It's A Sin – Contraceptive Use, Religious Beliefs, and Long-Run Economic Development

by

Klaus Prettner

and

Holger Strulik

Discussion Papers on Business and Economics
No. 11/2014

FURTHER INFORMATION
Department of Business and Economics
Faculty of Business and Social Sciences
University of Southern Denmark
Campusvej 55
DK-5230 Odense M
Denmark

Tel.: +45 6550 3271
Fax: +45 6550 3237
E-mail: lho@sam.sdu.dk
http://www.sdu.dk/ivoe

It's A Sin – Contraceptive Use, Religious Beliefs, and Long-Run Economic Development*

Klaus Prettner†

Holger Strulik‡

July 2014

Abstract. This study presents a novel theory on the interaction of social norms, fertility, education, and their joint impact on long-run economic development. The theory takes into account that sexual intercourse is utility enhancing and that the use of modern contraceptives potentially conflicts with prevailing social norms (religious beliefs). The theory motivates the existence of two steady states. At the traditional steady state, the economy stagnates, fertility is high, education is minimal, and the population sustains a norm according to which modern contraceptives are not used. At the modern steady state, the population has abandoned traditional beliefs, modern contraceptives are used, fertility is low and education and economic growth are high. Social dynamics explain why both equilibria are separated by a saddlepoint-equilibrium (a separatrix), i.e. why it is so hard to transit from the traditional regime to the modern regime. Enhancing the value of education is identified as a promising policy to encourage contraceptive use and to initiate the take-off to long-run growth.

Keywords: religion, fertility, sex, contraceptive use, education, economic growth.

JEL: 040; I25; J10; Z12.

* We would like to thank Gani Aldashev, Casper Worm Hansen, Ingrid Henriksen, Sophia Kan, Lars Loenstrup, Manuel Oechslin, and Sjak Smulders for helpful comments.

†University of Goettingen, Department of Economics, Platz der Goettinger Sieben 3, 37073 Goettingen, Germany; email: klaus.prettner@wiwi.uni-goettingen.de.

‡University of Goettingen, Department of Economics, Platz der Goettinger Sieben 3, 37073 Goettingen, Germany; email: holger.strulik@wiwi.uni-goettingen.de.

1. Introduction

The literature on long-run economic development has established the onset of the fertility transition as an important prerequisite for the take-off to modern growth (Galor, 2005, 2011; Dalgaard and Strulik, 2013). Fertility, in turn, depends crucially on the use of modern contraceptives. More precisely, the demographic literature identifies contraceptive use as one of the leading *proximate* determinants of fertility (Bongaarts and Potter, 1983). But what are the *deep* determinants of contraceptive use? In particular, why are modern contraceptives not used when they are available at little or no cost? One potential explanation, which is explored in this paper, is that the use of contraceptives conflicts with religious beliefs and entrenched social norms.

When contraceptives are not used and fertility is high, education levels of children are low. This is the well-known child quality-quantity trade-off at center of unified growth theory (see Galor, 2005; 2011 for surveys). In the present context, the quantity-quality trade-off generates a further feedback at the aggregate (community- or society-) level, which makes the prevalence of traditional beliefs sustainable. Specifically, it will be assumed that the value of traditional religious beliefs is individual-specific and increasing in the aggregate number of believers, as argued in the economics of religion (e.g. Iannaccone, 1998) and declining in education (or income), capturing the impact of enlightenment and modernization (Inglehart and Baker, 2000).

We show that this setup motivates the existence of two locally stable steady states. At one steady state, individuals share a belief in traditional religion and do not use contraceptives. Fertility is high, education is low, and the economy stagnates. At the other steady state, traditional beliefs are abandoned and contraceptives are used. Fertility is low, education is high, and the economy grows at a constant rate. The steady states are separated by a separatrix, i.e. a threshold for which the dynamics on either side lead to one of the steady states.

This means that in order to leave the steady state of stagnation, society has to solve a collective action problem according to which sufficiently many individuals start using contraceptives. This observation explains the self-sustainability of the steady states and why it is sometimes so hard to instigate widespread use of contraceptives even when they are freely distributed. The size of the collective action needed to leave stagnation depends on the location of the separatrix in the religiosity–education space. If the value of traditional religion is sufficiently low or if the productive value of education is sufficiently high, the traditional equilibrium ceases to exist and

society converges towards balanced growth. Along the transition path, average fertility and the share of believers in traditional religion are continuously declining, and average education and the share of users of modern contraceptives are continuously rising.

The paper contributes to unified growth theory by emphasizing the role of education and the fertility transition for the take-off to long-run growth.[1] The channel of traditional religion and contraceptive use, however, remained unexplored by conventional unified growth theory. Conventional theory ignores the human desire for sexual intercourse and thus, naturally, the use of contraceptives can play no role for the fertility transition. Implicitly, conventional theory assumes that sex is a functional and joyless activity executed to achieve a desired number of children. This approach, however, makes it difficult to discuss the role of religion and social norms for the use of contraceptives.

Here, we explicitly acknowledge that sex is a utility enhancing activity. The use of modern contraceptives allows households to experience utility from sex without a proportional increase in child births. Contraceptive use, however, may conflict with the religious beliefs of households. For linguistic ease, we define traditional religion as a belief-system, shared by members of a community, which prohibits the use of modern contraceptives. The value of traditional religion is assumed to be individual-specific and increasing in the number of households sharing these beliefs. The value of the alternative (modern) belief-system is, for simplicity and without loss of generality, normalized to zero. Households, as usual, decide on the number of children and their education. In the present context, they additionally solve the meta-decision problem of whether they share traditional beliefs and abstain from contraception or whether they abandon traditional beliefs, enjoy more sex, and limit their fertility. Since child rearing is a time consuming activity, the limitation of fertility generate extra time (potential income), which is used by households to improve their children's education.[2]

The assumption that sex is a utility enhancing activity is perhaps self-evident but there is also compelling evidence from the happiness literature (Blanchflower and Oswald, 2004; Kahneman

[1] For unified growth see Galor and Weil (2000), Kögel and Prskawetz (2001), Jones, 2001, Lucas (2002), Galor and Moav (2002, 2006), Doepke (2004), Cervelatti and Sunde (2005), Galor and Mountford (2008), Strulik and Weisdorf (2008), Strulik et al. (2013), and many others. See Galor (2005, 2011) for surveys.

[2] According to Akerlof and Kranton's (2000) economic theory of identity choice individuals are not necessarily aware that they are actively choosing the utility-maximizing identity. Referring to Friedman's (1953) general methodology of positive economics it only important that they behave as if they maximize their utility. Notice that a religious identity can be relatively easily adopted because it is less ascriptive than other dimensions of identity like, for example, ethnicity. See Caselli and Coleman (2013) for a recent economy theory of ethnic identity choice.

et al. 2004). The fact that humans like sex is readily explained by evolutionary psychology. In pre-modern times, when contraceptives were unavailable (and reproductive biology not yet understood), enjoying sex was a Darwinian fitness-maximizing trait. The notion that during evolution humans had no clear notion of how sexual intercourse was related to fertility, is helpful to motivate the desire for sex without the desire for (more) children as well as the demand for contraceptives (Wright, 1994; Potts, 1997).

The literature provides ample evidence supporting the impact of religion and religious beliefs on fertility and contraceptive use. With respect to the historical evolution of the (mainly Christian) West, it is shown that the prevalence of Catholicism and the intensity of religious beliefs (church attendance) had a delaying impact on the onset of the fertility transition (Lesthaeghe and Wilson, 1986; Hacker, 1999; Adsera, 2006; Frejka and Westoff, 2008; Zhang, 2008; Baudin, 2012; see McQuillan for a survey and a discussion of potential mechanisms). With respect to religious beliefs across contemporaneous developing countries, Heaton (2011) finds that the historical distinctive behavior of Catholics has almost vanished. Instead, a significant difference between Christians and Muslims emerges. Christians are found to be more than twice as likely to have used contraception. Iyer (2002) finds for a sample from Southern India, that 99% of Muslim women but only 19% of Hindu women believe that contraceptive use is against their religion. Muslim women are found to be less likely to use contraceptives but the significant impact of religion disappears once socioeconomic factors (education of husband and wife) are controlled for. Munshi and Myaux (2006) show that in rural Bangladesh the uptake of contraceptives depends crucially on the prevalence of contraceptive use in one's religious group within the village (Muslim or Hindu), suggesting that fertility norms operate through shared religious beliefs.

Many of the countries in which the fertility transition and the use of modern contraceptives is most severely delayed are situated in Sub Saharan Africa. The cultural roots of high African fertility most likely stem from traditional African religion emphasizing the cult of ancestors and the succession of the generation (Caldwell and Caldwell, 1987). In fact, some country studies suggest that Christian religious socialization *raises* the demand for contraceptives in Africa because Christian religious leaders propagate modern family planning (Agadjanian, 2001; Yeatmen and Trinitapoli, 2008). According to traditional African religion, in contrast, high fertility is associated with "divine approval and approbation by both living and dead ancestors"

whereas low fertility is "interpreted as evidence of sin and disapproval" (Caldwell and Caldwell, 1987, p. 416) and contraception is regarded as "unnecessary" and "evil" (ibid., p. 424). These aspects of traditional religion are found to be very persistent. Traditional beliefs pertaining to fertility and the use of contraceptives have survived regardless of the fact that contemporary Africans are mostly Christians or Muslims (ibid, p. 427).

Consequently, demographers diagnose Sub-Saharan Africa as the only region in the world where low levels of contraceptive use and high fertility still persist (Cleland, 2009). According to the most recent DHS surveys on Sub Saharan African countries, the contraceptive prevalence rate is still very low at an average of 20% and the total fertility rate is still very high at 5.0.[3] The slow development in some Sub Saharan African countries has motivated demographic research to speculate whether in some countries the fertility transition stalled in mid-transition and whether the demand for contraceptives have leveled off (Bongaarts, 2006).

This paper is related to a small body of literature on social norms and fertility. Palivos (2001) and Bhattacharya and Chakraborty (2012) proposed models of social conformism in which the individual utility that parents derive from their children depends on the average family size in society. Palivos investigates a setup in which fertility incurs opportunity costs in terms of less parental education and shows that complementarities can motivate the existence of multiple locally stable equilibria, sustained by a high or low fertility norm. Bhattacharya and Chakraborty integrate child mortality in this setup and show that net fertility declines as a response to improving child mortality when the society is situated at a high-fertility equilibrium. The role of sex, contraceptive use, and shared traditional religion for the emergence and sustainability of equilibria is not investigated.

Baudin (2010) develops a model of a society consisting of two types of individuals, traditionalists and modernists. These two types work in different sectors, receive a distinct income, and try to sustain a distinct fertility norm via vertical socialization as in Bisin and Verdier's (2001) model of preference formation. He then investigates how exogenous income shocks or exogenous technological progress in the two sectors affect aggregate fertility and norm sustainability. Bar-El et al. (2013) employ a partial equilibrium model of vertical socialization in which a preference for many children is identified with religiosity and use the model to derive testable hypotheses on the evolution of secularization. This paper shares with these studies a focus on the role of

[3]Contraceptive prevalence is the current use of modern contraception methods among currently married women. Data source: ICF (2012); 35 Sub-Saharan African surveys, average survey year 2007.

culture for fertility. It focuses on the role of sexual desire, contraceptive use, education, and endogenous long-run growth, which were not discussed in the earlier literature.[4]

The role of contraceptives for the fertility transition and the take-off to growth is also investigated by Bhattacharya and Chakraborty (2014) and Strulik (2014). Bhattacharya and Chakraborty also investigate (numerically) the role of social diffusion and conformism. Their approach, however, is based on different assumptions and focuses on different mechanisms. Most importantly, it neglects that sex is a utility enhancing activity. Strulik (2014), like this study, acknowledges the desire for sex as a main driver of human reproductive behavior but focuses on the role of costs and efficacy of contraceptives and, in its application, on the historical fertility transition of the West. Both papers do not consider the role of religious beliefs for contraceptive use and how the endogeneity of these beliefs can motivate multiple equilibria of stagnation and long-run growth.

This paper is organized as follows. Section 2 sets up the model, computes optimal fertility and child education under traditional and modern beliefs, solves the problem of individual identity choice, and computes the division of society according to shared beliefs. Section 3 computes social dynamics and determines the steady states of stagnation and long-run growth. It computes the shifters of the separatrix of the two equilibria and identifies the return to schooling as an important determinant for the existence of a locally stable steady state of stagnation. In Section 4, we generalize the model towards imperfect or absent intergenerational transmission of knowledge. In these cases, the former growth effects become level effects and the separatrix separates a traditional low-income equilibrium from a modern high-income equilibrium. Section 5 concludes.

2. The Model

2.1. **Households and Firms.** Consider an economy populated by a measure one of households and a measure one of competitive firms. At any given time, firms use human capital as input in order to produce output $y_t = \bar{h}_t \ell_t$, in which $\bar{h}_t$ is the average level of human capital in the economy and ℓ_t is aggregate labor supply. Household income is thus given by its supply of human capital.

[4]Here we focus on birth control as motivation for the use of contraceptives. With respect to condoms there exists another motive, protection from disease transmission. See Greenwood et al. (2013) for a general equilibrium model focussing on sexual behavior and disease transmission (and ignoring fertility).

Households consist of couples who cooperatively maximize utility from spending income on consumption, from having children, from the education of their children, and from having sex. For better comparison with related models of one-person-households, we measure all variables in units per parent, such that n_t is the number of children per parent, c_t is consumption expenditure per parent, etc. Notice that there is no conflict of interest between spouses. This case is left as an interesting extension for future research.

Furthermore, households experience utility from sharing a religious identity (or, more generally, a value system) with other households. Sharing a traditional value system requires avoiding the use of modern contraceptives ($u_t = 0$). It provides a utility $v_t R(i)$, in which v_t is a measure of the general value of traditional religion shared by all members of society and $R(i)$ is a measure of the individual-specific utility experienced by individual i. For simplicity we assume that $R(i) \in (0, 1)$ is uniformly distributed in each generation. Notice that $R(i)$ is individual-specific but constant over time, while v_t applies to all individuals and potentially varies over time. The determinants of the general value of traditional religion are exogenous to the individual household but endogenous at the community-level. Details will be introduced in Section 3. The value of the alternative religious identity (no religion, or a religion not condemning the use of modern contraceptives) is normalized to zero.[5]

In order to determine an analytically treatable solution, the household utility function is assumed to be separable and logarithmic. It reads

$$U = \log c_t + \alpha \log n_t + \gamma \log e_t + \sigma \log s_t + \chi v_t R(i), \tag{1}$$

in which e_t is education per child, s_t is sexual activity, and χ is an indicator variable that assumes the value of unity if the household abstains from modern contraceptives. Otherwise, $\chi = 0$. Besides the last two elements, the utility function is standard in unified growth theory. The optimal individual choices depend on the preferred religious identity and thus should be indexed by i as well. In order to avoid notational clutter we suppress the individual index unless needed for clarification.

For simplicity we measure s_t such that without the use of modern contraceptives a unit of s_t implies a unit of n_t. This number may be thought of as already taking into account costless

[5]Naturally, the results would not change if we replace the utility from sharing the traditional religion with a disutility experienced from not obeying traditional norms. The latter approach would imply a different interpretation of the results, based on social conformism (Bernheim, 1994) rather than religious identity (Akerlof and Kranton, 2000).

(and socially accepted) traditional methods of contraception, such as breastfeeding or the rhythm method. Using a unit of modern contraceptives prevents the birth of μ children. The parameter θ thus controls the effectiveness of modern contraceptives. Taking an upper limit of fertility, given by female fecundity, $\bar{n}$ into account, we thus have

$$n_t = \min\left\{s_t - (1-\chi)\mu u_t,\, \bar{n}\right\}, \tag{2}$$

in which u_t is household demand for modern contraceptives. Here, we assume that contraceptives are available at negligible costs. This assumption helps us to focus the analysis on social dynamics and attitudes and beliefs as a determinant of contraceptive use. At the dawn of the fertility transition in the West, the costs of modern contraception were significant (Guinnane, 2011), which makes them potentially crucial for the onset and speed of the fertility tradition. In contemporaneous developing countries, in contrast, contraception is frequently freely available and the question is why it is not more widely used. Moreover, the present study focuses on steady states and their stability characteristics, and not on the speed of transitional dynamics. Strulik (2014) provides a unified growth theory in which the costs of contraceptives are crucial for the onset and speed of the historical fertility transition but irrelevant for the steady states of stagnation and long-run growth. When contraceptives are unavailable. there is naturally no choice, which implies that any economy is likely to be situated originally at the traditional equilibrium where modern contraceptives are not used.

Households are endowed with human capital h_t and one time unit per adult, which is spent on work, child rearing, and sex. This implies the budget constraint

$$h_t(1 - \phi n_t - e_t n_t - \tau s_t) - c_t = 0, \tag{3}$$

in which ϕ is the time spent on child rearing, e_t is the time spent on education per child, and τ is the time spent on sex. The presence of a time cost for sex τ prevents sex from increasing without limit in a growing economy. An arbitrarily small time cost is sufficient to achieve asymptotically constant sexual activity. Alternatively, we could use a satiation level or a physiological upper limit for sex without changing the results. As common in unified growth theory (e.g. Galor, 2005, 2011), we make the analytically convenient assumption that education costs parental time. In the Appendix, we set up an alternative version of the model according to which education

is provided by teachers in a separate schooling sector and show that this leaves our results unaffected.

Households maximize (1) subject to (2)–(31), given non-negativity constraints on all variables. Additionally we assume $\gamma < \alpha$. The assumption ensures that parents always prefer to have children although children could be avoided at no cost. If parents decide not to share the traditional religion and to use contraceptives, the solutions for consumption, fertility, education, contraceptive use, and sex are:

$$c_t = \frac{h_t}{1+\alpha+\sigma} \tag{4}$$

$$n_t = n_M \equiv \frac{\alpha-\gamma}{(1+\alpha+\sigma)\phi} \tag{5}$$

$$e_t = e_M \equiv \frac{\gamma\phi}{\alpha-\gamma} \tag{6}$$

$$u_t = u_M \equiv \frac{\phi\sigma-(\alpha-\gamma)\tau}{(1+\alpha+\sigma)\phi\mu\tau} \tag{7}$$

$$s_t = s_M \equiv \frac{\sigma}{(1+\alpha+\sigma)\tau}. \tag{8}$$

Notice that all outcome variables aside from consumption are constant over time. A subscript M identifies the solution as an optimal solution, conditional on sharing a modern belief system (as opposed to traditional religion). Inspection of (8) shows that even couples with modern beliefs do not necessarily use modern contraceptives.

ASSUMPTION 1. *The desire for sex is sufficiently strong such that couples with modern attitudes towards contraception ($\chi = 0$) use contraception, that is $\sigma > \bar{\sigma} \equiv (\alpha-\gamma)\tau/\phi$.*

Notice that the threshold for the use of modern contraceptives is increasing in the desire for having children and the time cost of having sex, and that it is declining in the desire for education and child rearing costs. These results are very intuitive. In the context of the present paper, a solution according to which modern contraceptives are never used is uninteresting. Assumption 1 focusses on an interesting problem.

If parents share traditional beliefs and maximize (1) subject to (2)–(31), given $\chi = 1$, they arrive at the optimal solution

$$n_t = n_T \equiv \frac{\alpha-\gamma+\sigma}{(1+\alpha+\sigma)(\phi+\tau)} \tag{9}$$

$$e_t = e_T \equiv \frac{\gamma(\phi+\tau)}{\alpha-\gamma+\sigma} \tag{10}$$

$$s_t = s_T \equiv \frac{\alpha-\gamma+\sigma}{(1+\alpha+\sigma)(\phi+\tau)} \tag{11}$$

and c_t as in (4). An index T indicates the optimal solution contingent on sharing traditional beliefs. Comparing the traditional and the modern equilibrium, we find:

PROPOSITION 1. *Couples sharing modern beliefs have fewer and better educated children and have more sex than couples sharing traditional beliefs.*

For the proof, we use the fact that at the modern equilibrium from Assumption 1, $\sigma > \bar{\sigma}$, implying $(\alpha-\gamma)\phi+\sigma\phi > (\alpha-\gamma)\phi+(\alpha-\gamma)\phi$, that is, $\phi(\alpha+\gamma+\sigma) > (\phi+\tau)(\alpha-\gamma)$, such that $e_M > e_T$. The proofs for fertility and sexual activity are analogous.

Abandoning traditional beliefs thus goes hand in hand with sexual liberation. Notice the essentially "non-Darwinian" character of this result. The availability and use of contraceptives offers humans, the possibility to have simultaneously more sex and fewer offspring, an option, which is unavailable to (other) animals. Lower fertility reduces child rearing time and the extra time (or, more generally, the extra potential income) is used optimally in order to improve education of children. This is "the lever of riches" (Mokyr, 1990) provided by birth control technology.

Contraceptive technology also explains why the model predicts a different response of fertility to an increasing sex drive in traditional and modern societies:

PROPOSITION 2. *An increase in the desire for sex σ increases fertility at the traditional equilibrium and decreases fertility at the modern equilibrium.*

The proof follows immediately from inspecting equations (9) and (12). The rise of fertility at the traditional equilibrium is the expected (strong) Darwinian response to an increasing sex drive. At the modern equilibrium, this mechanism does not apply any longer. Instead there is a (weak) non-Darwinian response because more sex demands more time, which reduces the total time available for work or child-rearing and has a second order effect on fertility through the opportunity costs of child rearing. The effect is of second order because the time cost of sex is presumably small compared to the time spent on working and child-rearing.

2.2. **Identity Choice.** Inserting the solutions provided by (4)–(11) into (1), we get indirect utility conditioned on identity choice. Following Akerlof and Kranton (2000), we assume that individuals choose an identity that maximizes their utility. Comparing the utility differential $U_M - U_T$, we find that individual i prefers to share traditional beliefs if

$$R(i) \geq \bar{R} \equiv \omega / v_t, \tag{12}$$

with $\omega \equiv (\alpha - \gamma + \sigma)\log(\tau + \phi) - (\alpha - \gamma + \sigma)\log(\alpha - \gamma + \sigma) + (\alpha - \gamma)\log(\alpha - \gamma) - (\alpha - \gamma)\log(\phi) - \sigma\log(\tau) + \sigma\log(\sigma)$.

PROPOSITION 3. *Increasing sexual desire σ raises the threshold to share traditional beliefs $\bar{R}$, $\partial\omega/\partial\sigma > 0$.*

The proof computes the derivative of ω with respect to σ as $\log\left[\sigma(\tau + \phi)/((\alpha - \gamma + \sigma)\tau)\right]$. The expression is positive if the term in square brackets is larger than 1, which requires $\sigma(\tau + \phi) > (\alpha - \gamma + \sigma)\tau$. This inequality is fulfilled for $\sigma > (\alpha - \gamma)\tau/\phi$, that is, under Assumption 1.

The threshold $\bar{R}$ separates individuals sharing traditional religion (traditional beliefs) from those sharing modern beliefs. Now, the normalization of the support of religious identity $R(i) \in (0, 1)$ comes in handy since we can immediately infer population shares, taking into account potential corner solutions:

PROPOSITION 4. *The population share of individuals sharing modern beliefs (i.e. using contraceptives) is given by*

$$m_t = \max\left\{0,\, \min\left(\omega / v_t,\, 1\right)\right\}. \tag{13}$$

Notice that Proposition 3 ensures that we can always find a value for σ for which ω is strictly positive. This means that an appropriate choice of the desire for sex σ guarantees that there exists a situation in which at least some individuals prefer to abandon the traditional identity such that the uptake of contraceptives and the take-off to modern growth becomes feasible.

2.3. **Human Capital.** Human capital of the offspring of a household of type j is produced according to the production function

$$h_{t+1,j} = h_0 + A\bar{h}_t e_j, \tag{14}$$

in which $j = T, M$ indicates whether the household shares a traditional or a modern identity, A is a productivity parameter, and $\bar{h}_t$ is the average human capital in society. Average human capital is thought to capture the state of knowledge in society, i.e. the knowledge that can be transferred through education to the next generation. The constant h_0 captures basic skills picked up without investment effort by observing parents and peers at work. The parameter A is the marginal return to education per unit of human capital of the current (teacher-) generation, $A = \partial h_{t+1}/(\partial e_j \bar{h}_t)$. Here, we treat the return on education as a given parameter but it could be endogenously explained by skill-biased technological progress or structural change in a more complex unified growth model (Galor and Weil, 2000; Galor and Mountford, 2008). The linearity of (14) in e_j is innocuous and could be avoided without loss of generality. The linearity in human capital is essential for the model to create perpetual growth. See Strulik et al. (2013) for a motivation of the linearity assumption. In Section 4, we abandon the linearity assumption and discuss the case with decreasing or absent intergenerational transmission of knowledge.

2.4. **The Value of Traditional Religion.** At the macroeconomic level, the value of traditional religion has social and intellectual determinants. In terms of social determinants, we assume that the value of religion this period v_t is increasing in last period's population share of believers, which means is declining in last period's share of non-believers, $\partial v_t/\partial m_{t-1} < 0$. This intergenerational transmission of religious values avoids strategic complementarities, which could arise if v_t were dependent on the current generation's share of believers. Our modeling via intergenerational transmission appears to be a more plausible approach, since it allows us to capture entrenched values, which change only gradually. Formally, religious beliefs are a pre-determined variable according to the present approach, whereas they are a jump variable in models of strategic complementarities. A positive effect of the share of fellow believers on the value of religion is a standard assumption in the economics of religion (e.g. Iannaccone, 1998). Positive externalities arising from sharing one's beliefs with others are generally considered to be a central element of any religion. An exception, which we ignore henceforth, is the formation of religious sects, for which there exists an interior optimal size of members (Iannaccone, 1998).

In terms of intellectual determinants we assume that the value of traditional religion is declining in the average level of human capital in society $\bar{h}_{t-1}$. This is meant to capture the standard of knowledge, i.e. the degree to which the population has access to books, newspapers, etc. containing (scientific) information that questions traditional beliefs. Human capital,

which coincides with income per capita in the present study, is commonly regarded as a driver of modernization and disassociation with traditional values. Inglehart and Baker (2000) investigate modernization across countries quantitatively by, among other things, computing a secular value index from the World Value Surveys. Two out of five items of the secular value index directly measure religious values (God is not very important in the respondents life; it is not important to instill religious faith in children). The secular value index is then found to be significantly associated with income per capita across countries. Herzer and Strulik (2013) investigate the time series properties of church attendance rates and income per capita for a panel of countries 1930-1990 and find a strong negative association with causality running in both directions. This finding is consistent with our approach according to which the causality running from church attendance (as a measure of the strength of beliefs) to income growth is endogenously explained. The reverse causality, running from income (or human capital) to religious beliefs, is exogenous. An extensive discussion of potential channels is provided by Bruce (2011).

In principle, our results hold for any positive value function $v_t = v(m_{t-1}, h_{t-1})$ that is monotonously decreasing in its arguments and asymptotically approaching zero for perpetually increasing $\bar{h}_t$. However, it alleviates the derivation of an explicit solution to assume a Cobb-Douglas form:

$$v_t = \frac{\psi}{m_{t-1}\bar{h}_{t-1}^{\epsilon}}, \tag{15}$$

in which $\psi > 0$ measures other (constant or only occasionally varying) determinants of religious beliefs and ϵ measures the relative importance of human capital. This completes the description of the model.

3. Social Dynamics and Long-Run Economic Development

Human capital of children of parents with modern beliefs is given by $h_0 + Ae_M\bar{h}_t$, whereas children of traditional households have human capital $h_0 + Ae_T\bar{h}_t$. Thus, average human capital in society evolves according to

$$\bar{h}_{t+1} = h_0 + \frac{m_t n_m e_M + (1-m_t)n_T e_T}{m_t n_M + (1-m_t)n_T} A\bar{h}_t = h_0 + \frac{\phi(\phi+\tau)\gamma A\bar{h}_t}{\phi(\alpha-\gamma+\sigma-\sigma m_t) + m_t\tau(\alpha-\gamma)}. \tag{16}$$

Forwarding (15) one period and substituting v_t in (13) provides

$$m_{t+1} = \max\left\{0,\, \min\left(\frac{\omega}{\psi} m_t h_t^{\epsilon},\, 1\right)\right\}. \tag{17}$$

The dynamic system (16)-(17) fully describes the evolution of the economy. It is best discussed in a phase diagram. The isocline along which human capital is constant ($\Delta\bar{h}_t = 0$) is obtained from (16) as

$$\bar{h}_t = h_0 \left(1 - \frac{\phi(\phi+\tau)\gamma A}{\phi(\alpha-\gamma+\sigma-\sigma m_t) + m_t\tau(\alpha-\gamma)}\right)^{-1}. \tag{18}$$

In a m_t–$\bar{h}_t$ diagram, the $\Delta\bar{h}_t = 0$–isocline originates at $m_t = 0$ and $h_t = h_0/(1-e_T A)$ and has a convex shape. For $m_t = 1$, the right-hand side of (18) simplifies to $h_0(\alpha-\gamma)/\left[\alpha-\gamma(1+\phi-A)\right] = h_0/(1-e_M A)$. In this section, we focus on the case in which long-run economic growth is feasible. This implies that $e_M A > 1$ (see below). This in turn implies that the isocline exhibits a pole at some $m_t < 1$. To the right of the $\Delta\bar{h}_t = 0$–isocline, i.e. for larger m_t, h_t is increasing and to the left of the $\Delta\bar{h}_t = 0$–isocline, h_t is declining.

The isocline along which the population share of individuals with a modern identity is constant and is obtained from (17) as

$$\bar{h}_t = (\psi/\omega)^{1/\epsilon}. \tag{19}$$

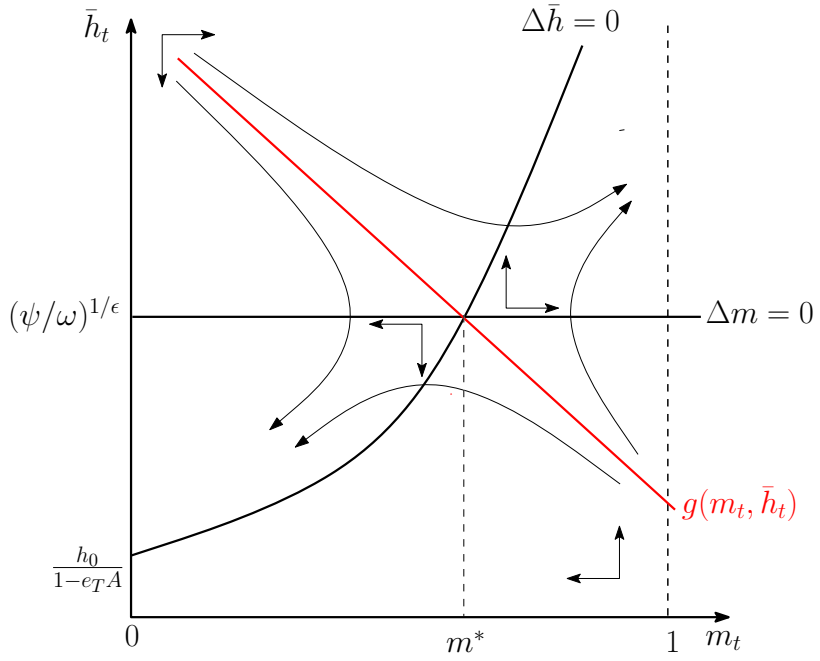
The $\Delta m_t = 0$–isocline is a horizontal line. The arrows of motion point towards lower m_t below the isocline and towards higher m_t above it.

For $h_0/(1-e_T A) < (\psi/\omega)^{1/\epsilon}$, there exists a unique intersection of the isoclines identifying the unique interior steady state $m^*, \bar{h}^*$. The phase diagram for this case is shown in Figure 1. Inspecting the arrows of motion leads to the conclusion that the interior steady-state is a saddle point. These observations verify the following proposition.

PROPOSITION 5. *For sufficiently small returns to education, i.e. for* $Ae_T < 1 - h_0/\left(\psi/\omega\right)^{1/\epsilon}$, *the economy exhibits a unique interior equilibrium, situated at* $(m^*, \bar{h}^*)$, *which is a saddle point. Economies starting above the stable manifold* $g(m_t, \bar{h}_t)$ *converge towards perpetual growth and generally shared modern beliefs,* $\bar{h}_t \to \infty$, $m_t \to 1$. *Economies starting below the stable manifold converge to subsistence and generally shared traditional beliefs,* $\bar{h}_t \to h_0/(1-e_T A)$, $m_t \to 0$.

Aside from the possibilities stated in Proposition 5, there exists the possibility that the economy starts exactly on the stable manifold and converges towards the interior steady-state. However, in contrast to infinite horizon optimal control problems, there exists no transversality condition that would move the economy on the stable manifold. This means that the economy is situated on the manifold with zero probability and diverges from it for any perturbation.

Figure 1: Phase Diagram: Separatrix and Multiple Equilibria



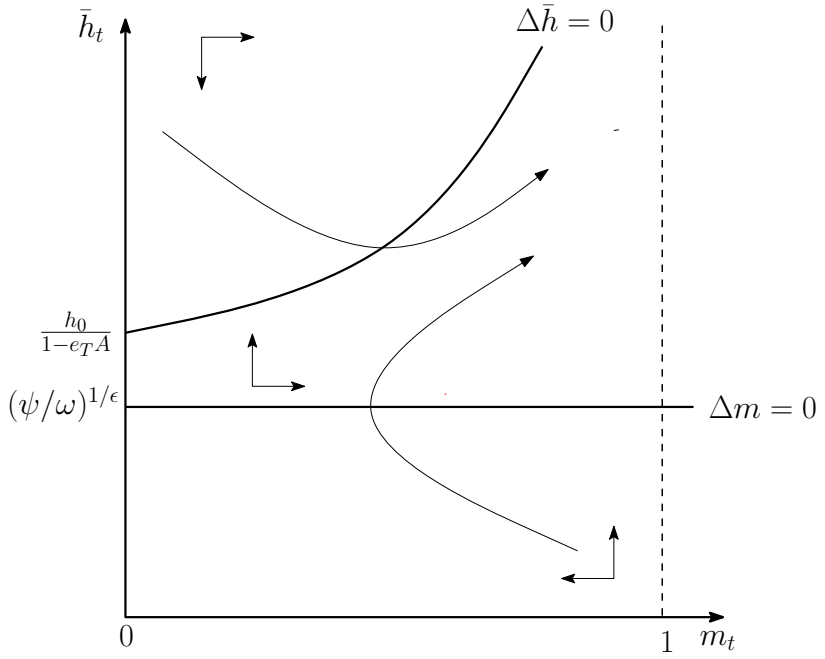
The stable manifold, as visualized in Figure 1, creates a boundary, a "separatrix" that separates the growth regime from the subsistence regime. The existence of the separatrix explains why it frequently appears to be so difficult to get rid of traditional beliefs and to initiate the use of contraceptives and the onset of the fertility transition. Consider a subsistence economy at $(0, h_0)$. In order to move out of the traditional steady state, society needs to solve a collective action that moves m_t and $\bar{h}_t$ up beyond the separatrix. However, without any coordination device to initiate collective action, everybody would stick to the traditional religion, refrain from using contraceptives, and provide low education to their children. As a consequence, the economy stagnates. The shared belief that contraception is bad is self-sustained by the poorly educated society.

If instead a society surpasses the boundary (starts above the separatrix), $\bar{h}_t$ is perpetually increasing. If productivity A is small, growth eventually peters out. If A is sufficiently large, such that $Ae_M > 1$, as assumed above, the economy converges towards perpetual growth.

PROPOSITION 6. *For $e_M A > 1$, that is, for $A > (\alpha - \gamma)/(\gamma\phi)$, an economy starting above the separatrix $g(h_t, m_t)$ converges towards perpetual growth at gross rate*

$$\frac{h_{t+1}}{h_t} = g \equiv \frac{\gamma\phi A}{\alpha - \gamma}.$$

Figure 2: Phase Diagram: Global Convergence to Balanced Growth



Along the transition path to constant growth,

- *the share of people abandoning traditional beliefs and using contraceptives increases;*
- *the average number of children per woman declines;*
- *the share of people with high education increases; and*
- *the growth rate of the economy increases gradually towards g.*

The proof begins with noting from (17) that m_t approaches unity along the growth path and thus individual human capital h_t approaches average human capital $\bar{h}_t$. Inserting education e_M from (7) into (16) with $m_t = 1$ provides g. Applying Proposition 1 and noting that an increasing share of individuals prefers the modern solution of the individual decision problem proves the remainder of Proposition 6.

Corollary 1. *If the return to education is sufficiently large, i.e. if $Ae_T > 1 - h_0/(\psi/\omega)^{1/\epsilon}$, there exists no equilibrium of stagnation. The economy converges globally to balanced growth.*

For the proof, notice that a sufficiently large return to education means that diagrammatically, the $\Delta\bar{h}_t = 0$–isocline originates above the $\Delta m_t = 0$–isocline. The associated phase diagram is shown in Figure 2.

The result is intuitive. When education is sufficiently productive, a relatively small education investment of parents at the traditional equilibrium suffices to let human capital grow. Perpetual growth of human capital diminishes the value of traditional religion such that more and more people abandon it and reduce their fertility and increase education. As a consequence, growth is perpetually increasing until it reaches its steady-state rate. In this sense, the supply of better education (construction of local schools, better teaching materials, etc.) may well be the best population policy.

Increasing the return to education is the most obvious policy conclusion drawn from the condition for global convergence. Other conclusions concern preferences, child rearing costs, and the value of religion. Inserting e_T from (10), the condition of Corollary 1 reads

$$\frac{\gamma(\phi+\tau)A}{\alpha-\gamma+\sigma} > 1 - \frac{h_0}{(\psi/\omega)^{1/\epsilon}}. \tag{20}$$

Inspection of the right hand side of condition (20) shows that the equilibrium of stagnation disappears, ceteris paribus, when the general value of traditional religion ψ is sufficiently low or when the shift parameter of the individual-specific threshold to prefer traditional religion ω is sufficiently high. Both results are, of course, hard to exploit by standard economic policy.

With respect to the left hand side of condition (20) we conclude that, ceteris paribus, the equilibrium of stagnation ceases to exist if the desire for education (γ) is sufficiently large, the desire for children (α) is sufficiently low, or if the desire for sex (σ) is sufficiently large. The latter result is perhaps most interesting. It is certainly a non-Darwinian result that the high fertility equilibrium disappears when people like sex to a high degree. This conclusion could not have been drawn in pre-modern human history when cheap and effective contraceptives were unavailable.

4. Level Effects

In this section we show that the main mechanism holds irrespective of whether the economy is capable of long-run growth. Without long-run growth, crossing the separatrix leads to a take-off from subsistence to a higher level of aggregate human capital and income per capita. In order to show this, we generalize the human capital production function to $h_{t+1,j} = h_0 + A\bar{h}_t^{\lambda} e_j$, $\lambda \in [0,1]$. Moreover, we generalize the religious value function to $v_t = \psi/(m_{t-1}^{\nu} h_{t-1}^{\epsilon})$, $\nu \geq 1$.

The dynamic system (16) and (17) is thus replaced by:

$$\bar{h}_{t+1} = h_0 + \frac{\phi(\phi+\tau)\gamma A \bar{h}_t^{\lambda}}{\phi(\alpha-\gamma+\sigma-\sigma m_t) + m_t\tau(\alpha-\gamma)} \tag{21}$$

$$m_{t+1} = \frac{\omega}{\psi} m_t^{\nu} h_t^{\epsilon}. \tag{22}$$

For $\nu > 1$, there are "increasing returns" in the value of beliefs. The value of an identity increases more than linearly in the share of community members who preferred this identity in the last period.

The $\Delta m_t = 0$–isocline is given by $h_t = (\psi/\omega)^{1/\epsilon} m_t^{-(\nu-1)/\epsilon}$. For $\nu > 1$ the isocline is a hyperbola in the positive quadrant. For $\nu = 1$, it collapses to the vertical line of the last section. We observe $\Delta m_t > 0$ above the isocline (for larger h_t) and $\Delta m_t < 0$ below. The $\Delta h_t = 0$–isocline is implicitly given by

$$G(m_t, h_t) = \bar{h}_t - h_0 - \frac{\phi(\phi+\tau)\gamma A \bar{h}_t^{\lambda}}{\phi(\alpha-\gamma+\sigma-\sigma m_t) + m_t\tau(\alpha-\gamma)} = 0.$$

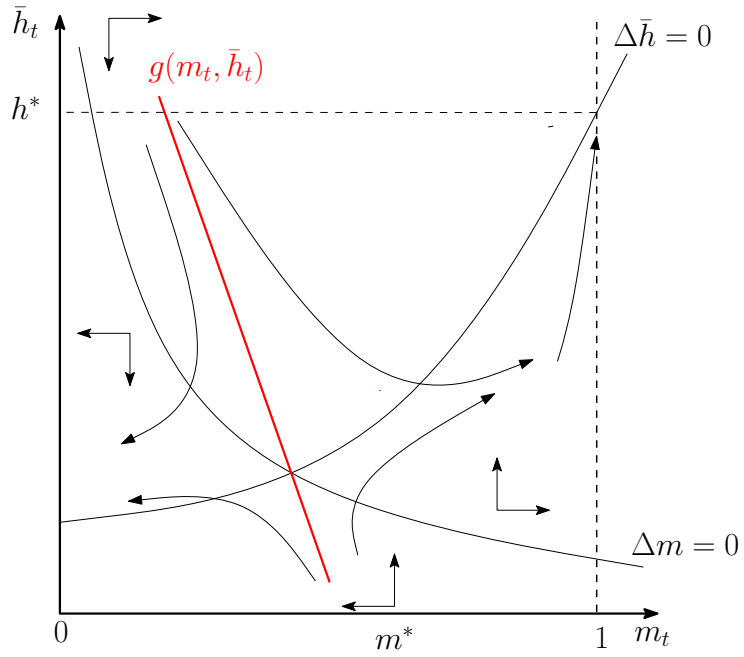
The derivative $\partial G/\partial m_t$ is equal to $(\alpha-\gamma)\tau - \phi\sigma$ times a positive term. It is thus negative and finite for $\phi\sigma > (\alpha-\gamma)\tau$, which is fulfilled due to Assumption 1. Moreover,

$$\frac{\partial G}{\partial h_t} = 1 - \lambda\left(1 - \frac{h_0}{h_t}\right) \geq 0. \tag{23}$$

The expression is non-negative since $h_t \geq h_0$ and $\lambda \in [0,1]$. Together this means that the slope of the $\Delta h_t = 0$ isocline, $\mathrm{d}h_t/\mathrm{d}m_t = -(\partial G/\partial m_t)/(\partial G/\partial h_t)$, is positive. The crucial difference between growth and level effects can be seen for $h_t \to \infty$: for $\lambda = 1$ we observe $\partial G/\partial h_t = 0$ and thus $\mathrm{d}h_t/\mathrm{d}m_t = \infty$. The isocline exhibits a pole, a feature that allows for long-run growth (see last section). For $\lambda < 1$, $\partial G/\partial h_t > 0$ and the slope of the isocline $\mathrm{d}h_t/\mathrm{d}m_t$ is finite everywhere. This means that it eventually intersects the $m_t = 1$–line. This feature inhibits long-run growth. The isocline originates at some positive $\hat{h}_t \in (0, h0/(1-Ae_T))$. To the right of the isocline we observe $\Delta h_t > 0$ and to the left, we observe $\Delta h_t < 0$.

Figure 3 shows the implied phase diagram. As before, the arrows of motion identify the interior equilibrium as a saddlepoint and the associated stable manifold creates a separatrix for the traditional steady state and the modern steady state. Compared to the case from the last section, two distinct features emerge: 1. The interior steady-state exists always when there are increasing returns in the share of believers. Diagrammatically, there is always an

Figure 3: Phase Diagram: Level Effects



intersection of isoclines when the Δm_t–isocline is a hyperbola. Thus, a locally stable traditional equilibrium always exists under increasing returns. 2. There is no long-run growth when $\lambda < 1$. Diagrammatically, the $\Delta h_t = 0$–curve ceases to have a pole. Since the isocline is monotonously increasing and m_t is bounded from above by 1, the steady state of the modern economy is obtained where the isocline intersects the $m_t = 1$–line, i.e. at $(1, \bar{h}^*)$ in Figure 3.

This result is robust to the limiting case, in which there is no intergenerational transmission of knowledge, i.e. for $\lambda = 0$. In this case, the $\Delta h_t = 0$–isocline is a positively sloped straight line and the modern steady state can be obtained analytically as $(1, h_0 + Ae_M)$. Notice that for all $\lambda \in [0, 1)$, aggregate human capital $\bar{h}_t$ and income per capita is higher at the modern steady state than at the traditional steady state. The growth effects of Section 3 become level effects. By placing the present environment into an R&D-driven growth model a la Romer (1990) the growth effects would re-appear. Since human capital is an essential input in R&D, growth would by higher at the modern equilibrium and lower or absent at the traditional equilibrium. Funke and Strulik (2000) and Strulik et al. (2013) propose innovation-based growth models in which there is no R&D but slow growth through learning-by-doing or through physical capital accumulation if the supply of human capital is sufficiently low.

5. Conclusion

In this paper we proposed a theory of economic growth and stagnation based on the use of contraceptives and its impact on fertility and education. We explicitly took into account that sex is a utility enhancing activity and thus creates a natural demand for contraceptives. This allows us to address the deep determinants of perhaps the most important proximate determinant of the delayed or even stalled fertility transition in least developed countries, i.e. of (insufficient) demand for contraceptives. Inspired by Caldwell and Caldwell (1987), we assumed that the use of contraceptives requires the abandonment of traditional religion, i.e. the sharing of social norms that condemn the use of contraceptives. We have then shown the that the assumption that the value of religion is high when it is shared by many and when average human capital is low creates a self-sustained equilibrium of high fertility, low education, and economic stagnation.

If returns to education are high enough (or the value of traditional religion is low enough) the equilibrium of stagnation ceases to exist, a fertility transition is initiated, the society gradually abandons traditional beliefs, education increases, and the economy converges to balanced growth. If the intergenerational transfer of knowledge is less than perfect, there is no endogenous growth; instead the economy converges towards a higher level of income per capita. It is straightforward to embed the theory into a unified growth context. In such a setting population growth would gradually increase the knowledge frontier (as in Galor and Weil, 2000) and the local equilibrium of stagnation would become a quasi steady state, which eventually loses its domain of attraction through ongoing technological change. Traditional religion would then not prevent but "only" delay the fertility transition and the take-off to growth.

Future extensions of the theory could try to integrate a more deeply micro-founded religious behavior through efforts of parents to instill religious values in their children (vertical socialization). Further realism could be gained by replacing the unitarian household by a bargaining approach and by considering gender-specific labor supply and demand for religion and contraceptives. Moreover, a multi-community version of the model could investigate whether exposure to a more modern culture of out-groups could erode the value of traditional religion and initiate the fertility transition and the escape from stagnation. Finally, it could be interesting to integrate the present approach with the health literature on contraceptive use in terms of condoms. Religious beliefs could provide an explanation for why condoms are not used although they reduce the risk of sexual disease transmission. Increasing health risk from unprotected

sex in turn could motivate the abandoning of traditional beliefs and initiate the use of modern contraceptives and the fertility transition.

Appendix A. Formal Schooling

This section shows the equivalence of the results for in-house schooling by the parents themselves and outsourced formal schooling by teachers financed by education expenditures of households. In doing so, we provide the rationale for the short-cut modeling we used in the main text. The utility function is still given by

$$U = \log c_t + \alpha \log n_t + \gamma \log e_t + \sigma \log s_t + \chi v_t R(i). \tag{24}$$

The budget constraint has to be modified to take into account that education of children is bought on the market rather than produced at home. The new budget constraint is

$$h_{t,i}(1 - \phi n_t - \tau s_t) = e_t n_t + c_t, \tag{25}$$

in which the left-hand side comprises household income of supplying the optimal amount of time (net of child-care and sex) on the labor market, while the right hand side comprises household expenditures for consumption and the education of each child. The solution of the optimization problem for households with modern beliefs is given by Equations (5), (6), (8), (9), and the modified Equation (7)

$$e_{t,M} = \frac{\gamma \phi h_{t,M}}{\alpha - \gamma}. \tag{26}$$

Total education expenditures for households with modern beliefs are then given by

$$m_t n_{t,M} e_{t,M} = \frac{\gamma m h_{t,M}}{1 + \alpha + \sigma}. \tag{27}$$

The solution of the optimization problem for households with traditional beliefs is given by Equations (5), (10), (12), $\chi = 1$, and the modified Equation (11)

$$e_{t,T} = \frac{\gamma(\phi + \tau) h_{t,T}}{\alpha - \gamma + \sigma}, \tag{28}$$

Total education expenditures for households with traditional beliefs are then given by

$$(1 - m_t) n_{t,T} e_{t,T} = \frac{\gamma(1 - m) h_{t,T}}{1 + \alpha + \sigma}. \tag{29}$$

Recall that average human capital is denoted by $\bar{h}_t = m_t h_{t,M} + (1 - m_t) h_{t,T}$. Furthermore, we denote the number of teachers by $P_{t,M}$ and $P_{t,T}$ for households with modern beliefs and

households with traditional beliefs, respectively. Here we assume that teachers are endowed with average human capital and that all pupils have access to the same teacher quality. The costs of education are thus pinned down to $\bar{h}_t P_{t,M}$ for households with modern beliefs, while the costs of education for households with traditional beliefs are given by $\bar{h}_t P_{t,T}$. Market clearing for education implies

$$\bar{h}_t P_{t,M} = \frac{\gamma m h_{t,M}}{1+\alpha+\sigma} \Leftrightarrow P_{t,M} = \frac{\gamma m h_{t,M}}{(1+\alpha+\sigma)\bar{h}_t}, \tag{30}$$

$$\bar{h}_t P_{t,T} = \frac{\gamma (1-m) h_{t,T}}{1+\alpha+\sigma} \Leftrightarrow P_{t,T} = \frac{\gamma (1-m) h_{t,T}}{(1+\alpha+\sigma)\bar{h}_t}. \tag{31}$$

Assuming that average human capital of the next generation is given by basic skills (h_0) plus the productivity of teachers ($A\bar{h}_t$) multiplied by the number of teachers per pupil ($P_{t,i}/n_{t,i}$) for $i = M, T$, leads to the evolution of human capital for households with modern beliefs and traditional beliefs as, respectively,

$$h_{t+1,M} = h_0 + \frac{A\gamma\phi h_{t,M}}{\alpha-\gamma}, \tag{32}$$

$$h_{t+1,T} = h_0 + \frac{A\gamma(\tau+\phi) h_{t,T}}{\alpha-\gamma+\sigma}. \tag{33}$$

Finally, by definition, average human capital at time $t+1$ is given by

$$\begin{aligned} \bar{h}_{t+1} &= \frac{m_t n_{t,M} h_{t+1,M} + (1-m_t) n_{t,T} h_{t+1,T}}{m_t n_{t,M} + (1-m_t) n_{t,T}} \\ &= \frac{A\gamma\phi(\tau+\phi)\bar{h}_t}{\phi(\alpha-\gamma-m_t\sigma+\sigma) + m_t\tau(\alpha-\gamma)} + h_0. \end{aligned} \tag{34}$$

This expression is the same as Equation (16) in the main part which establishes the equivalence between schooling at home and schooling bought on the market.

References

Adsera, A., 2006, Marital fertility and religion in Spain, 1985 and 1999, *Population Studies* 60, 205-221.

Agadjanian, V., 2001, Religion, social milieu, and the contraceptive revolution, *Population Studies* 55, 135-148.

Akerlof, G.A. and Kranton, R.E., 2000, Economics and identity, *Quarterly Journal of Economics* 115, 715–753.

Bar-El, R., Garcia-Munoz, T., Neuman, S., and Tobol, Y., 2013, The evolution of secularization: cultural transmission, religion and fertilitytheory, simulations and evidence, *Journal of Population Economics* 26, 1129-1174.

Baudin, T., 2010, A role for cultural transmission in fertility transitions, *Macroeconomic Dynamics* 14, 454-481.

Baudin, T., 2012, More on Religion and Fertility: The French Connection, Discussion Paper, University of Lille.

Bhattacharya, J., and Chakraborty, S., 2012, Fertility choice under child mortality and social norms, *Economics Letters* 115, 338-341.

Bhattacharya, J. and Chakraborty, S., 2014, Contraception and the fertility transition, MPRA Discussion Paper, Munich.

Bisin, A., and Verdier, T., 2001, The economics of cultural transmission and the dynamics of preferences. *Journal of Economic Theory* 97, 298-319.

Blanchflower, D.G., and Oswald, A.J., 2004, Money, sex and happiness: An empirical study, *Scandinavian Journal of Economics* 106, 393-415.

Bernheim, D.B., 1994, A theory of conformity, *Journal of Political Economy* 102, 841–877.

Bongaarts, J., and Potter, R.G., 1983, *Fertility, Biology, and Behavior: An analysis of the Proximate Determinants*, Academic Press, New York.

Bongaarts, J., 2006, The causes of stalling fertility transitions, *Studies in Family Planning* 37, 1-16.

Bruce, S. (2011). *Secularization.* Oxford University Press.

Caldwell, J.C. and Caldwell, P., 1987, The cultural context of high fertility in sub-Saharan Africa, *Population and Development Review* 13, 409-437.

Caselli, F. and Coleman, J., 2013, On the theory of ethnic conflict, *Journal of the European Economic Association* 11, 161-192.

Cervellati, M. and Sunde, U., 2005, Human capital formation, life expectancy, and the process of development, *American Economic Review* 95, 1653-1672.

Cleland, J., 2009, Contraception in historical and global perspective. *Best Practice & Research Clinical Obstetrics and Gynaecology* 23, 165-176.

Dalgaard. C.-J. and Strulik, H., 2013, The History Augmented Solow Model, *European Economic Review* 63, 134-149.

Doepke, M., 2004, Accounting for fertility decline during the transition to growth, *Journal of Economic Growth* 9, 347–383.

Frejka, T. and Westoff, C. F., 2008, Religion, religiousness and fertility in the US and in Europe, *European Journal of Population* 24(1), 5-31.

Friedman, M., 1953, *Essays in Positive Economics*, University of Chicago Press, Chicago.

Funke, M. and Strulik, H., 2000, On endogenous growth with physical capital, human capital and product variety, *European Economic Review* 44, 491-515.

Galor, O., 2005, From stagnation to growth: unified growth theory, in: P. Aghion and S. Durlauf, *Handbook of Economic Growth* Vol 1A, Amsterdam, North-Holland.

Galor, O., 2011, *Unified Growth Theory*, Princeton University Press.

Galor, O. and Weil, D.N., 2000, Population,technology and growth: From the Malthusian regime to the demographic transition and beyond, *American Economic Review* 110, 806–828.

Galor, O. and Moav, O., 2002, Natural selection and the origin of economic growth, *Quarterly Journal of Economics* 117, 1133-1192.

Galor, O., and Moav, O., 2006, Das human-kapital: A theory of the demise of the class structure, *Review of Economic Studies* 73, 85-117.

Galor, O. and Mountford, A., 2008, Trading population for productivity: theory and evidence, *Review of Economic Studies* 75, 1143-1179.

Greenwood, J., Kircher, P., Santos, C., and Tertilt, M., 2013, An equilibrium model of the African HIV/AIDS epidemic. National Bureau of Economic Research Working Paper 18953.

Guinnane, T. W., 2011, The Historical Fertility Transition: A Guide for Economists, *Journal of Economic Literature* 49(3), 589-614.

Hacker, J.D., 1999, Child naming, religion, and the decline of marital fertility in nineteenth-century America, *History of the Family* 4(3), 339-365.

Heaton, T. B., 2011, Does religion influence fertility in developing countries, *Population Research and Policy Review* 30, 449-465.

Herzer, D. and Strulik, H., 2013, Religiosity and income: A panel cointegration and causality analysis, University of Goettingen Cege Discussion Paper 168.

Iannaccone, L.R., 1998, Introduction to the economics of religion, *Journal of Economic Literature* 36, 1465-1495.

ICF, 2012, ICF International. The DHS Program STATcompiler - `http://www.statcompiler.com` - April 1 2014.

Inglehart, R. and Baker, W.E., 2000, Modernization, cultural change, and the persistence of traditional values, *American Sociological Review* 65, 19-51.

Iyer, S., 2002, Religion and the decision to use contraception in India, *Journal for the Scientific Study of Religion* 41, 711-722.

Kahneman, D., and Krueger, A.B., 2006, Developments in the measurement of subjective well-being, *Journal of Economic Perspectives* 20, 3-24.

Kögel, T. and Prskawetz, A., 2001, Agricultural productivity growth and escape from the Malthusian trap, *Journal of Economic Growth* 6, 337-357.

Lesthaeghe, R. and Wilson, C., 1986, *Modes of Production Secularization and the Pace of the Fertility Decline in Western Europe 1870-1930*, Princeton University Press.

McQuillan, K., 2004, When does religion influence fertility? *Population and Development Review* 30(1), 25-56.

Mokyr, J., 1990, The Lever of Riches: Technological Creativity and Economic Progress, *Oxford University Press.*

Munshi, K. and Myaux, J., 2006, Social norms and the fertility transition, *Journal of Development Economics* 80, 1-38.

Palivos, T., 1995, Endogenous fertility, multiple growth paths, and economic convergence, *Journal of Economic Dynamics and Control* 19, 1489-1510.

Potts, M., 1997, Sex and the birth rate: Human biology, demographic change, and access to fertility-regulation methods, *Population and Development Review* 23, 1-40.

Romer, P.M., 1990, Endogenous technological change, *Journal of Political Economy* 98, S71-S102.

Strulik, H., 2013, School attendance and child labor - A model of collective behavior, *Journal of the European Economic Association* 11, 246-277.

Strulik, H., Prettner, K., and Prskawetz, A., 2013, The Past and Future of Knowledge-based Growth, *Journal of Economic Growth* 18, 411-437.

Strulik, H., 2014, Contraception and development: A unified growth theory, Discussion Papers on Business and Economics 07/2014, University of Southern Denmark.

Yeatman, S. E., and Trinitapoli, J., 2008, Beyond denomination: The relationship between religion and family planning in rural Malawi, *Demographic Research* 19(55), 1851-1882.

Wright, R., 1994, *The Moral Animal*, Random House, New York.

Zhang L., 2008, Religious affiliation, religiosity, and male and female fertility, *Demographic Research* 18(8), 233-262.