests are two-tailed and heteroskedasticity and autocorrelation robust (HAC) standard errors are in parentheses. LDV stands for Lagged Dependent Variable. All models include controls for GDP per capita and trade openness of country i.
* $p < .05$, ** $p < .01$, *** $p < .001$

Table 3. Detailed Autoregressive Dyadic Diffusion Model Estimates for Absolute TFR Differences

	(1)	(2)	(3)	(4)
LDV	0.995***	0.994***	0.994***	0.995***
	(0.000118)	(0.000118)	(0.000126)	(0.000128)
Bilateral Trade				
Not Rich/Not Rich	0.0171*			0.0144
	(0.00864)			(0.0106)
Not Rich/Rich	-0.177***			-0.224***
	(0.00873)			(0.00960)
Trade Blocs				
Common Market		0.0224***		0.0262***
		(0.00284)		(0.00286)
Free Trade Area		-0.00923***		-0.0146***
		(0.00260)		(0.00264)
Monetary Union		0.0137***		0.0138***
		(0.00303)		(0.00307)
IGOs				
World Bank			0.0106***	0.0106***
			(0.000643)	(0.000643)
UN			-0.0201***	-0.0208***
			(0.00171)	(0.00170)
WHO			0.00299	0.00522*
			(0.00221)	(0.00220)
IMF			0.00476***	0.00535***
			(0.000937)	(0.000937)
UNESCO			-0.00479***	-0.00680***
			(0.000901)	(0.000900)
WTO			0.0290***	0.0293***
			(0.000562)	(0.000563)
N	801389	801389	672244	672244

Note: All tests are two-tailed and heteroskedasticity and autocorrelation robust (HAC) standard errors are in parentheses. LDV stands for Lagged Dependent Variable. All models include controls for GDP per capita and trade openness of country i.

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 4. Pooled OLS, Fixed Effects, and IV-Fixed Effects Diffusion Model Estimates for Absolute TFR Differences

	(1) Pooled OLS	(2) Fixed Effects	(3) IV-Fixed Effects
LDV	0.994***	0.984***	0.961***
	(0.000118)	(0.000261)	(0.00587)
Bilateral Trade	-0.0709***	0.0642***	0.111***
	(0.00573)	(0.0109)	(0.0159)
N	801389	801389	793980

Note: All tests are two-tailed and standard errors are in parentheses. LDV stands for Lagged Dependent Variable. All models include controls for GDP per capita and trade openness of country i.

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 5. Pooled OLS, Fixed Effects, and IV-Fixed Effects Detailed Diffusion Model Estimates for Absolute TFR Differences

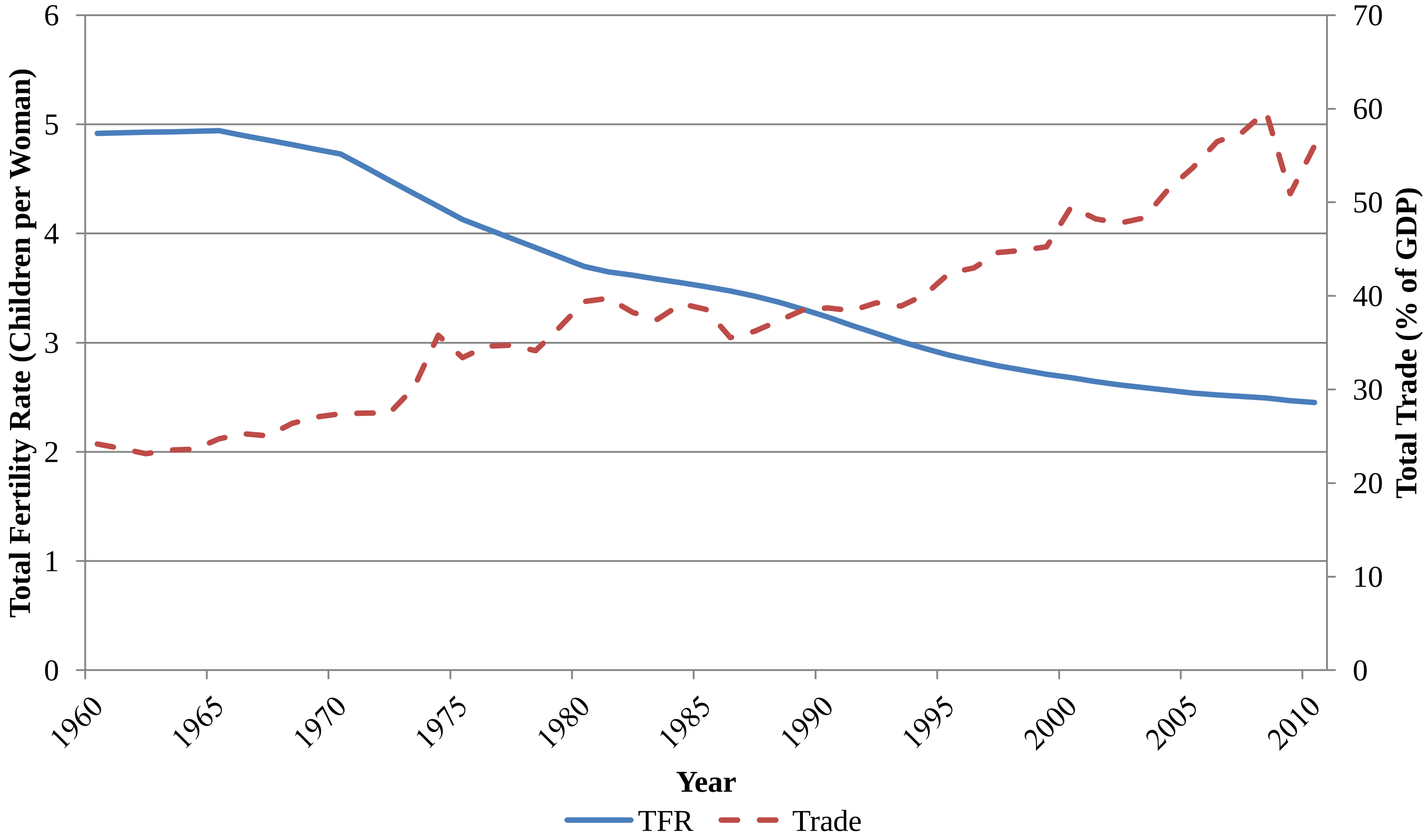
	Pooled OLS	Fixed Effects	IV-Fixed Effects
LDV	0.995***	0.981***	1.050***
	(0.000128)	(0.000315)	(0.00459)
Bilateral Trade			
Not Rich/Not Rich	0.0144	0.122***	0.0290
	(0.0106)	(0.0148)	(0.0168)
Not Rich/Rich	-0.224***	-0.0533**	-0.202***
	(0.00960)	(0.0186)	(0.0214)
Trade Blocs			
Common Market	0.0262***	0.0417***	0.0295***
	(0.00286)	(0.00327)	(0.00372)
Free Trade Area	-0.0146***	-0.0229***	-0.0252***
	(0.00264)	(0.00302)	(0.00335)
Monetary Union	0.0138***	0.0293***	0.0400***
	(0.00307)	(0.00487)	(0.00514)
IGOs			
World Bank	0.0106***	0.00651*	0.0277***
	(0.000643)	(0.00255)	(0.00319)
UN	-0.0208***	-0.0255***	-0.0227***
	(0.00170)	(0.00252)	(0.00280)
WHO	0.00522*	-0.0200***	-0.0106**
	(0.00220)	(0.00395)	(0.00396)
IMF	0.00535***	-0.00500*	-0.00381
	(0.000937)	(0.00248)	(0.00284)
UNESCO	-0.00680***	-0.00714***	-0.0116***
	(0.000900)	(0.00105)	(0.00119)
WTO	0.0293***	0.0244***	0.0159***
	(0.000563)	(0.000674)	(0.000826)
N	672244	671957	657296

Note: All tests are two-tailed and heteroskedasticity and autocorrelation robust (HAC) standard errors are in parentheses. LDV stands for Lagged Dependent Variable. All models include controls for GDP per capita and trade openness of country i.

* $p < .05$, ** $p < .01$, *** $p < .001$

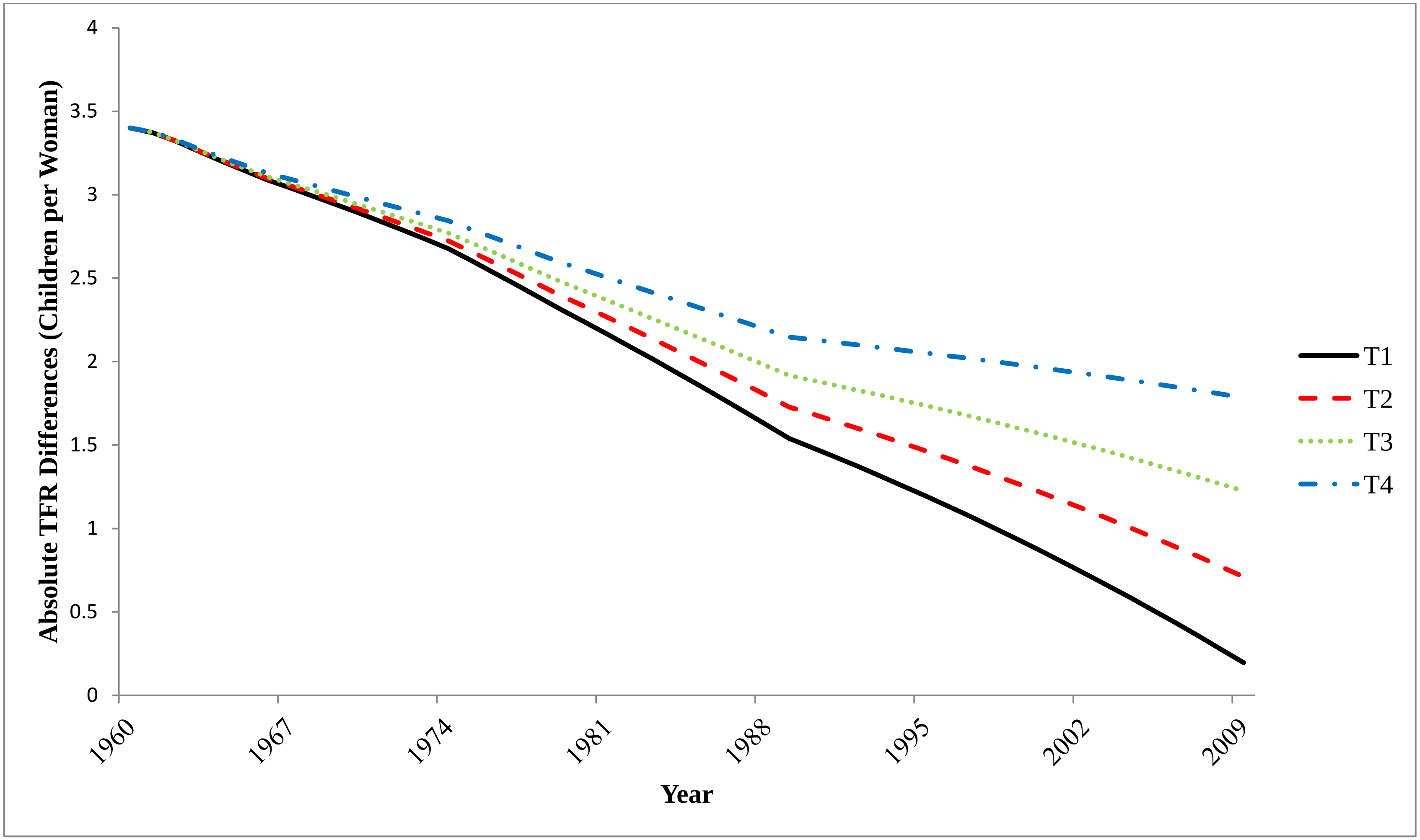
FIGURES

Figure 1. World Total Fertility Rate and Total Trade, 1960-2010



Source: World Bank World Development Indicators

Figure 2. Simulated Trajectories of Absolute TFR Differences, 1960-2009



Note: T1 through T4 represent four different stylized bilateral trade trajectories, where T1 is the scenario where the most trade occurs and T4 is the scenario where zero trade occurs. T2 and T3 are intermediate scenarios (described on page 25).

Source: Author's calculations based on regression 4 in Table 3 and stylized data described in text (see pages 25-26)

APPENDIX A. SUPPLEMENTARY TABLES

Table A1. Trade Bloc Classifications

Type of Bloc	Names of Blocs
Free Trade Area	Association of Southeast Asian Nations (ASEAN), Caribbean Community (CARICOM), Caribbean Free Trade Association (CARIFTA), Central European Free Trade Agreement (CEFTA), Common Market for Eastern and Southern Africa (COMESA), East African Community (EACM), East Caribbean Common Market (ECCM), Economic and Monetary Union of Central Africa (CEMAC), Economic Community of Central African States (ECCAS), European Free Trade Association (EFTA), European Union (EU), Latin American Free Trade Association (LAFTA), Mercosur, Monetary Union of Central Africa (UMAC), North American Free Trade Agreement (NAFTA), South Asian Association for Regional Cooperation (SAARC), West African Economic and Monetary Union (UEMOA), West African Monetary Union (UMOA)
Common Market	Association of Southeast Asian Nations (ASEAN), Common Market for Eastern and Southern Africa (COMESA), East African Community (EACM), East Caribbean Common Market (ECCM), European Union (EU), Mercosur
Monetary Union	Caribbean Community (CARICOM), Economic and Monetary Union of Central Africa (CEMAC), Monetary Union of Central Africa (UMAC), West African Economic and Monetary Union (UEMOA), West African Monetary Union (UMOA)

Table A2. Fixed Effects Autoregressive Dyadic Diffusion Model Estimates for Absolute TFR Differences

	(1)	(2)
LDV	0.984***	0.984***
	(0.000261)	(0.000261)
Bilateral Trade		0.0642***
		(0.0109)
N	801086	801086

Note: All tests are two-tailed and heteroskedasticity and autocorrelation robust (HAC) standard errors are in parentheses. LDV stands for Lagged Dependent Variable. All models include controls for GDP per capita and trade openness of country i.
* $p < .05$, ** $p < .01$, *** $p < .001$

Table A3. Fixed Effects Detailed Autoregressive Dyadic Diffusion Model Estimates for Absolute TFR Differences

	(1)	(2)	(3)	(4)
LDV	0.984***	0.984***	0.981***	0.981***
	(0.000261)	(0.000261)	(0.000315)	(0.000315)
Bilateral Trade				
Not Rich/Not Rich	0.102***			0.122***
	(0.0122)			(0.0148)
Not Rich/Rich	-0.0349*			-0.0533**
	(0.0162)			(0.0186)
Trade Blocs				
Common Market		0.0349***		0.0417***
		(0.00300)		(0.00327)
Free Trade Area		-0.0238***		-0.0229***
		(0.00278)		(0.00302)
Monetary Union		0.0283***		0.0293***
		(0.00363)		(0.00487)
IGOs				
World Bank			0.00636*	0.00651*
			(0.00255)	(0.00255)
UN			-0.0252***	-0.0255***
			(0.00252)	(0.00252)
WHO			-0.0202***	-0.0200***
			(0.00395)	(0.00395)
IMF			-0.00499*	-0.00500*
			(0.00248)	(0.00248)
UNESCO			-0.00713***	-0.00714***
			(0.00105)	(0.00105)
WTO			0.0243***	0.0244***
			(0.000674)	(0.000674)
N	801086	801086	671957	671957

Note: All tests are two-tailed and heteroskedasticity and autocorrelation robust (HAC) standard errors are in parentheses. LDV stands for Lagged Dependent Variable. All models include controls for GDP per capita and trade openness of country i.

* $p < .05$, ** $p < .01$, *** $p < .001$

Table A4. IV-Fixed Effects Autoregressive Dyadic Diffusion Model Estimates for Absolute TFR Differences

	(1)	(2)
LDV	0.951***	0.961***
	(0.00664)	(0.00587)
Bilateral Trade		0.111***
		(0.0159)
N	793980	793980

Note: All tests are two-tailed and heteroskedasticity and autocorrelation robust (HAC) standard errors are in parentheses. LDV stands for Lagged Dependent Variable. All models include controls for GDP per capita and trade openness of country i.

* $p < .05$, ** $p < .01$, *** $p < .001$

Table A5. IV-Fixed Effects Detailed Autoregressive Dyadic Diffusion Model Estimates for Absolute TFR Differences

	(1)	(2)	(3)	(4)
LDV	0.976***	0.977***	1.050***	1.050***
	(0.00563)	(0.00562)	(0.00488)	(0.00459)
Bilateral Trade				
Not Rich/Not Rich	0.116***			0.0290
	(0.0157)			(0.0168)
Not Rich/Rich	-0.0164			-0.202***
	(0.0212)			(0.0214)
Trade Blocs				
Common Market		0.0365***		0.0295***
		(0.00313)		(0.00372)
Free Trade Area		-0.0239***		-0.0252***
		(0.00280)		(0.00335)
Monetary Union		0.0282***		0.0400***
		(0.00370)		(0.00514)
IGOs				
World Bank			0.0274***	0.0277***
			(0.00323)	(0.00319)
UN			-0.0226***	-0.0227***
			(0.00280)	(0.00280)
WHO			-0.0107**	-0.0106**
			(0.00396)	(0.00396)
IMF			-0.00374	-0.00381
			(0.00283)	(0.00284)
UNESCO			-0.0117***	-0.0116***
			(0.00119)	(0.00119)
WTO			0.0158***	0.0159***
			(0.000836)	(0.000826)
N	793980	793980	657296	657296

Note: All tests are two-tailed and heteroskedasticity and autocorrelation robust (HAC) standard errors are in parentheses. LDV stands for Lagged Dependent Variable. All models include controls for GDP per capita and trade openness of country i.
* $p < .05$, ** $p < .01$, *** $p < .001$