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The Impact of Growth on the Transmission of Patience

Abstract

Patience affects economic growth, no news. This paper investigates the opposite causal relationship, i.e., how growth influences patience. We propose a simple theoretical framework where heterogeneous parents may choose to transmit their cultural trait - patience - to their offspring. Our model shows that parental effort to educate children to patience positively depends on economic growth. We test empirically this result using both country-level and individual data and show that, coherently with the model's prediction, growth has a significant impact on the effort to teach patience.

JEL-Codes: D150, D910, E210, O470.

Keywords: growth, patience, cultural transmission.

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The Impact of Growth on the Transmission of Patience

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1 Introduction

That patience affects economic performance comes as no surprise. Much less explored is the causal link that goes in the opposite direction, from economic performance to patience. In this paper we focus on the latter link, making two contributions. First of all, we show that, in an OLG model of consumption/saving behavior augmented with a process of cultural socialization à la Bisin-Verdier, the transmission of the trait of patience across generations is positively affected by long waves of growth. The channel through which economic performance affects patience is parental *effort* to transmit this cultural trait to children. Second, we empirically corroborate this theoretical prediction detecting a positive correlation between past growth and current parental effort to educate children to patience.

To frame the problem in its most general terms, let's start from the causal link that goes from patience to economic performance. At the microeconomic level, theory generally predicts a positive effect of patience on individual economic outcomes, such as education, health, and income. The reason is straightforward. The higher the individual degree of patience, the higher the "weight" of future welfare into microeconomic decision making – i.e., the discount factor – and the greater the investment in human and physical capital. This prediction has been corroborated by a sizable strand of empirical literature (e.g., Mischel et al., 1989; Sunde et al., 2021). At the macroeconomic level, a higher degree of patience – i.e., a higher discount factor – leads to higher GDP growth and higher levels of per capita income, capital and consumption (e.g., Becker, 1962; Romer, 1990; Aghion and Howitt, 1992).

The positive relationship between patience and macroeconomic performance, albeit clearly established in theory, has not been convincingly validated empirically for a long time due to lack of reliable data on time preferences across countries. This difficulty has been recently overcome thanks to the Global Preference Survey (Falk et al., 2018), that documents the preferences expressed by 80,000 people across 76 countries. Using data concerning time preferences, Falk et al. (2018) show that, at the individual level, patience is positively correlated with savings and education, while at the country level, (average) patience is positively correlated with GDP per capita. Moreover, using the same survey data, Sunde et al. (2021) show that (average) patience is positively correlated with income levels, income growth, accumulation of physical and human capital and productivity. This line of research considers patience as an *exogenous* deep parameter and, accordingly, assumes that causality runs from the degree of patience to economic performance.

As anticipated above, the causal link that goes in the opposite direction, from economic performance to patience is certainly under-researched. The idea that patience may be *endogenous* can be found in Böhm, Bawerk and Fisher and has been put forward in analytical terms by Becker and Mulligan (1997). They present a model of households' behavior in which the discount factor is increasing with the households' investment in "future-oriented capital", i.e., resources spent on imagining future pleasures and making them less remote. In their setting, quite straightforwardly, the higher households' wealth, the greater investment in imagining the future and the higher the discount factor. In a series of more recent papers Doepke and Zilibotti explore the link from economic conditions to patience by conceiving the discount factor as the outcome of an inter-generational transmission process. In Doepke and

Zilibotti (2008, 2014) altruistic parents put effort in shaping their children's time preference, instilling patience in response to economic incentives. The parental effort to instill patience is increasing with the steepness of lifetime earning profile: since the acquisition of skills takes time and requires investment in human capital, parents that benefit from high returns to labor late in life put more effort in teaching patience to their children than parents with a flat lifetime earning profile. Doepke and Zilibotti (2017) endogenize the choice of parenting style as a function of individual preferences and the socioeconomic environment. Galor and Özak (2016) explore empirically the relation between time preference and economic development and establish a causal relationship that goes from economic variables to patience. The empirical analysis exploits the exogenous variation of agricultural yields in the pre-industrial era to explain modern day levels of patience. They find that regions where ancestral populations were exposed to higher potential crop yields display higher levels of patience in the present period. The empirical findings are interpreted through a model in which parents experiencing higher returns to (agricultural) investments learn to delay gratification and transmit their higher level of patience to their offspring.

We contribute to this literature by explaining the endogenous evolution of time preferences with a cultural transmission mechanism. The idea that preferences are shaped by cultural transmission is coherent with the findings in Michalopoulos and Xue (2021). They show that recurrent themes in oral traditions, "folklore", are correlated with average cultural traits in societies. Folklore is thus a way to transmit cultural traits to next generations. In our model, cultural transmission is determined by parental effort to transmit patience, and this effort is chosen optimally in response to the economic environment. After developing the theoretical model, we provide empirical evidence validating its core mechanism relating parental effort and economic performances.

To simplify the analysis we abstract from the two-way feedback mechanism between the transmission of patience and economic growth, and focus only on the impact of economic growth on the transmission of patience.[1] We consider an exchange economy with two overlapping generations – young (adults) and old – in which each agent can have either high or low patience (i.e, discount factor). The endowment changes at an exogenous rate from one generation to the next. We assume there is a credit market so that agents can borrow and lend at an interest rate endogenously determined in equilibrium. Agents with high or low patience, then, experience different utilities that are determined in equilibrium by the preference parameters of both groups, by economic growth, and by the shares of the two

[1] We provide a discussion about how this two-ways relationship can be taken into account in our framework in Appendix C.

groups in the population. Parents are then willing to transmit the trait (i.e., patience level) that delivers the highest expected utility to their children. As in the Bisin and Verdier (2001) model, parents can only exert effort to bias transmission in favor of their own trait with respect to random transmission according to population shares. In our context the incentives that parents have to exert effort endogenously depend on the forces at play in the credit market.

The proposed model has a testable implication concerning the effect of economic growth on parental effort to induce patience in children. When the growth rate increases, parents want their children to be *more* patient, hence triggering a dynamics that leads to an increase of the average level of patience in the economy. To the best of our knowledge, this is the first paper that shows how growth affects the intergenerational transmission (and evolution) of patience by changing the parental incentives to transmit intertemporal preferences to children. The empirical validation of this prediction exploits data from the World Value Survey from 1981 to 2021 and shows that countries with higher growth in the 35 years before the survey give higher importance to teach at home the importance of "thrift saving money and things". Therefore, this paper offers support to the idea that patience evolves in response to the economic environment through transmission from parents to children and provides empirical support also to the theoretical results presented in Doepke and Zilibotti (2008, 2014). Moreover, we show that this mechanism is still ongoing, especially in countries with relatively recent phenomena of high growth. This extends the results in Galor and Özak (2016). In fact, the level of patience does not depend only on ancestral economic success, but it depends on more recent economic dynamics.

The paper is organized as follows. In Section 2 we describe our model and derive the main result positively relating growth and parental effort to transmit patience to children. This relation is investigated empirically in Section 3. Finally, Section 4 concludes.

2 The Model

Let's consider an overlapping generation model in which each generation, or cohort of agents, has mass 1. Agents of a given generation live for two periods, t and $t+1$. At t they are *adults*, receive an exogenous endowment of a unique, undifferentiated consumption good, make consumption/saving decisions, and have children, who must be socialized to some cultural traits; at $t+1$ they become *old*, consume the proceeds of their savings, and their offspring become adults, entering the first period of their life.

We assume within-cohort intertemporal *preference heterogeneity*: in each cohort there are two types of agents, characterized by different rates of time preference, which we model as different discrete cultural traits. The set of possible traits is $I := \{l, h\}$ where l stands for *low patience* and h for *high patience*. For each $i \in I$, let $\beta^i \in [0,1]$ be the discount factor, i.e., the reciprocal of the (gross) rate of time preference. Without loss of generality, we assume that $\beta^l < \beta^h$, so that we can characterize agents with trait l as *impatient* and agents with trait h as *patient*. Hence, we define two groups in each cohort, one for each trait. Assuming that there is a representative agent for each group, we can abuse notation indexing the representative agent of group $i \in I$ with the index i itself. We denote with $q_t \in [0,1]$ the fraction of the adult population consisting of agents of type l at time t, so that $1 - q_t$ is the share of type h. Therefore, in period t the economy is populated by patient and impatient adults of generation t and patient and impatient old people of generation $t-1$. In Section 2.2 we model the law governing the transmission of cultural types along generations by using a standard cultural transmission technology and no bequests.

2.1 Single cohort choice

We start by considering the decision-making process of a single cohort. As we will show momentarily (Section 2.2), the cultural transmission process makes the fraction of impatient agents q_t time-varying. However, in consumption/saving decision making, each cohort takes this fraction as given, and thus, in this section, we omit the time index and denote this variable with q.

For each $i \in I$, let c^i_{t+s} and y^i_{t+s} be the agent's consumption and (exogenous) endowment of the good in period $t+s$, with $s \in \{0,1\}$. We assume a log-linear intertemporal material payoff function for adults at time t:

$$v^i_t := v(c^i_t, c^i_{t+1}; \beta^i) = \log(c^i_t) + \beta^i \log(c^i_{t+1}). \tag{1}$$

Following Bisin and Verdier (2001), we assume that, at time t, an adult of type $i \in I$ asexually gives birth to one child and exerts an effort $\tau^i_t \in [0,1]$ to induce her own trait to the child. We denote with $\mathbb{E}^i_{\tau^i_t}[v^{ch^i}_{t+1}]$ the utility a parent of trait i expects to gain from own child's material payoff when choosing effort τ^i_t. We will describe how this utility is formed in Section 2.2. For the time being we just assume that it is independent of the parent's consumption/saving choices, and that parents do not care about the child's type *per se*, but about the material well-being of the child delivered by the child's type.[2]

[2]We could have added an element capturing the parent's ideological concerns, usually referred to as

An agent of type i in each cohort maximizes her intertemporal utility under the lifetime budget constraint. Intertemporal utility, in turn, is the sum of the agent's material payoff and the expected utility the agent receives from the material payoff of the child. For each $i \in I$, the maximization problem of the adult in t is

$$\max_{c_t^i, c_{t+1}^i, \tau_t^i} \; U(c_t^i, c_{t+1}^i, \tau_t^i; \beta^i) = v^i(c_t^i, c_{t+1}^i; \beta^i) + \mathbb{E}^i_{\tau_t^i}[v_{t+1}^{ch^i}], \tag{2}$$

$$\text{s.t.} \;\; Ry_t^i + y_{t+1}^i = Rc_t^i + c_{t+1}^i, \tag{3}$$

where $R := 1 + r$ is the (gross) real interest rate which, in our setting, will be endogenously determined by market clearing on the credit market. We omit the time index because – as we will see below – the equilibrium interest rate is a function of the discount factors of the two groups and of the fraction q of impatient agents, which in this section is not time-varying.

We assume that the endowment of agents in each cohort is uniform across types and that it changes across cohorts at a given growth rate. Formally:

Assumption **1.** *For each* $t \in \mathbb{N}$, $y_{t+1}^l = y_{t+1}^h = y_{t+1} = gy_t$.

The scalar $g \in \mathbb{R}_+$ represents the (gross) rate of growth of the endowment between adulthood (period t) and old age (period $t+1$), i.e., $g = y_{t+1}/y_t$. Notice that "period t" is not one year but the time window necessary for one generation to grow and reproduce. In numerical examples below, we consider this interval to last 35 years. Hence, we can interpret g as the pace of aggregate economic activity (GDP growth) across time intervals of approximately three decades. While $g > 1$ indicates an expansion of the macroeconomy and an increase of the endowment accruing to the agent when old, $0 < g < 1$ identifies macroeconomic decline and a reduction of the endowment in old age. Since we will consider g as an exogenous parameter, we are implicitly assuming that GDP grows (or decreases) exponentially: $y_t = y_0 g^t$, where y_0 is the initial condition for GDP, i.e., the endowment of an arbitrary initial generation.[3]

For each $i \in I$, the optimal consumption and saving choice of adults at t and the con-

paternalism in the literature on cultural transmission. This additional element would complicate the analysis without changing the results.

[3] Appendix C briefly discusses the implications of endogenous growth in our model.

sumption of the old in $t+1$ are given by (see Appendix A.1 for the derivation)

$$c_t^i = \frac{(R+g)y_t}{R(1+\beta^i)}, \tag{4}$$

$$s_t^i = \frac{(R\beta^i - g)y_t}{R(1+\beta^i)}, \tag{5}$$

$$c_{t+1}^i = Rs_t^i + gy_t = \frac{\beta^i(R+g)y_t}{1+\beta^i}. \tag{6}$$

The optimal consumption and saving choices are functions of the interest rate, the agent's discount factor, the current endowment, and the growth rate. It is easy to see that the adult is a saver if and only if

$$\frac{R}{g} > \frac{1}{\beta^i}. \tag{7}$$

Since the right hand side of the inequality is the (gross) rate of time preference, equation (7) states that the agent is a saver if and only if the interest rate (normalized to growth) is higher than her own rate of time preference.
In $t+1$ the agent is *old*, receives interest payments if she was a saver/lender at t or pays back her debt if a dissaver/borrower, and spends in goods the endowment, augmented or reduced by interest payments depending on saving/dissaving behavior when adult. Therefore, only *adult* agents participate to the credit market as lenders or borrowers.

In a pure exchange economy, the credit market is in equilibrium when aggregate savings are zero.[4] The credit market clearing condition therefore reads as $qs_t^l + (1-q)s_t^h = 0$, where qs_t^l is total savings in t by type l agents and $(1-q)s_t^h$ is total savings in t by type h agents. This allows to determine the equilibrium interest rate as (see Appendix A.2 for the derivation)

$$R^* = g \cdot \frac{(1-q)(1+\beta^l) + q(1+\beta^h)}{(1-q)(1+\beta^l)\beta^h + q(1+\beta^h)\beta^l}, \tag{8}$$

where $R^* > 1$ for any $0 < \beta^l < \beta^h < 1$. The equilibrium interest rate is a function of relative endowments (captured by g), intertemporal preferences (captured by the discount factors), and, crucially for our purposes, the composition of the population in terms of patient and impatient agents (captured by q). As intuition suggests, in equilibrium patient agents lend their endowment to impatient agents. Indeed, it is easy to show that

$$\frac{1}{\beta^h} < \frac{R^*}{g} < \frac{1}{\beta^l}. \tag{9}$$

[4]This condition assures also that total adults' consumption is equal to total adults' endowments.

Since $\beta^l < \beta^h$, in equilibrium $s_t^l < 0$ and $s_t^h > 0$, so that agents of type l (impatient for short) are borrowers, and agents of type h (patient) are lenders. This is true for any q, i.e., independently of the composition of the population.

Consider now how the equilibrium interest rate changes with g and q. When g increases, the endowment in old age goes up relative to the endowment when adult. The desire to smooth consumption implies a higher interest rate because patient adults save less and therefore the supply of credit goes down while impatient adults dissave more increasing the demand for credit. The effect of a change in the composition of the population, q, on the equilibrium interest rate is also in line with the intuition. As the fraction of impatient agents q increases, the aggregate demand for funds on the part of dissavers increases and the supply of funds coming from savers decreases, pushing up the equilibrium interest rate.

The material payoff in equilibrium. Let's now dig deeper into the features of the economy in equilibrium. Substituting the equilibrium interest rate in (8) into the optimal consumption choices (4) and (6), we get the equilibrium consumption of the adult and the old representative agents of type i, which we denote with c_t^{i*}, c_{t+1}^{i*}. Substituting the latter into the material payoff function, we get the material payoff function *in equilibrium*, which allows to express the payoff as a function of the discount factors (β^h, β^l) and of q, given g. With a slight abuse of notation, in the following we will denote the *equilibrium* payoffs with v^i, $i \in I$, dropping the star from the superscript. Therefore $v^i := v^i(c_t^{i*}, c_{t+1}^{i*}) = v^i(q, \beta^l, \beta^h, g)$. In particular:

$$v^l = \log\left[\frac{1+\beta^h}{1+q\beta^h+(1-q)\beta^l}\right] + \beta^l \log\left[\frac{\beta^l(1+\beta^h)}{\beta^l\beta^h + q\beta^l + (1-q)\beta^h}\cdot g\right], \tag{10}$$

$$v^h = \log\left[\frac{1+\beta^l}{1+q\beta^h+(1-q)\beta^l}\right] + \beta^h \log\left[\frac{\beta^h(1+\beta^l)}{\beta^l\beta^h + q\beta^l + (1-q)\beta^h}\cdot g\right]. \tag{11}$$

The growth rate g affects only the equilibrium consumption of the old agent, whereas changes in the composition of the population, q, affect material payoffs both in adulthood and in old age. In Appendix B.1 we prove the following

PROPOSITION **1.** *Given $q \in (0,1)$, the material payoff of the impatient (resp. patient) agent is monotonically decreasing (increasing) with q, that is:*

$$\frac{\partial v^l}{\partial q} < 0, \tag{12}$$

$$\frac{\partial v^h}{\partial q} > 0. \tag{13}$$

Proof. See Appendix B.1 □

The intuition behind this proposition goes as follows. Suppose that the fraction of the impatient agents q increases. From equation (8) it follows that the interest rate increases. The equilibrium consumption of the adults decreases both for patient and impatient agents (substitution effect): the saver saves more and the dissaver dissaves less, i.e., she asks for a loan of a smaller size. When the saver grows old, she will tap into a larger pool of resources (the old's endowment and interest payments) to consume. The increase of discounted utility from consumption when old prevails over the reduction of utility from consumption when adult and the overall payoff of the patient agent increases. When the dissaver grows old, she is forced to pay a higher interest rate but on a loan of a smaller size. Interest payments indeed decrease and also the old dissaver consumes more. However, the increase of discounted utility from consumption when old does not prevail over the reduction of utility from consumption when adult and the overall payoff of the impatient agent decreases. This has repercussions on the cultural transmission of traits that we will analyze later.

We now compare utilities of patient and impatient agents depending of their relative shares. Given that utilities are monotonic in q, as shown in Proposition 1, we proceed by identifying the value of q equating the two utilities. This will be useful in the analysis of the intergenerational transmission of patience developed in Section 2.2. Let $\bar{q}$ be the value of q such that $v^h = v^l$. Then

$$\bar{q} := \frac{(1+\beta^l)\beta^h - g\left(\beta^l\left(1+\beta^l\right)\left(\left(1+\beta^l\right)\beta^h\right)^{\beta^h}\left(\beta^l\left(1+\beta^h\right)\right)^{-\beta^l-1}\right)^{\frac{1}{\beta^h-\beta^l}}}{\beta^h-\beta^l}. \tag{14}$$

According to (14) the cutoff value $\bar{q}$ is a decreasing function of the growth rate g. In the following proposition we will exploit this feature to characterize the relative payoff of the patient and impatient agents as functions of g.

PROPOSITION **2.** *For each pair (β^l, β^h), there exist $\underline{g} \in (0,1]$, and $\bar{g} \in [1,\infty)$ such that*

1. *if $g < \underline{g}$, then $\bar{q} > 1$ and $v^l > v^h$ for all $q \in [0,1]$;*
2. *if $g > \bar{g}$, then $\bar{q} < 0$ and $v^l < v^h$ for all $q \in [0,1]$;*
3. *if $g \in [\underline{g}, \bar{g}]$, then $\bar{q} \in [0,1]$ and $v^l = v^h$ if and only if $q = \bar{q}$.*

Proof. See Appendix B.2 □

Proposition 2 identifies two cutoff values for g, namely $\underline{g}$ and $\bar{g}$, which are polynomials of the discount factors of the patient and impatient agents. These thresholds determine three scenarios.

Scenario 1 is characterized by $g < \underline{g}$. The economy is in a period of sizable and protracted economic decline, the interest rate is "very low", and impatient agents are always better off than patient agents.

Scenario 2 is the opposite polar case, characterized by $g > \bar{g}$. In this case there is strong economic growth, the interest rate is "very high" and patient agents are always better off than impatient agents.

Scenario 3 is characterized by economic growth in the interval $[\underline{g}, \bar{g}]$. In this case there is either a mild decline $\underline{g} < g < 1$ or a weak expansion $1 < g < \bar{g}$ and the payoffs of patient and impatient agents are equal at $\bar{q} \in (0, 1)$. In this scenario, if the fraction of impatient agents is "low" ($q < \bar{q}$), the interest rate is also relatively low and, therefore, impatient agents are better off, otherwise the opposite occurs.

Proposition 2 is going to be important to characterize the steady state of the cultural transmission process that we will discuss in Section 2.2. To clarify the implications of this proposition, we present two simple examples. In Example 1 we show the behavior of the material payoff function of the two types of agents as g and q change. In Example 2, we show the behavior of $\underline{g}$ and $\bar{g}$ for different values of β^l keeping β^h constant.

Example 1. Consider Figure 1. Each panel shows the material payoffs of agent l and h as functions of q for different values of g. As shown in Proposition 1, the payoff of agent l (h) is monotonically decreasing (increasing) in q. Since the time span of a generation is the interval (in years) necessary for one generation to grow and reproduce – say T –, for any yearly value of the discount factor, say β^i_{year}, we must consider an overall "generational" discount rate of $\beta^i = (\beta^i_{year})^T$. We set $T = 35$ in this example.

The left panel shows scenario 1: $g < \underline{g} < 1$. As discussed above, in this case the interest rate is very low. This is beneficial to the impatient borrower to the point of making her always – i.e., for all q – better off than the patient lender. On the contrary, when $g > \bar{g} > 1$ (scenario 2, right panel), resources in old age are abundant, the interest rate is very high, and patient lenders are always happier than impatient borrowers. Finally, when g ranges between the lower and the upper thresholds, (scenario 3, intermediate panel), there exists $\bar{q} \in (0, 1)$ such that the payoffs of agents l and h are equal. In this scenario, the impatient agent is better off if the fraction of the impatient agents in the population is relatively low ($q < \bar{q}$), so that also the interest rate is relatively low.

Example 2. In Figure 2 we plot the thresholds $\underline{g}$ (dashed line) and $\bar{g}$ (continuous line)

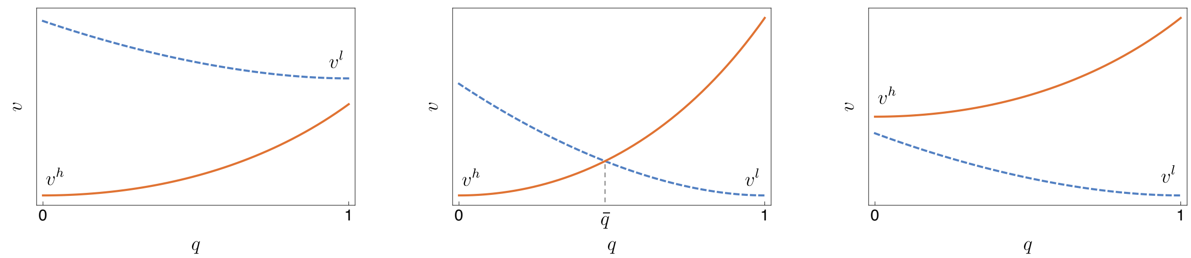

Figure 1: Material payoff of agents of type l and type h as function of q for different levels of g. **Left**: $g = 0.55$. **Center**: $g = 1$. **Right**: $g = 1.45$. Parameters: $\beta^l = 0.96^{35}$ and $\beta^h = 0.99^{35}$.

as functions of the impatient agent's discount factor. We set the yearly discount factor for patient agents $\beta^h_{year} = 0.99$, so that the generational discount factor ($T = 35$ years) is about $\beta^h = 0.7$. Given the patient's discount factor, for any level of the patient's discount factor we plot the vertical segment of length $\bar{g} - \underline{g}$, i.e., the interval of g-values such that $\bar{q} \in (0, 1)$. The union of these segments is the gray area, which consists of all the points which represent combinations of the impatient's discount factor and growth rate which are associated to scenario 3. Therefore the white area above the continuous line (below the dashed line) is associated to scenario 2 (scenario 1).

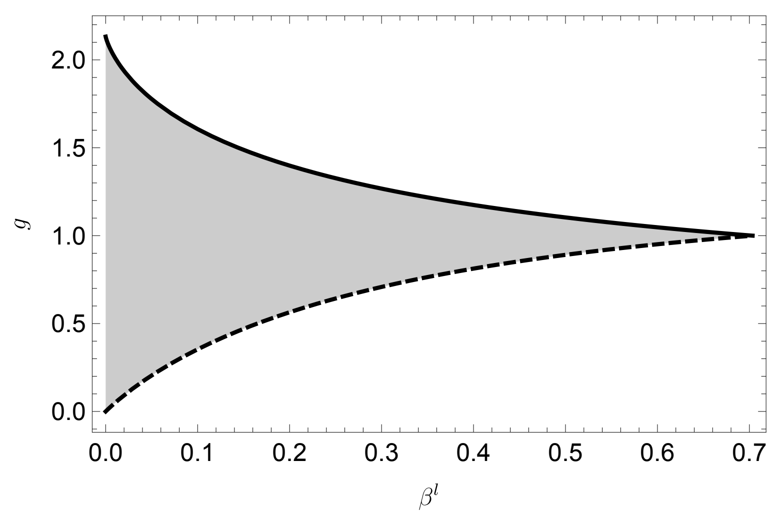

Figure 2: The gray area represents the set of growth rates g such that $\bar{q} \in (0, 1)$, for different values of β^l given $\beta^h = 0.99^{35}$. The solid line represents $\bar{g}$, whereas the dashed line represents $\underline{g}$.

Suppose, for example, that the yearly discount factor of the impatient agent is 0.96. On a 35-years basis, this translates into $\beta^l = 0.24$ approximately. From the figure we infer that, if in the time span of 35 year the current generation were more than 40% richer than the previous one ($g > 1.4$, corresponding to a growth rate of about 1% per year for 35 years), then $\bar{q} > 1$ and patient agents would always be better off than impatient agents. If, on the contrary, the current generation were more than 40% poorer than the previous one ($g < 0.6$, corresponding to a growth rate of about -1.4% per year for 35 years), then $\bar{q} < 0$ and impatient agents would always be better off than patient agents. For intermediate values of g, approximately $0.6 < g < 1.4$, then $\bar{q} \in (0, 1)$.

In this section we have investigated the material payoff functions of the two types of agents within one generation, so q is fixed. In the next section we study the interaction between market outcomes and social dynamics switching to a long-term analysis. In the long run – an interval that spans more than one generation – q_t is time-varying as it changes endogenously in reaction to different market environments.

2.2 The intergenerational transmission of patience

We model the long-run dynamics of types as a process of intergenerational transmission of traits à la Bisin-Verdier. As mentioned earlier, in each period $t \in \mathbb{N}$, each adult reproduces asexually and gives birth to one child. In the same period children are socialized to one of the cultural traits in the population. The set of possible traits coincides with the set of types $I = \{l, h\}$, defined in the previous section. For each $i \in I$ at time t, let the fraction of individuals with trait i be q_t^i. Using the notation previously introduced, $q_t^l = q_t$ and $q_t^h = 1 - q_t$.

Socialization follows the standard Bisin-Verdier technology, with parent i exerting a *vertical socialization* effort $\tau_t^i \in [0, 1]$ to instill her own trait in the offspring. Socialization can also be oblique. *Oblique socialization* occurs when vertical socialization fails and the child picks the trait of a role model randomly chosen in the population.

We define two transition probabilities. The probability at time t that a parent of trait i has a child of trait i, denoted with P_t^{ii}, is given by

$$P_t^{ii} = \tau_t^i + (1 - \tau_t^i) q_t^i. \tag{15}$$

The first addendum in the right hand side of equation (15) can be interpreted as the probability of success of the vertical socialization process. If vertical socialization is not successful, with probability $1 - \tau_t^i$, the oblique socialization process drives the child to randomly take a trait from her own parent's generation. Thus, q_t^i is the probability that oblique socialization drives the child to pick the parent's own trait. The probability P_t^{ij} that a parent of trait i has a child of trait j, where $j \in I \setminus \{i\}$ is given by

$$P_t^{ij} = (1 - \tau_t^i)(1 - q_t^i) = 1 - P_t^{ii}. \tag{16}$$

In the previous section, we anticipated that each parent derives utility from the child's wellbeing (see equation (2)). We define the expected utility that a parent of type i, who exerts effort τ_t^i, derives at time t from the material payoff of the child (born in t) when she will be adult, i.e., in $t+1$, as follows:

$$\mathbb{E}^i_{\tau_t^i}[v_{t+1}^{ch^i}] = P_t^{ii}\mathbb{E}^i[v_{t+1}^i] + P_t^{ij}\mathbb{E}^i[v_{t+1}^j] - \frac{1}{2}(\tau_t^i)^2, \tag{17}$$

where $\mathbb{E}^i[v_{t+1}^i]$ is the expected child's payoff if the child's type is the same as the parent's, $\mathbb{E}^i[v_{t+1}^j]$ is the expected child's payoff if the child's type is the opposite of the parent's, and $\frac{1}{2}(\tau_t^i)^2$ is the psychological cost of the socialization effort.

For each $i \in I$, recalling the definition of the transition probabilities in equations (15) and (16), equation (17) now reads

$$\mathbb{E}^i_{\tau_t^i}[v_{t+1}^{ch^i}] = \left[\tau_t^i(1-q_t^i) + q_t^i\right]\mathbb{E}^i[v_{t+1}^i] + (1-\tau_t^i)(1-q_t^i)\mathbb{E}^i[v_{t+1}^j] - \frac{1}{2}(\tau^i)^2. \tag{18}$$

The optimal effort crucially depends on how parents form their expectations. For simplicity we assume *adaptive conjectures formation*:

Assumption **2.** *For every $i \in I$, and for every $t \in \mathbb{N}$, $\mathbb{E}^i[q_{t+1}] = q_t$.*

Assumption 2 greatly simplifies the analysis of the model, but, as argued in Section 2.3 below, assuming perfect foresight of children's future utility does not change the main implications of the model. From Assumption 2 it follows that, for each $i \in I$, $\mathbb{E}^i[v_{t+1}^i] = v^i(q_t, \beta^l, \beta^h) = v_t^i$. Substituting in equation (18), we get

$$\mathbb{E}^i_{\tau_t^i}[v_{t+1}^{ch^i}] = \left[\tau_t^i(1-q_t^i) + q_t^i\right] v_t^i + (1-\tau_t^i)(1-q_t^i)v_t^j - \frac{1}{2}(\tau^i)^2. \tag{19}$$

For a generic $x \in \mathbb{R}$, let $[x]^+ := \max\{0, x\}$. Solving the problem of maximizing equation (19) with respect to τ_t^i, for each $i \in I$, we get

$$\tau_t^{i*} = [\min[1, (1-q_t^i)(v_t^i - v_t^j)]]^+, \tag{20}$$

where $q_t^l = q_t$ and $q_t^h = 1 - q_t$. Therefore, we can write

$$\begin{aligned}\tau_t^{l*} &= [\min[1, (1-q_t)(v_t^l - v_t^h)]]^+,\\ \tau_t^{h*} &= [\min[1, q_t(v_t^h - v_t^l)]]^+.\end{aligned}$$

At this point, using Proposition 2, we characterize the optimal socialization efforts of parents in Proposition 3.

Proposition **3.** *Given $g > 0$ and $q_t \in [0,1]$,*

1. *if $g < \underline{g}$ then, $\tau_t^{h*} = 0$ and $\tau_t^{l*} = \min[1, (1-q_t)(v_t^l - v_t^h)]$;*
2. *if $g \in [\underline{g}, \bar{g}]$ and*
   - *if $q_t < \bar{q}$, then $\tau_t^{h*} = 0$ and $\tau_t^{l*} = \min[1, (1-q_t)(v_t^l - v_t^h)]$;*
   - *if $q_t = \bar{q}$, then $\tau_t^{h*} = \tau_t^{l*} = 0$;*
   - *if $q_t > \bar{q}$, then $\tau_t^{l*} = 0$ and $\tau_t^{h*} = \min[1, q_t(v_t^h - v_t^l)]$;*
3. *if $g > \bar{g}$, then $\tau_t^{l*} = 0$ and $\tau_t^{h*} = \min[1, q_t(v_t^h - v_t^l)]$.*

Proof. Immediate from inspection of definitions of τ_t^{i*} and v_t^i. □

This proposition characterizes the effort levels of parents of different types, depending on the state of the economy. In the presence of a sizable economic decline, i.e., when $g < \underline{g}$, the interest rate is very low and the material payoff of the child if she happens to be impatient when adult will always be larger than her payoff if she turns out to be patient. This implies that the effort of the patient parent to transmit her own trait h is always null, whereas the impatient parent exerts a positive level of effort to transmit trait l, as long as $q_t < 1$ (and a null effort when $q_t = 1$, i.e., when all the agents are impatient).

When there is strong economic growth, i.e., when $g > \bar{g}$, just the opposite occurs: the interest rate is very high and the material payoff of the child if she happens to be impatient when adult will always be smaller than her payoff if patient. In this case, parental effort of type l is always null, whereas a parent of type h exerts a positive level of effort as long as $1 - q_t < 1$ (and a null effort when $q_t = 0$, i.e., when the entire population consists of patient agents). For intermediate levels of g (a mild recession or a weak expansion), i.e., when $g \in [\underline{g}, \bar{g}]$, parents of type l exert some vertical socialization effort as long as $q_t < \bar{q}$, that is, as long as the interest rate is relatively low and the payoff of a child of type l is larger than that of a child of type h (while parental effort of type h is null). On the contrary, when $q_t > \bar{q}$, that is, as long as the interest rate is relatively high and the payoff of a child of type h is larger than that of a child of type l, parents of type h exert some effort in transmitting their trait, while parents of type l will exert no effort. When $q_t = \bar{q}$ the payoffs of different types are equal, so parental efforts of both types are null.[5] Given the discussion above, the

[5]Note that, had we considered also paternalistic motivations, there would be a range of g in which both groups exert a positive effort. However, the basic message of our results would not change.

dynamics of the shares of different types is given by

$$\begin{aligned} q^i_{t+1} &= P^{ii}_t q^i_t + P^{ji}_t (1 - q^i_t) \\ &= q^i_t [1 + (\tau^{i*}_t - \tau^{j*}_t)(1 - q^i_t)] \\ &= q^i_t + q^i_t (\tau^{i*}_t - \tau^{j*}_t) - (q^i_t)^2 (\tau^{i*}_t - \tau^{j*}_t). \end{aligned} \tag{21}$$

Notice that $\tau^{l*} > \tau^{h*}$ if and only if $v^l > v^h$. Since v^l and v^j are endogenous, the direction of the dynamics is fully determined by the ordering of the equilibrium payoffs at each point in time, characterized in Proposition 2. Proposition 4 characterizes the steady values of q and their stability properties, given the values of g, β^l and β^h.

PROPOSITION 4. *Consider the dynamics in (21). For every triplet (g, β^l, β^h),*

- *if $g \leq \underline{g}$, $q = 0$ and $q = 1$ are the unique steady states, and $q = 1$ is globally stable;*
- *if $g \geq \overline{g}$, $q = 0$ and $q = 1$ are the unique steady states, and $q = 0$ is globally stable;*
- *if $g \in (\underline{g}, \overline{g})$, $q = \{0, \bar{q}, 1\}$ is the set of steady states, with $q = \bar{q}$ globally stable;*

Proof. See Appendix B.3. □

In this framework, different market configurations induce different incentives to socialize children to the two types so that in the steady state the population could be characterized either by cultural heterogeneity – i.e., the co-existence of patient and impatient types – or homogeneity. Cultural homogeneity occurs if the material payoff of one type is always greater than that of the other, independently of the initial composition of the population. If the economy grows or declines strongly, then patient or impatient agents are favored, respectively, and parents make their best to induce those traits in their own children. For intermediate levels of g, interest rates play a crucial role, and act as a balancing mechanism. Indeed, if there are "too few" patient agents, then their utility is high (since they can lend at a high interest rate) and this provides an incentive for parents to instill patience in their children. The opposite holds when impatient agents are too few. Thus, the credit market shapes socialization incentives and leads to cultural heterogeneity. In our framework the credit market and the growth rate play the roles of cultural substitution and paternalism in the standard Bisin and Verdier setting.

2.3 Discussion and comparative statics

According to Proposition 2, when the economy is in scenario 1 – i.e., a period of protracted economic decline characterized by $g \leq \underline{g}$ – the (equilibrium material) payoff of the impatient agent is always (i.e., for any value of $q \in [0,1]$) greater than that of the patient one. In this scenario, as shown by Proposition 3, patient parents always exert a zero level of (vertical socialization) effort, because they do not want their children to be of their own type. On the contrary, impatient parents exert a positive effort to induce the impatient trait in their children for any value of $q \in [0,1)$. When $q = 1$, also impatient parents exert zero effort, because the oblique socialization process will necessarily lead children to take on the impatient trait, the population of parents consisting only of impatient agents. Proposition 4 shows that, in this scenario, $q = 1$ is the unique globally stable equilibrium. Summing up: in a period of economic decline, the cultural transmission mechanism leads to a homogeneous long-run equilibrium in which the whole population has the impatient trait.

When there is strong economic growth – i.e., in scenario 2 characterized by $g \geq \bar{g}$ – from Propositions 2–4 we infer that population dynamics follow a symmetrical pattern. In this case, in fact, the payoff of the patient type is always greater than that of the impatient one and the economy converges to a culturally homogeneous long-run equilibrium in which the whole population has the patient trait.

In the intermediate case (scenario 3, characterized by $\underline{g} < g < \bar{g}$), Proposition 2 shows that the ranking of payoffs of the two types and the vertical socialization efforts of the parents depend on the composition of the population. Proposition 3 states that patient parents exert a positive effort only when $q > \bar{q}$, i.e., when there are (relatively) many impatients, the interest rate is (relatively) high and therefore the patient type is better off than the impatient one. Symmetrically, impatient parents exert a positive effort only when $q < \bar{q}$, i.e., when there are (relatively) few impatients, the interest rate is (relatively) low and therefore the impatient type is better off than the patient one. Both types of parents exert zero effort when $q = \bar{q}$, i.e., when the material payoff of the patient and impatient agent are equalized. Finally, Proposition 4 shows that in this case $q = \bar{q}$ is the unique globally stable equilibrium. Thus, for intermediate levels of growth, the cultural transmission mechanism leads to a long-run equilibrium in which heterogeneous time preferences coexist. The "average" discount factor will be $\bar{\beta} = \bar{q}\beta^l + (1 - \bar{q})\beta^h$.

The main feature of the economy under scrutiny is the *dependence of patience on growth*. Propositions 2–4 in fact show that the state of the economy influences the outcome of the cultural transmission of patience because it affects the parents' socialization effort and, in the long run, the composition of the population in terms of patient and impatient agents.

In order to identify testable implications to assess the empirical validity of our model of endogenous evolution of patience, we perform a comparative statics exercise to analyze the consequences of a sudden, permanent increase of the growth rate g. In our setting this shock translates into an increase of the agents' endowment when old. It is easy to show that this shock boosts the (equilibrium material) payoff of both types for every value of q. However, the magnitude of this positive effect is not uniform across types. The payoff of type h, in fact, increases more than that of type l:

$$\frac{\partial(v^h - v^l)}{\partial g} = \frac{\beta^h - \beta^l}{g} > 0 \; .$$

Given that $\partial(\tau^h - \tau^l)/\partial g = \partial(v^h - v^l)/\partial g$, our model implies that parental effort to transmit patience should increase after an increase in growth. Appendix D shows that this results also holds if we relax Assumption 2 and suppose instead that parents have perfect foresight of children's future utility. The intuition for the result derived above is as follows. Given the pre-shock interest rate, the immediate effect of an increase in g is an increase in consumption when adult for both types (see equation (4)). This is the wealth effect of the shock. Both types, in fact, want to increase consumption in the first period of their life in order to smooth consumption across periods. In order to increase consumption in adulthood patient agents must reduce lending and impatient agents must increase borrowing. Lower supply and higher demand for loans leads to an increase of the equilibrium interest rate.

The higher interest rate induces a substitution effect, which exactly offsets the wealth effect. In fact, substituting the equilibrium interest rate defined by equation (8) into the first period consumption decision defined by equation (4), it is easy to see that consumption in adulthood does not depend on g. Thus, in equilibrium, consumption (and saving) *in adulthood* does not change for both types of agents. On the contrary, due to the increase of g, agents of both types will be richer when old and therefore will increase their consumption. The increase of the interest rate, however, reverberates differently on consumption of the old depending on the type. The patient old will benefit from an increase of interest payments but the impatient old will face higher debt commitments. The overall effect of g on c^{i*}_{t+1} is positive for both agents – i.e., $\partial c^{i*}_{t+1}/\partial g > 0$ – but consumption in the old age is higher for patient lenders than for impatient borrowers. Therefore, the lifetime material payoff of patient agents, v^h, increases more than that of impatient agents, v^l. By affecting differently the payoffs of different types in $t + 1$, an increase in g will have an impact on parents' behavior: due to the positive change in the state of the economy, patient parents will make an additional effort to educate their children to become patient.

Let's describe the transmission mechanism of the shock in detail. Figure 3 depicts the equilibrium material payoffs v^l and v^h as functions of q. Suppose that, for a given growth rate $\underline{g} < g_0 < \bar{g}$ (scenario 3), the system is in steady state at point A and the initial composition of the population given by $q_0 := \bar{q} = \bar{q}(g_0)$. In a given period T, an exogenous positive shock

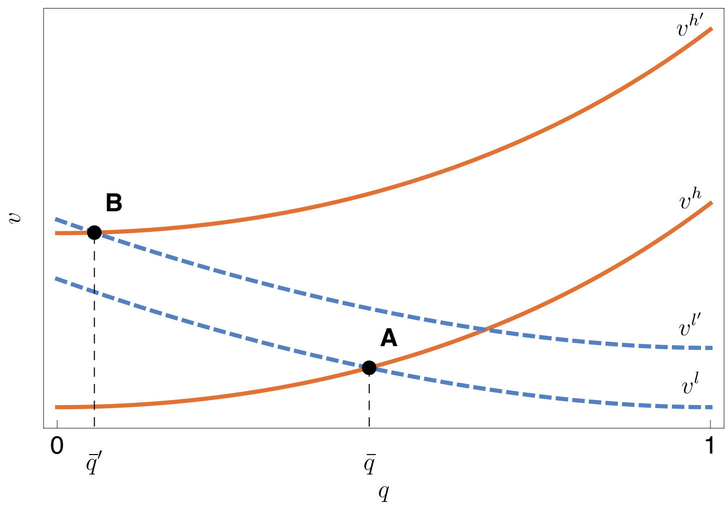

Figure 3: Effects of higher growth g on parental efforts and long-run share $\bar{q}$. Parameters: $\beta^l = 0.96^{35}$, $\beta^h = 0.99^{35}$, $g_0 = 1$ and $g_1 = 1.3$.

to g occurs, $g_1 > g_0$, causing both payoff functions to shift up respectively to $v^{l'}$ and $v^{h'}$. The new long run equilibrium is in point B, characterized by $\bar{q}' = \bar{q}(g_1)$ with $\bar{q}' < \bar{q}$. As pointed out above, after a positive shock to growth, the payoff of the patient agent increases more than that of the impatient one. Hence a positive gap will open between the two: $v^{h'} - v^{l'} > 0$. This gap induces the patient parents to try and socialize their children to their own trait. Therefore, in period $T+1$ we will observe that $\bar{q}' < q_{T+1} < \bar{q}$. From Proposition 2, we know that as long as q is greater than the steady state value, the payoff of patient agents is greater than that of impatient agents, i.e., $v^{l'} < v^{h'}$. From Proposition 3, we know that in this case we will have that $\tau^{h*} = q[v^{h'} - v^{l'}] > 0$, while $\tau^{l*} = 0$. Hence the fraction of impatient agents in the population decreases until the new steady state $\bar{q}'$ is reached in point B.

The model has a clear empirically testable implication. *If the growth rate in the time window of a generation t is greater than the past growth rate, we should observe a higher parental effort in educating children to patience.* In the next section, we take this implication to the data.

3 Empirical validation

For the empirical analysis we use data from the World Values Survey (WVS). The WVS is a project studying the change of human beliefs and values across countries and in time. It started in 1981 and it arrived at its 7th wave in 2021 (Inglehart et al., 2014). The WVS consists of national representative surveys containing questions on social values, political issues and demography.[6] Among other questions, subjects are asked to answer to the following: *"Here is a list of qualities that children can be encouraged to learn at home. Which, if any, do you consider to be especially important?"*. Respondents can choose up to 5 answers among the following options: 1. Independence; 2. Hard work; 3. Feeling of responsibility; 4. Imagination; 5. Tolerance and respect for other people; 6. Thrift, saving money and things; 7. Determination, perseverance; 8. Religious faith; 9. Unselfishness; 10. Obedience and 11. Self-expression. We consider the percentage of subjects choosing *"thrift saving money and things"* in each country as a measure of the importance given by families in educating children to patience in each wave. We refer to this measure as "Patience Transmission Index" (PTI) and we interpret it as the average effort made by parents, in each country and wave, to teach "patience" to their children. Following Falk et al. (2018), we argue that this variable does not capture the level of patience in a country because the WVS survey question is about childrearing rather than individual patience. In fact, Falk et al. (2018) build a measure of individual patience using experimentally validated survey data (Global Preference Survey) and show that it is not significantly correlated with the WVS measure.

According to our model, higher growth (relative to the past) implies higher effort to transmit thriftiness. For each country considered in the WVS, we consider real GDP per capita using the Maddison Project Database (Bolt et al., 2018) and compute the cumulative growth rate experienced in the 35 years before the year of the survey. We consider this to be the relevant growth rate for parental choices to transmit patience to their children. As a first step in our analysis, Figure 4 plots the growth rate and the PTI for each country in each wave. Graphical inspection shows that indeed there exists a positive relationship between growth and PTI, both when considering all waves together - shown in the upper-left panel of Figure 4 - and when considering data wave by wave. Our model predicts that the level of effort to educate children to patience is higher during a transition period triggered by an increase of growth relative to the past. Therefore, in order to test this theoretical prediction, we relate the PTI with recent and historical growth. If recent growth is higher than historical growth, the effort should be higher. We therefore estimate the following empirical model:

$$PTI_{c,w} = \alpha + \beta \cdot growth_{c,w} + \gamma \cdot level_{c,w} + controls + \varepsilon_{c,w}$$

where $PTI_{c,w}$ is the Patience Transmission Index computed for country c in wave w, $growth_{c,w}$ is the growth of real GDP per capita in country c in the 35 years before wave w of the survey and $level_{c,w}$ is the logarithm of real GDP per capita 35 years before wave w. The variable $level_{c,w}$ is interpreted as a proxy measuring historical growth. Among the controls we include

[6] A full description of the survey can be found at http://www.worldvaluessurvey.org/

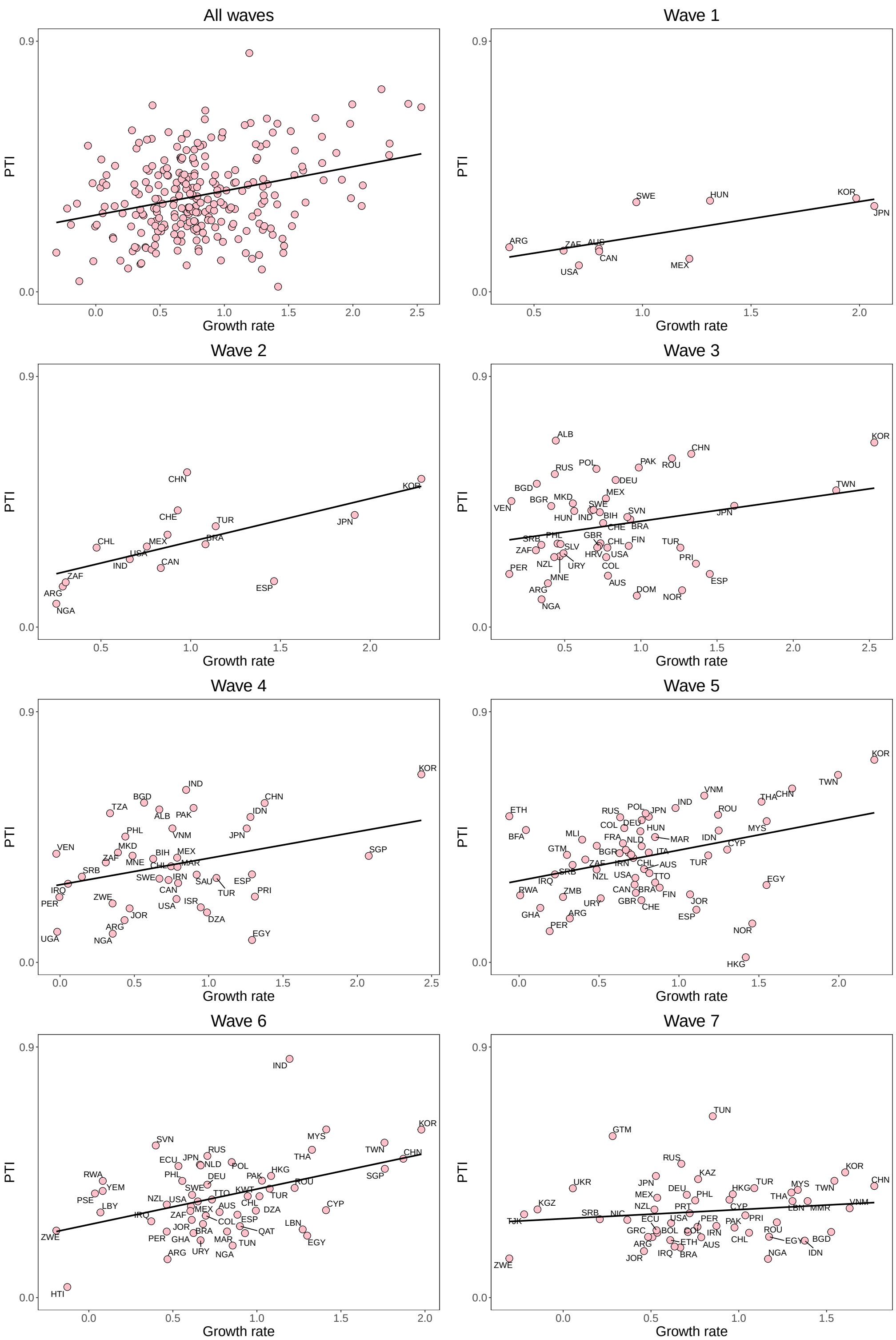

Figure 4: Countries by Patience Transmission Index and growth rate.

	Dependent variable: PTI		
	(1)	(2)	(3)
Growth GDP	0.081***	0.090***	0.064***
Log GDP	−0.022**	−0.024**	−0.041***
Country-Level Controls	NO	NO	YES
Wave Fixed Effect	NO	YES	YES
n.obs	261	261	237

OLS estimates with robust standard errors.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 1: Country-level estimation results. Country-Level Controls include average religiosity, absolute latitude, crop yield and crop growth cycle.

a wave fixed effect and a set of country-level controls such as average religiosity, absolute latitude, crop yield and crop growth cycle. The last two variables are the ancestry adjusted variables used in Galor and Özak (2016) to explain average level of patience in different countries. They could therefore be considered as instruments allowing to include the level of patience among the controls. We do not include country fixed effects because the time span between the waves of the survey is too short to detect any significant within-country effect. In fact, the change in growth in countries between different survey years may reflect business cycle movements, which are unlikely to cause changes in parental effort. For this reason we exploit between-country variability to determine whether there is any impact of changes in growth on parental effort to teach patience. Nevertheless, we remark that country-level controls should account for relevant country-specific factors affecting effort. Results are listed in Table 1. Regression results suggest a strong and positive correlation between the patience transmission index and the growth rate of real GDP per capita. Countries with 1% higher cumulative growth rate in the 35 years before the survey - corresponding to about 0.033% higher annual growth - displays about 0.09 percentage points higher PTI. Parents in countries that experienced higher growth attribute more importance to teaching patience at home. The coefficient associated to the level of GDP per capita 35 years before the wave date is significantly negative. This is in line with the prediction of our model, i.e., that a higher effort in teaching patience should be observed after an *increase of growth*. Therefore, The higher the *past* growth rate (proxied by the past level of GDP), given the *recent* growth rate, the lower the average effort to transmit patience to children.

We now move from country averages to a more formal regression analysis using individual data from the WVS. This allows us to control for the individual characteristics of respondents. We use a logit model to estimate the probability for an individual to choose thrift as an

	Dependent variable: Choosing thrift		
	(1)	(2)	(3)
Growth GDP	0.405***	0.319***	0.222**
Log GDP	−0.101	−0.154**	−0.122**
Country-Level Controls	NO	NO	YES
Individual-Level Controls	NO	YES	YES
n.obs	380778	263855	246417

Logit estimates with clustered standard errors at the country level.

$^{*}\ p < 0.1$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$.

Table 2: Individual estimation results. Logit estimates of probability of choosing thrift with clustered standard errors at the country level. All models include wave fixed effects. Country-Level Controls include: absolute latitude, crop yield and crop growth cycle. Individual Controls include: age, age squared, gender, education, religiosity, religion, saving, children and income.

important quality to teach children, which we interpret as a proxy for the individual effort to teach patience. The dependent variable in our analysis is a dummy indicating whether the respondent chose thrift among the qualities that children should learn at home. We regress this variable on GDP growth in the 35 years prior to the survey date and the logarithm of GDP per capita 35 years before the survey. We include a set of individual characteristics such as gender, age, age squared and a set of dummies describing the cultural and social status of the respondent: religiosity, which indicates whether religion is important or not;[7] religion, which indicates the type of religious beliefs; education, which we divide in three classes, namely primary and lower, high school and university; saving, which describes the savings of respondent's family in the previous year;[8] children, indicating whether the respondent has no children, or one or more child; income, which describes the respondent's self-reported decile in income distribution. Moreover, we include a set of country-level controls such as absolute latitude, crop yield and crop growth cycle. Our data include respondents from 105 countries and standard errors are clustered at the country level. Results are shown in Table 2 and confirm the analysis performed using aggregate data: an increase in the growth rate recently experienced by individuals positively affects parental effort in educating children to thrift.

Overall, the empirical analysis confirms the predictions of the model developed in Section

[7]Religiosity is based on the answer to the question "For each of the following, indicate how important it is in your life. Would you say religion is: Very Important, Rather Important, Not Very Important, Not At All Important". We classify a respondent as religious if she chooses one of the first two answers.

[8]Saving is based on the answer to the question: "During the past year, did your family: Saved money, Just got by, Spent some savings and borrowed money, Spent savings and borrowed money".

2: education effort to transmit patience is influenced by economic conditions.

4 Conclusions

The causal relationship that goes from patience to growth is now well established both theoretically and empirically. Traditionally, patience is considered as a deep exogenous parameter leading to different levels of economic success. The idea that patience may itself be evolving endogenously has been investigated only by few recent contributions. Our contribution to this literature is twofold. First, we describe a theoretical model where the evolution of patience over time is influenced by economic growth through intergenerational cultural transmission. The choice of parents to educate children to patience is aimed at maximizing their offspring's expected welfare. According to our model, the welfare of agents with different levels of patience depends on aggregate economic performance. In particular, when the economy grows faster, patient agents enjoy higher welfare. Therefore, in economies characterized by higher growth, the incentive to educate children to patience is higher. Second, we empirically validate this theoretical mechanism using WVS data. Our findings suggest that the level of patience in an economy is not constant but it evolves over time as a result of a cultural transmission process. Moreover, the heterogeneity in the levels of patience across countries does not only depend on geographic motives, but also on relatively recent economic performance.

Appendix

A Derivations

A.1 Optimal Consumption

The households' maximization problem can be solved by maximizing the following Lagrangian (where the i index is dropped for notation simplicity):

$$\mathcal{L} = \log(c_t) + \beta \log(c_{t+1}) + \lambda \left[(R+g)y_t - Rc_t - c_{t+1}\right],$$

where we have used Assumption 1 to substitute y_{t+1} with gy_t. The first order conditions are:

$$\frac{1}{c_t} - \lambda R = 0 \tag{22}$$

$$\frac{\beta}{c_{t+1}} - \lambda = 0 \tag{23}$$

$$(R+g)y_t - Rc_t - c_{t+1} = 0. \tag{24}$$

Substitute equation (23) in equation (22), to obtain

$$\frac{1}{c_t} - \frac{\beta}{c_{t+1}}R = 0, \tag{25}$$

from which

$$c_{t+1} = \beta c_t R. \tag{26}$$

Equation (26) can be substituted in equation (24) to get

$$(R+g)y_t - Rc_t - \beta c_t R = 0,$$

from which the optimal consumption in t can be written as

$$c_t = \frac{(R+g)y_t}{(1+\beta)R},$$

which is equation (4) in the main text. Savings in t are given by $s_t = y_t - c_t$, while consumption in $t+1$ is $c_{t+1} = Rs_t + y_{t+1}$.

A.2 Equilibrium interest rate

The equilibrium interest rate is derived using the market clearing condition

$$-qs_t^l = (1-q)s_t^h.$$

Substituting the optimal saving decision of the different agents in the equation above we obtain

$$-q\left(y_t - \frac{(1+r)y_t + y_{t+1}}{(1+r)(1+\beta^l)}\right) = (1-q)\left(y_t - \frac{(1+r)y_t + y_{t+1}}{(1+r)(1+\beta^h)}\right)$$

$$-q\left(\frac{(1+r)(1+\beta^l)y_t - (1+r)y_t - y_{t+1}}{(1+r)(1+\beta^l)}\right) = (1-q)\left(\frac{y_t(1+r)(1+\beta^h) - (1+r)y_t - y_{t+1}}{(1+r)(1+\beta^h)}\right)$$

$$-q\left(\frac{(1+r)(1+\beta^l)y_t - (1+r)y_t - y_{t+1}}{1+\beta^l}\right) = (1-q)\left(\frac{y_t(1+r)(1+\beta^h) - (1+r)y_t - y_{t+1}}{1+\beta^h}\right)$$

$$-q(1+r)\frac{\beta^l y_t}{1+\beta^l} + q\frac{y_{t+1}}{1+\beta^l} = (1-q)(1+r)\frac{y_t\beta^h}{1+\beta^h} - (1-q)\frac{y_{t+1}}{1+\beta^h}.$$

Denoting $R \equiv (1+r)$ and rearranging we get

$$
\begin{aligned}
qR\frac{\beta^l y_t}{1+\beta^l} + (1-q)R\frac{y_t\beta^h}{1+\beta^h} &= (1-q)\frac{y_{t+1}}{1+\beta^h} + q\frac{y_{t+1}}{1+\beta^l} \\
R\left(q\frac{\beta^l y_t}{1+\beta^l} + (1-q)\frac{y_t\beta^h}{1+\beta^h}\right) &= (1-q)\frac{y_{t+1}}{1+\beta^h} + q\frac{y_{t+1}}{1+\beta^l}.
\end{aligned}
$$

The equilibrium interest rate is thus given by

$$
R = \frac{(1-q)\frac{y_{t+1}}{1+\beta^h} + q\frac{y_{t+1}}{1+\beta^l}}{q\frac{\beta^l y_t}{1+\beta^l} + (1-q)\frac{y_t\beta^h}{1+\beta^h}} = \frac{(1-q)y_{t+1}(1+\beta^l) + qy_{t+1}(1+\beta^h)}{q\beta^l y_t(1+\beta^h) + (1-q)y_t\beta^h(1+\beta^l)}.
$$

Using Assumption 1 and substituting y_{t+1} with gy_t we obtain equation 8 in the main text.

B Proofs

B.1 Proof of Proposition 1

Consider the following derivatives

$$
\frac{\partial v^l(q,g)}{\partial q} = \frac{(q-1)(1+\beta^l)(\beta^l-\beta^h)^2}{(1+\beta^l(1-q)+q\beta^h)(q\beta^l+(1-q)\beta^h+\beta^l\beta^h)}, \tag{27}
$$

$$
\frac{\partial v^h(q,g)}{\partial q} = \frac{q(1+\beta^h)(\beta^l-\beta^h)^2}{(1+\beta^l(1-q)+q\beta^h)(q\beta^l+(1-q)\beta^h+\beta^l\beta^h)}. \tag{28}
$$

It is straightforward to see that for every $q \in [0,1]$, the denominator of (27)–(28) is always positive. On the other hand, the numerator of (27) is always negative for $q \in [0,1)$ and equal to zero for $q = 1$, while the numerator of (28) is always positive for $q \in (0,1]$ and equal to zero for $q = 0$.

B.2 Proof of Proposition 2

Given monotonicity of $v^l(q,g)$ and $v^h(q,g)$, we have that $v^l(q,g) = v^h(q,g)$ if and only if $v^h(0,g) \leq v^l(0,g)$ and $v^h(1,g) \geq v^l(1,g)$. In what follows we assume that $\beta^l < \beta^h$, i.e., type

l is impatient when compared to type h. The first inequality implies that

$$\begin{aligned}
v^h(0,g) &\leq v^l(0,g),\\
\beta^h \log(g) &\leq \log\left(\frac{1+\beta^h}{1+\beta^l}\right) + \beta^l \log\left(g\frac{\beta^l(1+\beta^h)}{\beta^h(1+\beta^l)}\right),\\
(\beta^h-\beta^l)\log(g) &\leq (1+\beta^l)\log\left(\frac{1+\beta^h}{1+\beta^l}\right) + \beta^l \log\left(\frac{\beta^l}{\beta^h}\right),\\
g &\leq \exp\left(\frac{(1+\beta^l)\log\left(\frac{1+\beta^h}{1+\beta^l}\right) + \beta^l\log\left(\frac{\beta^l}{\beta^h}\right)}{\beta^h-\beta^l}\right).
\end{aligned}$$

Denoting the RHS of the inequality above as $\bar{g}$ we can rewrite the first condition as $g \leq \bar{g}$. The second inequality implies that

$$\begin{aligned}
v^l(1,g) &\leq v^h(1,g),\\
\beta^l \log(g) &\leq \log\left(\frac{1+\beta^l}{1+\beta^h}\right) + \beta^h \log\left(g\frac{\beta^h(1+\beta^l)}{\beta^l(1+\beta^h)}\right),\\
(\beta^l-\beta^h)\log(g) &\leq -(1+\beta^h)\log\left(\frac{1+\beta^h}{1+\beta^l}\right) - \beta^h \log\left(\frac{\beta^l}{\beta^h}\right),\\
g &\geq \exp\left(\frac{(1+\beta^h)\log\left(\frac{1+\beta^h}{1+\beta^l}\right) + \beta^h\log\left(\frac{\beta^l}{\beta^h}\right)}{\beta^h-\beta^l}\right).
\end{aligned}$$

Denoting the RHS of the inequality above as $\underline{g}$ we can rewrite the first condition as $g \geq \underline{g}$. It is trivial to verify that, when $\beta^l < \beta^h$, we have that $\underline{g} < \bar{g}$. Denoting $\bar{q}$ as the q such that $v^l(q,g) = v^h(q,g)$, equations (27)–(28) imply that $v^l(q,g) > v^h(q,g)$ if and only if $q < \bar{q}$. Moreover, if $g < \underline{g}$ we have that $v^l(1,g) > v^h(1,g)$ and thus $v^l(q,g) > v^h(q,g)$ for all q, while if $g > \bar{g}$ we have that $v^l(0,g) < v^h(0,g)$ and thus $v^l(q,g) < v^h(q,g)$ for all q.

B.3 Proof of Proposition 4

Dynamics of the share of impatient agents in the economy are described by

$$q_{t+1} = q_t + q_t(\tau_t^{l*} - \tau_t^{h*}) - (q_t)^2(\tau_t^{l*} - \tau_t^{h*}).$$

When $g \leq \underline{g}$, the system has two steady states, namely $q = \{0,1\}$. In fact, from Proposition 3 we know that τ_t^{l*} is always larger that τ_t^{h*} and therefore dynamics converge to $q = 1$, which is globally stable.

When $g \geq \bar{g}$, the system has two steady states, namely $q = \{0, 1\}$. In fact, from Proposition 3 we know that τ_t^{h*} is always larger that τ_t^{l*} and therefore dynamics converge to $q = 0$, which is globally stable.

When $g \in [\underline{g}, \bar{g}]$, the system has three steady states, namely $q = \{0, \bar{q}, 1\}$, where $\bar{q}$ is the steady state level that equates parental efforts of the two types. From Proposition 3 we know that $\tau_t^{l*} = \tau_t^{h*}$ when $v_t^l = v_t^h$, i.e., when $q = \bar{q}$ as defined in equation 14. Moreover, since τ_t^{l*} is larger (smaller) than τ_t^{h*} whenever q is below (above) $\bar{q}$, we have that dynamics converge to $\bar{q}$, which is globally stable.

More formally, consider the map

$$f(q) = q + q(\tau^l - \tau^h) - q^2(\tau^l - \tau^h),$$

and notice that

$$\tau^l - \tau^h = \begin{cases} [\min[1, (1-q)(v^l - v^h)]]^+ > 0 & \text{for } q < \bar{q} \\ 0 & \text{for } q = \bar{q} \\ -[\min[1, q(v^h - v^l)]]^+ < 0 & \text{for } q > \bar{q} \end{cases}$$

To prove global stability of $\bar{q}$, we need to show that f cuts the 45-degree line from above in $\bar{q}$. Given that

$$f'(q) = (1 + \tau^l - \tau^h) + q\frac{\partial(\tau^l - \tau^h)}{\partial q} - 2q(\tau^l - \tau^h) - q^2\frac{\partial(\tau^l - \tau^h)}{\partial q},$$

in a neighborhood of $\bar{q}$,[9] we have that the right and left derivatives of f at $\bar{q}$ are respectively given by

$$f'_+(\bar{q}) = 1 + \bar{q}^2(1-\bar{q})\left(\frac{-(\beta^h - \beta^l)^2}{\bar{q}\beta^l + (1-\bar{q})\beta^h + \beta^l\beta^h}\right)$$
$$f'_-(\bar{q}) = 1 + \bar{q}(1-\bar{q})^2\left(\frac{-(\beta^h - \beta^l)^2}{\bar{q}\beta^l + (1-\bar{q})\beta^h + \beta^l\beta^h}\right).$$

Consider for example $f'_+(\bar{q})$. Given that

$$\frac{-(\beta^h - \beta^l)^2}{\bar{q}\beta^l + (1-\bar{q})\beta^h + \beta^l\beta^h} < 0,$$

for map f to cut the 45-degree line from above in $\bar{q}$, condition

$$\bar{q}^2(1-\bar{q})\left(\frac{-(\beta^h - \beta^l)^2}{\bar{q}\beta^l + (1-\bar{q})\beta^h + \beta^l\beta^h}\right) > -1$$

[9] When $q < \bar{q}$ is such that $(1-q)(v^l - v^h) > 1$, we have that $f'(q) = 2 - 2q$. On the other hand, when $q > \bar{q}$ is such that $q(v^h - v^l) > 1$, we have that $f'(q) = 2q$.

must hold. Since $0 < \beta^l < \beta^h < 1$ and $0 < \bar{q} < 1$, the condition above is always satisfied. This can be proved by contradiction. In fact, suppose that

$$\begin{aligned}
\bar{q}^2(1-\bar{q})\left(\frac{-(\beta^h-\beta^l)^2}{\bar{q}\beta^l+(1-\bar{q})\beta^h+\beta^l\beta^h}\right) &< -1 \\
\bar{q}^2(1-\bar{q})(\beta^h-\beta^l)^2 &> \bar{q}\beta^l+(1-\bar{q})\beta^h+\beta^l\beta^h \\
(\bar{q}\beta^h)^2+(\bar{q}\beta^l)^2 &> \bar{q}\beta^l+(1-\bar{q})\beta^h+\beta^l\beta^h+2\bar{q}^2\beta^h\beta^l+\bar{q}^3(\beta^h-\beta^l)^2 \\
(\bar{q}\beta^h)^2+(\bar{q}\beta^l)^2 &> \bar{q}\beta^l+(1-\bar{q})\beta^h+\beta^l\beta^h+\bar{q}^3(\beta^h)^2+\bar{q}^3(\beta^l)^2 \\
(\bar{q}\beta^h)^2+(\bar{q}\beta^l)^2 &> \bar{q}\beta^l+(1-\bar{q})\beta^h+(\beta^l)^2+\bar{q}^3(\beta^h)^2+\bar{q}^3(\beta^l)^2 \\
(\bar{q}\beta^h)^2 &> \bar{q}\beta^l+(1-\bar{q})\beta^h+\bar{q}^3(\beta^h)^2+\bar{q}^3(\beta^l)^2 \\
(\bar{q}\beta^h)^2 &> (1-\bar{q})\beta^h+\bar{q}^3(\beta^h)^2 \\
\bar{q}^2\beta^h+\bar{q}-\bar{q}^3\beta^h &> 1,
\end{aligned}$$

where the fourth inequality follows from the fact that $\bar{q}^3(\beta^h-\beta^l)^2 = \bar{q}^3(\beta^h)^2+\bar{q}^3(\beta^l)^2 - 2\bar{q}^3\beta^h\beta^l$ and that $2\bar{q}^2\beta^h\beta^l - 2\bar{q}^3\beta^h\beta^l > 0$, the fifth inequality follows from $(\beta^l)^2 < \beta^h\beta^l$, the sixth inequality follows from $(\beta^l)^2-(\bar{q}\beta^l)^2 > 0$, and the seventh inequality follows from $\bar{q}\beta^l+\bar{q}^3(\beta^l)^2 > 0$. Given that

$$\bar{q}^2\beta^h+\bar{q}-\bar{q}^3\beta^h < \bar{q}^2+\bar{q}-\bar{q}^3,$$

and that $\bar{q}^2+\bar{q}-\bar{q}^3 < 1$ for $0 < \bar{q} < 1$, it follows that $0 < f'_+(\bar{q}) < 1$ since $\beta^h < 1$ by assumption. A similar reasoning applies to $f'_-(\bar{q})$. Therefore we conclude that $\bar{q}$ is globally stable. Figure 5 displays map f for different values of growth rate g.

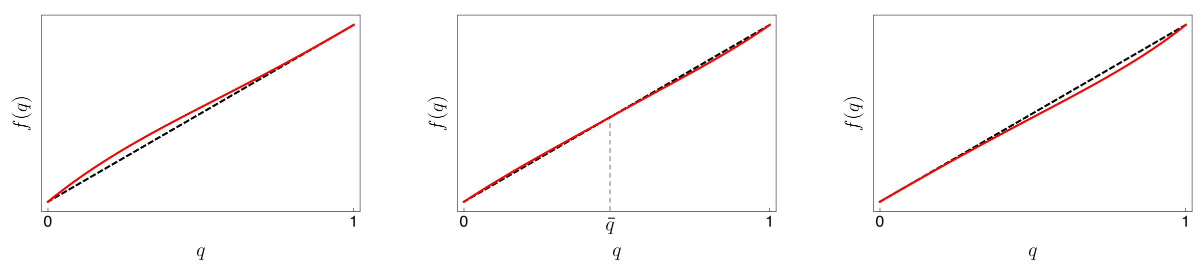

Figure 5: Map f for different levels of g. **Left**: $g = 0.55$. **Center**: $g = 1$. **Right**: $g = 1.45$. Parameters: $\beta^l = 0.96^{35}$ and $\beta^h = 0.99^{35}$.

C Endogenous growth

Consider now the case in which growth is endogenous and it depends on q, i.e. on the average level of patience in the economy. We can postulate a negative relationship between g and q

on the grounds that higher patience leads to more savings, more investments and ultimately to higher growth, so that $g := g(q)$ with $g' < 0$. We thus have equilibrium utilities given by

$$v^l = v^l(q; \beta^l, \beta^h) = \log\left[\frac{1+\beta^h}{1+q\beta^h+(1-q)\beta^l}\right] + \beta^l \log\left[\frac{\beta^l(1+\beta^h)}{\beta^l\beta^h+q\beta^l+(1-q)\beta^h}\cdot g(q)\right],$$
$$v^h = v^h(q; \beta^l, \beta^h) = \log\left[\frac{1+\beta^l}{1+q\beta^h+(1-q)\beta^l}\right] + \beta^h \log\left[\frac{\beta^h(1+\beta^l)}{\beta^l\beta^h+q\beta^l+(1-q)\beta^h}\cdot g(q)\right].$$

The derivatives of the utilities of the two types of agents with respect to q are given by

$$\frac{dv^l}{dq} = \frac{(q-1)(\beta^h-\beta^l)^2(1+\beta^l)}{(1+q(\beta^h-\beta^l)+\beta^l)(q\beta^l+\beta^h(1-q+\beta^l))} + \frac{\beta^l g'(q)}{g(q)} \tag{29}$$
$$\frac{dv^h}{dq} = \frac{q(\beta^h-\beta^l)^2(1+\beta^h)}{(1+q(\beta^h-\beta^l)+\beta^l)(q\beta^l+\beta^h(1-q+\beta^l))} + \frac{\beta^h g'(q)}{g(q)} \tag{30}$$

The first terms in equations (29) and (30) capture the impact on equilibrium utilities of a change in q through the interest rate channel. These terms are respectively negative and positive in equations (29) and (30). In fact, an increase in q leads to higher credit demand and consequently to a higher interest rate. This has a negative impact on the utility of type l agents and a positive impact on the utility of type h agents. The second term of equations (29) and (30) depends on the sensitivity of growth with respects to q, i.e., $g'(q)$ how growth changes as average patience changes. If $g'(q) \to 0$, the dynamic properties of the model with endogenous growth are the same of the model with exogenous growth analyzed in the main text. More generally, this happens when the interest rate channel dominates the growth channel in equation (30).

D Perfect Foresight

Consider now the case in which parents have perfect foresight of children's future utility. As before, the optimization problem of parent of type i is given by

$$\max_{\tau_t^i} \mathbb{E}^i_{\tau_t^i}[v_{t+1}^{ch^i}] = \left[\tau_t^i(1-q_t^i)+q_t^i\right]\mathbb{E}^i[v_{t+1}^i] + (1-\tau_t^i)(1-q_t^i)\mathbb{E}^i[v_{t+1}^j] - \frac{1}{2}(\tau_t^i)^2.$$

Notice that $v_{t+1}^{ch^i}$ depends on q_{t+1} via the equilibrium interest rate, and that q_{t+1} is a deterministic function of q_t, τ_t^l and τ_t^h given by

$$q_{t+1}^i = q_t^i[1+(\tau_t^i-\tau_t^j)(1-q_t^i)] \, .$$

The first order condition of the optimization problem thus reads

$$\begin{aligned}\tau_t^i &= (1-q_t^i)\left(v_{t+1}^i - v_{t+1}^j\right)\\ &\quad + \left[\tau_t^i(1-q_t^i)+q_t^i\right]\frac{\partial v_{t+1}^i}{\partial q_{t+1}^i}\frac{\partial q_{t+1}^i}{\partial \tau_t^i}\\ &\quad + (1-\tau_t^i)(1-q_t^i)\frac{\partial v_{t+1}^j}{\partial q_{t+1}^i}\frac{\partial q_{t+1}^i}{\partial \tau_t^i}.\end{aligned}$$

Considering q_t as given at the time of the optimization, and noting that both $\frac{\partial v_{t+1}^i}{\partial q_{t+1}^i}\frac{\partial q_{t+1}^i}{\partial \tau_t^i}$ and $\frac{\partial v_{t+1}^j}{\partial q_{t+1}^i}\frac{\partial q_{t+1}^i}{\partial \tau_t^i}$ do not depend on g, we have that totally differentiating condition above yields

$$\begin{aligned}\frac{\partial \tau_t^i}{\partial g} &= (1-q_t^i)\frac{\partial(v_{t+i}^i - v_{t+i}^j)}{\partial g} + \frac{\partial \tau_t^i}{\partial g}(1-q_t^i)\frac{\partial v_{t+1}^i}{\partial q_{t+1}^i}\frac{\partial q_{t+1}^i}{\partial \tau_t^i} - \frac{\partial \tau_t^i}{\partial g}(1-q_t^i)\frac{\partial v_{t+1}^j}{\partial q_{t+1}^i}\frac{\partial q_{t+1}^i}{\partial \tau_t^i}\\ &= \frac{(1-q_t^i)\frac{\partial(v_{t+i}^i - v_{t+i}^j)}{\partial g}}{1-(1-q_t^i)\frac{\partial q_{t+1}^i}{\partial \tau_t^i}\left(\frac{\partial v_{t+1}^i}{\partial q_{t+1}^i} - \frac{\partial v_{t+1}^j}{\partial q_{t+1}^i}\right)}.\end{aligned}$$

In particular, we have that

$$\frac{\partial \tau_t^l}{\partial g} = \frac{(1-q_t)\frac{-(\beta^h-\beta^l)}{g}}{1-(1-q_t)^2 q_t \frac{-(\beta^h-\beta^l)^2}{q_{t+1}\beta^l+\beta^h(1-q_{t+1}+\beta^l)}} < 0,$$

while

$$\frac{\partial \tau_t^h}{\partial g} = \frac{q_t\frac{(\beta^h-\beta^l)}{g}}{1-q_t^2(-1+q_t)\frac{(\beta^h-\beta^l)^2}{q_{t+1}\beta^l+\beta^h(1-q_{t+1}+\beta^l)}} > 0.$$

These results show that, after a positive growth shock, parental effort to transmit their cultural trait increases (decreases) for patient (impatient) agents. This in turn implies that, after an increase in the growth rate of the economy, the share of impatient agents declines, that is

$$\frac{\partial q_{t+1}}{\partial g} = q_t(1-q_t)\left(\frac{\partial \tau^l}{\partial g} - \frac{\partial \tau^h}{\partial g}\right) < 0.$$

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