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The origins of monetary income inequality☆ Patience, human capital, and division of labor

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Abstract

We present an explanation about the origins of monetary income inequality when an economically self-sufficient society opens to a market economy. The chain of associations runs from patience, to the accumulation of different forms of human capital, to self-selection into different occupations, and to the division of labor, which contributes to monetary income inequality. In a self-sufficient society, patience is exogenously determined and people rely on folk knowledge as the only form of human capital. With the establishment of schools, patient and impatient people sort themselves out by the type of human capital they begin to accumulate. Impatient people do not acquire folk knowledge because return to schooling takes many years to bear fruit. Schooling opens opportunities in occupations outside the village, whereas folk knowledge enhances employment opportunities that draw on farming or foraging. Self-selection into different occupations with different earnings potential spawns monetary income inequality. To test the explanation, we draw on data from a foraging–farming society in the Bolivian Amazon, the Tsimane'. We collected data during four consecutive quarters in 1999–2000 and a follow-up interview (2004). Data came from 151 adults (age, 16 years or more) from all households ($n=48$) in two villages with different levels of market exposure. During 1999–2000, impatience was associated with (a) greater folk knowledge and fewer years of schooling, (b) lower likelihood of working in wage labor, and (c) greater likelihood of working in rural subsistence occupations. People who had been patient in 1999–2000 had greater wage earnings and more modern physical assets in 2004.

Keywords: Patience; Division of labor; Income inequality; Human capital; Tsimane'; Bolivia; Amazon; Indigenous populations; Amerindians; Latin America

How poor are they that have no patience! (*Othello*, Shakespeare)

1. Introduction

In this article, we present and test an explanation about the origins of monetary income inequality when a small-scale economically self-sufficient society opens to a market economy. We posit a chain of associations from patience or private time preference, to the accumulation of different forms of human capital, to the occupational division of labor, ending with the growth of monetary income inequality. We start by asking a simple question: "Why do societies have monetary income inequality?" We trace monetary income inequality back to earning differentials across occupations, and then ask: "Given differences in earning across occupations, why do people select to enter some occupations and not others?" We trace the occupational division of labor to differences in the type of human capital people have, and then pose the last question: "What causes people to invest in different forms of human capital?" The answer to the last question takes us to patience, which, we suggest, shapes the accumulation of different forms of human capital and produces associations with the occupational division of labor and the monetary income inequality just described.

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Here we present the intuition behind the explanation and empirical evidence bearing on the explanation from a small-scale preindustrial society of foragers and farmers in the Bolivian Amazon in the early stages of continual exposure to the market economy. Hard to test in an industrial society where many confounds muddle associations, the explanation can be tested more easily in a preindustrial setting because such a setting provides one with a simpler natural laboratory to measure variables and to detect their links. A relatively isolated society of foragers and farmers allows one the rare opportunity to see in a snapshot what things must have been like over a broad swath of societies and time before "the great transformation" to the market economy took place (Polanyi, 1944).

Evolutionary anthropologists have been interested in patience (Rogers, 1994), human capital (particularly embodied human capital; Kaplan & Bock, 2001), and economic inequality (Godoy, Gurven, et al., 2004; Henrich et al., 2004). They have been interested in patience because patience presumably confers adaptive advantage since it makes people plan for the future. They have been interested in various forms of human capital because the various forms allow people to deal with disequilibrium and to use local resources better, thereby enhancing their inclusive fitness. In addition, they have been interested in economic inequality, in part, because it might threaten cooperative and prosocial behavior, which has adaptive advantages. These three lines of research have advanced our understanding of patience, human capital, and inequality, but they have left unanswered two large questions that we try to fill here. First, how do these three seemingly disparate aspects of human condition link with each other? Second, how do the three aspects interact with each other to explain the evolution of inequality?

2. The explanation

We posit a causal chain linking patience, the accumulation of different forms of human capital, occupational choice, and monetary income inequality. Researchers have studied the links between adjacent rings of the chain, or the drivers of income inequality, but not the entire chain. Parts of our hypothesis in linking economic with psychological variables hark back to the work of Banfield (1958) and Foster (1965), but we go beyond earlier works in linking psychological states with different patterns of human capital accumulation and then in tracing the effects of human capital on income inequality. Unlike Banfield or Foster, we test the hypothesis with quantitative information.

Our explanation begins in a self-sufficient remote economy without modern forms of human capital, without an occupational division of labor (other than along sex or age lines), and without much income inequality. In our idealized preindustrial economy, as Marx (1983) taught more than a century ago and as modern ethnographers have since confirmed (Siskind, 1975), people hunt and fish in the morning, farm in the afternoon, and beguile the rest of the day socializing with kith and kin (Sacket, 1996). In this idealized preindustrial economy, patience is exogenously determined. Patience or the rate of private time preference refers to the ability to delay gratification (Camerer, 1995; Frederick, Loewenstein, & O'Donoghue, 2002). High rates of private time preference imply a greater propensity to consume now rather than later, impulsiveness, myopia, inability to defer gratification, and a lower proclivity to invest in the future. Empirical work supports the assumption that the rate of private time preference comes partially hardwired in childhood (Shoda, Mischel, & Peake, 1990) and that it may even have neurological roots (McClure, Laibson, Loewenstein, & Cohen, 2004). Nevertheless, even in a small-scale relatively remote preindustrial society, the rate of time preference will change with age (Rogers, 1994) or illness (Kirby et al., 2002). However, differences in the rate of time preference between people cannot reflect schooling since preindustrial societies lack schools, nor can they reflect differences in wealth or income because such societies presumably lack salient economic inequalities.

In preindustrial societies, people rely on only one form of human capital—what evolutionary anthropologists have called embodied capital. Embodied capital includes growth-based attributes such as body size, strength, and balance, but also experience-based attributes such as knowledge, memory, or skills (Kaplan, 1996; Kaplan & Bock, 2001). Embodied capital allows children to become competent adults. As Bock (2002) points out, there is a tradeoff between the acquisition of experience-based embodied capital and immediate productivity among children. Time allocated to different economic activities reflects the short-term and long-term costs and benefits to parents of investing in children's embodied capital. Unlike schooling, embodied capital yields immediate and long-term benefits. Some complex skills, such as hunting or craft production, generate benefits in the long term or after people have become proficient in the skill, but simpler skills, such as the ability to identify and prepare medicinal plants, yield immediate benefits. For instance, children in rural preindustrial societies self-medicate with local herbs (Geissler et al., 2000; Reynolds, 1996; Sternberg et al., 2001). In short, in remote preindustrial societies, people are stuck with one and only one form of human capital that, in many cases, produces immediate tangible benefits.

Many changes follow when these societies open up to the market economy. In particular, the introduction of schools allows people, for the first time, a choice in the type of human capital they can accumulate. Unlike embodied capital, modern human capital only yields payoffs in the distant future, and in the early stages of contact with the market economy, even those returns come with much uncertainty (Schultz, 1975). Furthermore, returns from schooling only come after many years of exposure to schools (Mingat & Bruns, 2002). With a standard school curriculum in which teachers transmit academic skills by drawing on examples from the modern world, schooling and folk knowledge likely substitute for, rather than complement, each other. Time and resources invested in the accumulation of one form of human capital deflect from time and resources invested in the accumulation of other forms of human capital because people cannot be in two places or learn two topics at the same time (Benz, Cevallos, Santana, Rosales, & Graf, 2000; Carbonaro, 2005; Sternberg, 1997; Sternberg et al., 2001).

Once a society opens up to the market economy, one should see patient and impatient people sorting themselves into different groups by the type of human capital they start to accumulate. Patient people will sidle to schools, while the impatient will continue to rely on embodied capital because people have to wait a long time to reap any returns to schooling but can reap some returns to embodied capital immediately. Our explanation complements the Becker–Mulligan hypothesis about the endogenous determination of patience (Becker & Mulligan, 1997). Becker and Mulligan note that schooling enhances a person's ability to simulate future scenarios, and therefore increases patience. We turn their line of thinking around, but end in the same place. Patience induces people to invest in modern human capital, but once in school, schooling should make people even more patient for the reasons identified by Becker and Mulligan.

Once people split by the type of human capital they accumulate, obvious consequences follow for the occupational division of labor. Economies of scale induce specialization in the division of labor in the production of goods and services (Dasgupta, 1993; Locay, 1990). People with more schooling will have the endowments of human capital to enter modern occupations or to compete for employment in the formal labor market, whereas those with folk knowledge will only have the endowments to enter informal rural occupations or to remain self-employed in subsistence occupations in the countryside. The unschooled will not have enough academic, language, and other skills learned in school to take advantages of opportunities in the formal labor market. They will also lack the mien and the discipline needed to catch the attention of employers (Bowles & Gintis, 1975; Bowles, Gintis, & Osborne, 2001; Hunter & Leiper, 1993; Murphy, Schleifer, & Vishny, 1991).

Predictable consequences for the emergence of monetary income inequality follow after people get locked into different occupations. As Kuznets (1955) noted a half century ago, one reason for the legendary spike in income inequality associated with economic growth at low levels of income has to do with the emergence of the occupational division of labor into a subsistence traditional sector and a formal modern sector (Fields, 2001; Ray, 1998). We complement this line of thinking by explaining why people would seek and find employment in different sectors. During the early stages of economic development, income growth across sectors will differ, with income in formal occupations growing at a rate faster than that of income in traditional subsistence occupations.

Following are three testable hypotheses about the link between patience, the accumulation of different forms of human capital, self-selection into different occupations, and the growth of monetary income inequality in societies:

Hypothesis 1. Patient people will invest in modern human capital more than in folk knowledge, and impatient people will do the opposite.

Hypothesis 2. Since patient people accumulate more modern human capital and modern human capital enhances the likelihood of finding employment in formal occupations, patient people will find employment in modern occupations, whereas the impatient will continue to find employment in subsistence occupations that rely on folk knowledge.

Hypothesis 3. Patient people will enjoy higher growth rates in monetary income than impatient people. The difference in the growth rate between the two groups will accentuate income inequality.

We now turn to an ethnographic description of the study participants before presenting the methods used to collect data and the econometric evidence bearing on the hypotheses.

3. The Tsimane'

3.1. Missionaries and schooling

The Tsimane' are a native Amazonian society in Bolivia. They hunt, collect plants, fish, and practice slash-and-burn agriculture. The latest Bolivian census of 2001 puts the Tsimane' population at about 8000 people (Instituto Nacional de Estadística, 2003). The Tsimane' live in over 100 villages along river banks and logging roads, mostly in the department of Beni. In continuous contact with Westerners since the early 1950s, the Tsimane' still have low levels of schooling and academic skills, and have much economic self-sufficiency.

Until the late 1940s, the Tsimane' lived like any other precontact Amazonian society. They hunted, fished, gathered wild plants, and practiced slash-and-burn agriculture with Paleolithic tools. They often married their cross-cousins, listened to their shamans, drew on myths to explain the universe, and relied on folk knowledge to use the natural resources around them (Daillant, 2003; Huanca, 2006). Much changed with the arrival of missionaries in the early 1950s.

Soon after arriving, the missionaries started to convert Tsimane' to the Protestant faith. The missionaries visited villages every year for a few weeks, proselytizing and teaching basic academic skills. After a few years, they selected the more promising young men for training in a summer school in the town of Tumichuco, several days away from the Tsimane' territory. While in Tumichuco, Tsimane' served as informants for missionary linguists translating the Bible. In Tumichuco, the missionaries taught academic and practical skills such as modern farming and hygiene. After 27 years of operating in Tumichuco, the missionaries transferred their training to the outskirts of the town of San Borja (population ~19,000), which lies close to the Tsimane' territory. After receiving training, schooled Tsimane' returned to their villages, where they worked as lay missionaries and teachers using instructional materials prepared by the missionaries in the Tsimane' language.

At present, about 40% of Tsimane' villages have a primary school covering the first five grades. No village has a middle school or a high school. Four villages close to the town of San Borja have an adult educational program where Tsimane' with primary school can earn a high school degree by attending classes 1 week a month.

From the founding of the first schools during the 1970s to this day, the Tsimane' have been able to select the type of human capital they want for themselves or for their offspring since school attendance remains, in practice, voluntary. Because the area has yet to experience significant technological changes in farming, demand for schooling and academic skills remains modest (Foster & Rosenzweig, 1996). Parents in remote villages take out their children from school when they need them to do chores in the house or in the farm. Some of the older children leave school to work for loggers or ranchers.

Despite nearly three decades of exposure to schooling, the typical man over 16 years of age in our sample had only 3.1 years of schooling (S.D.=4.15) and the typical woman had half as much (mean=1.8; S.D.=2.52). Half of the sample had received no schooling. Owing, in part, to low levels of school achievement, Tsimane' have weak academic skills and most cannot speak fluent Spanish, Bolivia's national language. Over 60% of the sample could not read Spanish, about half could not do the four basic arithmetic operations, and only 24% could speak fluent Spanish (Table 1).

This said, some Tsimane' parents seek schooling for their children; recently, some young Tsimane' have started to seek more schooling for themselves. Ethnographic interviews suggest that the Tsimane' we have followed since 1999 as part of a panel study in progress (13 villages, 267 households, and 655 adults) have left the sample for two reasons. Some have hurtled away from market towns to take advantage of better hunting and fishing opportunities; they have opted to abjure modern human capital, retreat to the backlands, and rely on folk knowledge. They gravitate to places with more forests and wildlife. Others have moved closer to villages with schools to take advantage of educational opportunities; they are the ones who see in schooling, academic skills, and Spanish fluency the passport to employment in modern occupations. About eight Tsimane' who have completed primary school take night courses in the town of San Borja to earn a high school degree. About a dozen have started to take courses in accounting, typing, and computer basics, also in the town of San Borja.

Table 1
Summary statistics of schooling, academic skills, and competence in speaking Spanish among Tsimane' adults (age, 16 years or more) ($n=147$)

Variable	Definition		%
Schooling	Maximum educational attainment measured in school grades completed	No school	50
		3 years of primary school	26
		Between 3 and 5 years of primary school	19
		Secondary school	5
Spanish literacy	Ability to read a simple sentence written in Spanish	Illiterate	67
		Some literacy	7
		Proficient	26
Tsimane' literacy	Ability to read a simple sentence written in Tsimane'	Illiterate	63
		Some literacy	10
		Proficient	27
Arithmetic	Ability to solve the four basic arithmetic operations	No knowledge	53
		Addition	18
		Subtraction	8
		Multiplication	6
		Division	15
Fluency in spoken Spanish	Ability to communicate in Spanish as measured by the interviewer at the moment of interview	No knowledge	31
		Some knowledge	46
		Fluent in Spanish	24

Questions about academic skills and Spanish fluency were coded as 1=*with skills or competence* or 0=*without skills or competence*.

3.2. Mode of incorporation into the market economy

Owing to the recent history of continuous contact with Westerners, the Tsimane' only lately started to trade with Westerners. Tsimane' avoided contact with the market economy and attempts to make them take up sedentary living. They did so by killing some Catholic missionaries and traders who entered their territory and by withdrawing farther into the backlands (Ellis, 1996). To this day, they remain economically self-sufficient. A survey done in 2004 suggests that 61.87% of adults of working age (20–65 years of age) had spent no money and 40.77% had earned no cash during the 2 weeks before the day of the interview.

At present, the Tsimane' connect with the modern labor market through employment in cattle ranches, logging camps, and farms of colonist farmers. To get jobs, Tsimane' must speak some Spanish. Besides working for loggers and cattle ranchers, Tsimane' with schooling and Spanish fluency also work for the government as teachers in village schools, and as professionals for different organizations working in the Tsimane' territory. Those without schooling or Spanish fluency enter the market economy by selling thatch palm from the forest or by selling rice and other crops from their farms, all of which are occupations that do not require Spanish fluency, a school diploma, or academic skills. Tsimane' can work in those jobs without leaving their village because traders come to the villages to swap or to buy those goods, and most traders speak rudimentary

Tsimane'. Tsimane' without schooling mostly do subsistence work. In contrast to employment with outsiders, including employment as a village school teacher, selling goods or farming–foraging for a household's own consumption requires only folk knowledge.

Living at the doorsteps of a highly stratified empire (the Inkas), the Tsimane' managed to remain an egalitarian society until recently (Ellis, 1996). In their lack of economic differentiation, they resemble other native Amazonian societies. Except for the shaman (healer, priest, and political leader), we find no evidence of social stratification in the past (Huanca, 2006), but recent evidence suggests that village income inequality has increased (Godoy, Gurven, et al., 2004). Drawing on a survey done in 2000 in 59 Tsimane' villages, we estimated Gini coefficients of village income and wealth inequality, and found that the typical Tsimane' village had a Gini coefficient of income inequality of 0.53, similar to the Gini coefficient of income inequality of the UK. To identify the covariates of village income inequality, we tested the Kuznets hypothesis and also tested whether income inequality bore an association with other variables (such as village population size or distance from village to town) and found no strong results. This, then, presents a puzzle: What drives income inequality in the early stages of market exposure? Patience and investments in different forms of human capital might provide the partial answer.

4. Sample

We draw on panel data collected by four researchers during four consecutive quarters, from May 1999 until May 2000. Researchers collected information from all residents in two Tsimane' villages that varied in their distance from the market town of San Borja. The remove village, Yaranda, lies 47.7 km up the river from San Borja (or 6–18 h by canoe, depending on the season and the type of canoe); the village of San Antonio lies only 10 km down the river from San Borja, or about 2 h by foot. The total sample size included 51 households (Yaranda, 24; San Antonio, 27), composed of 81 adult men (Yaranda, 37; San Antonio, 44) and 70 adult women (Yaranda, 32; San Antonio, 38). We limit our analysis to adults or to people over the age of 16 years because, by that age, people have generally stopped going to school and have embarked on their main adult occupations. We asked informants to estimate their age. Elsewhere, we discuss measurement errors associated with estimates of age among Tsimane' (Godoy et al., in press). During 1999–2000, we measured patience, income, and human capital, and in 2004, 5 years later, we measured different indicators of well-being from the same participants.

The panel for the four quarters of 1999–2000 did not suffer from attrition. The composition of the sample remained stable over time. In fact, the number of households and adults in the sample grew during 1999–2000 because outsiders married into the villages. During each of the four quarters, the total sample size of the households was 45, 47, 48, and 51. People who moved into one of the two villages to join a household were added to the panel. Only two households in the remote village (Yaranda) and three households in the accessible village (San Antonio) refused to take part in the study for reasons that remain unclear.

Of the 151 people who took part in the 1999–2000 study, 51 (33%) had left the sample by 2004. Of the people who left the sample, 18% died; 20% refused to continue participation; 22% moved to villages closer to market towns or to cities to take advantage of schooling, modern medical services, and employment opportunities; and 33% moved to villages farther away to take advantage of better places to forage and to farm. Six percent of the original sample moved to other villages, neither much closer nor much farther from the market town of San Borja as their village of residence during 1999–2000. We could not find 8% of attriters.

5. Methods of data collection

5.1. Time preference at baseline (1999–2000)

Elsewhere, we have discussed the methods we used to elicit information on time preference (Godoy, Byron, et al., 2004; Godoy, Kirby, & Wilkie, 2001; Kirby et al., 2002). Here, we provide only a summary.

We asked participants to make real (rather than hypothetical) choices between having a smaller reward now or having a larger reward 7–157 days in the future. Participants were asked to make eight choices using money as a reward, and seven choices using food (candy) as a reward. The discount rates with the two currencies were made as similar as possible. The values of the monetary rewards were not trivial; the average monetary reward amounted to 25% of a daily wage.

To make choices real and to lower the perceived risks of the experiment, we took two steps. First, we told the participants that, at the end of the interview, we would randomly select one of the monetary choices and one of the food choices they had made, and that we would give them those rewards according to the preference they had revealed in the answer. Second, to reduce the concerns of the participants about the uncertainty of future payments (Spence & Zeckhauser, 1972), data collection during the fourth quarter took place early enough so that we could deliver delayed reward before the end of fieldwork.

We estimated individuals' discount rate from the choices they made using a hyperbolic function and an exponential discount function. For each question, we solved for the value of k (hyperbolic) or r (exponential) that made a person indifferent between each of the immediate and delayed rewards of Table 2. Columns 5 and 6 of Table 2 contain the estimated values for k and r. Taken together, the questions

Table 2
Choice values and associated discount rates for questions used to elicit rates of private time preference for money and food

Question	Reward values (B$)		Delay	Rate at indifference	
	Today	Later	(days)	k	r
Money					
5	8.0	8.5	157	0.00040	.00039
3	6.7	7.5	119	0.0010	.00095
4	6.9	8.5	91	0.0025	.0023
1	5.5	7.5	61	0.0060	.0051
8	5.4	8.0	30	0.016	.013
7	4.1	7.5	20	0.041	.030
6	3.3	8.0	14	0.10	.063
2	3.1	8.5	7	0.25	.14
Candy					
4	16	17	157	0.00040	.00039
3	13	15	153	0.00101	.00094
1	11	15	61	0.0060	.0051
7	11	16	28	0.016	.013
6	8	15	21	0.042	.030
5	7	17	14	0.102	.063
2	6	17	7	0.26	.15

"Rate at indifference" indicates the value of hyperbolic (k) and continuously compounded exponential (r) discount rates at which immediate and delayed rewards are of equal value.
US$1.00 ≈ B$6.00.

define nine ranges of discount rates for money and eight ranges of discount rates for food.

The results that we present below do not depend on the use of a hyperbolic function or an exponential function. The values with exponential or hyperbolic discounting are nearly identical over most of the observed range (Columns 5 and 6). Because we measured delays in days, the parameters we report for hyperbolic discount rates, multiplied by 100, are approximately interpretable as expressing percent decreases per day. Because hyperbolic and exponential discounting produced similar results, and because hyperbolic discounting explained observed data better than exponential discounting, we present results using hyperbolic discount rates (Ainslie, 1992; Frederick et al., 2002; Kirby, 1997; Laibson, 2003; O'Donoghue & Rabin, 2001).

A person's choices were not always consistent with one value of k, so parameter estimates could not be made by identifying the switch from the immediate to the delayed rewards moving down (Table 2). Instead, we assigned each participant a k value that yielded the highest proportion of consistent choices. That is, for each participant, we computed the proportion of that person's choices that was consistent with assignment to each of the values of k defined by the questionnaire (bounded or unbounded). Consistency here is a relative—rather than an absolute—measure, with the discount rate that yields the highest relative consistency across trials providing the best estimate of the participant's k value. When two or more values yielded equal consistency, the participant was assigned a value corresponding to the geometric mean of those values. In regression analysis, we use information only from participants for whom we were able to assign values that were consistent with at least six of eight monetary choices and with at least five of seven food choices.

The mean consistency score for patience with money (0.946) was nearly identical to the mean consistency score for patience with food (0.947). Almost three quarters of participants (70.35% for money and 72.67% for food) had fully consistent measures (i.e., consistency=1). From among the rest, only 14 (2.71%) had consistency scores with money below 0.75, and only eight participants (1.55%) had consistency scores with food below 0.71; we excluded these participants from analysis. We regressed the score of consistency with money against the score of consistency with food, and we found a moderate positive and statistically significant coefficient of 0.41 (p=.001).

Repeated surveys with the same participants improved the reliability of answers as the study unfolded, probably because participants understood the task better and trusted researchers more. For instance, mean consistency scores with money or with food improved from 0.91 during the first quarter to 0.96 during the last quarter. Within-subject correlation in scores of patience also improved over time. Within-subject correlation coefficients of patience between the first quarter and the second quarter were 0.004 for money and 0.12 for food, and in neither case were results statistically significant at the 10% level. Within-subject correlation coefficients for patience between the third quarter and the fourth quarter (the last two quarters of data collection) were 0.32 for money and 0.46 for food, and, in both cases, results were statistically significant at the 99% confidence level or higher.

The mean measure of patience with money (k=0.143) was 20.10% lower than the mean measure of patience with food (k=0.172), probably because of a built-in bias to select the delayed rewards with money and a built-in bias to select the immediate reward with food. People in remote areas of the Bolivian Amazon have few opportunities to spend money immediately, so using money as a reward may have induced subjects to select the delayed reward. Participants who may have selected the larger delayed reward for food may have opted for the smaller immediate reward owing to the absence of storage technology to preserve more food received in the future. In addition, when mothers took part in the survey with active young children at their side, they sometimes opted for the immediate reward of food so they could share it with their children to deflect their attention and thus make it easier on the mother to continue speaking with the surveyor. Measures of patience with the two currencies bore a strong positive association. Using hyperbolic measures of patience, we regressed scores of patience measured with money against scores of patience measured with food for participants, with consistency scores above 0.75 for money and with consistency scores above 0.71 for food, and found a positive and statistically significant coefficient of 0.63 (p=.001). For the analysis, we present results using only hyperbolic rates of time preference with food as a reward, but we then present results using money and exponential rates of time preference, and do so to assess the robustness of the main results.

5.2. Modern and traditional human capital at baseline (1999–2000)

We equate modern human capital with the number of years participants attended school rather than with the highest school grade attained because years of school exposure capture better the amount of time unavailable to learn folk knowledge. To estimate years of school exposure, we asked participants the age when they first enrolled in school and the age when they completed their highest grade in school. The variable likely contains random measurement error from faulty recall of the age of initial school attendance.

We proxy embodied capital with folk or local knowledge of wild and semidomesticated plants. To measure folk knowledge, we used a cultural consensus model (Romney, Weller, & Batchelder, 1986). We estimated folk knowledge by calculating agreement in responses between informants (Reyes-García et al., 2005). To arrive at individual estimates of folk knowledge, we developed three multiple-choice questionnaires from a list of useful plants. In the questionnaires, we asked people whether plants could be used for none, one, or more of the following uses: firewood, food, medicine, or construction of a house, canoe, or tool. We used the answers to calculate individual scores of cultural competence, which refers to the share of questions coinciding with the most frequent response given by participants in the two villages. Scores of cultural competence ranged from zero to one.

5.3. Income and controls at baseline (1999–2000)

Income refers to the sum of a person's monetary earnings from the sale of goods and from wage labor plus the value of goods received in barter, all for the 30 days before the day of the interview. Control variables include age, sex, three dummy variables for quarters (n=4−1=3), and one dummy variable for the two villages.

5.4. Indicators of individual well-being on follow-up (2004)

During 2004, we measured income from barter, sale, and wage labor for the 2 weeks before the day of the interview. We also measured the monetary value of individual wealth embodied in selected local and industrial assets. Local assets are the ones produced in the village and refer to goods such as bows and canoes owned by the person. Industrial assets include assets bought in the market (e.g., metal fishhooks) and owned by the person. We collected information on village selling prices for the assets and multiplied the amount of the asset by its village price to arrive at the value of the asset. We measured body mass index (BMI; weight in kilograms/physical stature in meters squared), sex-standardized and age-standardized z scores of midarm muscle area (ZAM) and weight (ZWT), and self-reported health. Table 3 contains the definition and summary statistics of the variables used in regression analyses.

Table 3
Definition and summary statistics of variables

Variable	Definition	Observations	Mean	S.D.
Baseline (four quarters): 1999–2000				
Impatience	Hyperbolic rate of private time preference using food as a reward (see text)	142	−2.12	1.21
Schooling	Years of school attendance	128	2.71	3.62
Folk knowledge	Share of questions on plant uses coinciding with the most frequent response of the group	115	0.84	0.09
Income	Monetary earnings from sale and wage labor plus the value of goods received in barter (in B$, US$1=B$6.1 in 2000)	141	8.73	20.2
Age	Age of subject in years	113	34.1	16.0
Male	Participant's sex (1=*male*; 0=*female*)	113	0.51	0.50
Yaranda	Village of residence (1=*Yaranda*; 0=*San Antonio*)	145	0.44	0.50
Wage labor	1=*Participant worked in wage labor*; 0=*no wage labor*	141	0.13	0.33
Follow-up (one annual survey): 2004				
Income from	Measured for the 14 days before the day of the interview			
Barter	Value of goods received in barter	98	6.55	12.93
Sales	Value of goods sold	98	28.97	150.80
Wage	Earnings from wage labor	98	72.10	168.50
Credit	Total debts outstanding (in B$) (US$1=B$7.92 in 2004)	98	94.69	506.82
Wealth	Measured in *bolivianos* at the individual level			
Modern	Value of modern assets	98	586.76	529.05
Traditional	Value of traditional assets	98	188.16	153.66
Total	Modern plus traditional assets	98	838.60	617.93
BMI	Weight in kilograms/ physical stature in meters squared	93	23.71	2.55
ZAM	Midarm muscle area	93	−0.64	0.75
ZSF	Sum of triceps and subscapular skin folds	93	−0.59	0.62
ZWT	Body weight	93	−0.90	0.53
Illness	Self-reported days ill in the last 14 days	99	5.25	6.45

ZAM, ZSF, and ZWT are z scores standardized by age and sex using the norms of Frisancho (1990).

6. Results

6.1. Hypothesis 1: patience, schooling, and folk knowledge

Contrary to our expectations, folk knowledge and modern human capital bore no strong association with each other. In an ordinary least squares (OLS) regression (not shown) with years of school exposure as a dependent variable, with folk knowledge as an explanatory variable, and with sex, age, and dummies for quarters and communities as control variables, the coefficient for folk knowledge was −0.09 (p=.96).

Among variables related to modern human capital, only Spanish fluency bore the expected negative association with folk knowledge. A regression not shown of Spanish fluency (dependent variable) and the explanatory variables just described produced a coefficient of −1.21 (p=.04) for folk knowledge. The results suggest that, at low levels of school exposure, greater schooling might not displace local knowledge at low levels of schooling.

We next examine the relation between impatience and the two forms of human capital: schooling and folk knowledge (Table 4). Conditioning for sex, age, and dummy variables for quarters and villages, impatience was associated with greater folk knowledge of plants and with fewer years of school exposure. A 1% increase in impatience was associated with a 0.01% (p=.01) increase in the score of folk knowledge of plants, and with 0.54 fewer years of school exposure (p=.05). As predicted in Hypothesis 1, we found that impatient and patient people diverged in the type of human capital they accumulated, although the increase is low.

6.2. Hypothesis 2: patience and occupational choice

We move on to examine the relation between different forms of human capital and the likelihood of working for wages (Hypothesis 2). We ran a probit regression in which the dependent variable took the value of 1 if the participant earned cash from wage labor during the quarter, and 0 otherwise (results not shown). We found that, conditioning for impatience, age, and sex, an increase of 1 year in school exposure over the sample mean of 2.61 years of school exposure was associated with a 1.4% greater probability of working in a modern occupation (p=.002), whereas a 1% increase in the score of folk knowledge over the sample mean of 0.83 was associated with a 0.09% lower probability of working in wage labor (p=.48). The coefficient for folk knowledge was statistically insignificant, but bore the expected sign.

Table 4
Relation between impatience and the accumulation of different types of human capital

Explanatory variable	Dependent variable (type of human capital)	
	Schooling	Folk knowledge
Impatience	−0.547 (0.278)**	0.011 (0.004)***
Age	−0.096 (0.017)***	0.001 (0.0003)***
Male	1.592 (0.542)***	0.024 (0.012)***
R^2	0.31	0.39
n	406	309

** Significant at the 5% level.
*** Significant at the 1% level.

6.3. Hypothesis 3: patience, occupational choice, and income growth

Last, to test Hypothesis 3, we estimated rates of income growth during the four quarters of 1999–2000 for patient and impatient people (results not shown). We ran OLS regressions with the logarithm of the following outcomes as separate dependent variables: earnings from wage labor, earnings from the sale of goods, the monetary value of goods received in barter transactions, and total income (total monetary earnings plus the value of goods received in barter). Explanatory variables included impatience, age, sex, dummy variables for quarters and villages, and an interaction term that captured the differential quarterly growth rate in income for an impatient participant compared with that for a patient participant. The coefficients of interaction terms suggest that patient participants saw their incomes increase at a faster rate than impatient participants. Rates ranged from 0.10–0.15% per quarter for sales and total income to 0.20–0.28% per quarter for wage earnings and barter. Except for barter, the results were not significant at the 10% level. Note that the direct effect of impatience on various forms of income is positive; starting out from a lower initial base of earnings, patient people will likely catch up and surpass the income levels of impatient people. A 0.10–0.28% quarterly growth rate in income implies an annual growth rate in income of about 0.4–1.2%; traced over several years, those annual growth rates in income would translate into meaningful income differences between patient and impatient people.

6.4. The patience and the impatient: 5 years later

How do patient and impatient people compare with each other in monetary income and in other indicators of well-being 5 years after the baseline study? To answer the question, we reinterviewed the participants of 1999–2000 in 2004.

Before presenting results, we test for attrition bias by following two steps. We first performed a regression analysis (not shown) with attrition in 2004 (dependent variable) against impatience in 1999–2000 (explanatory variable), and we then regressed income in 1999–2000 (dependent variable) against attrition in 2004 (explanatory variable). The two steps allow us to explore the likely sign of the bias from the omission of attriters in the 2004 survey. A probit regression with a dummy for attrition in 2004 (dependent variable) against sex, age, a village dummy variable, and a measure of impatience using food as a reward suggests that a 1% increase in impatience was associated with a 0.091 lower likelihood of leaving the sample by 2004 (p=.04).

We then regressed various measures of income (i.e., earnings from wage labor, earnings from the sale of goods, and the value of goods received in barter) as dependent variables against age, sex, and dummies for village and attrition as explanatory variables. We found that attrition did not bear a significant association with income. The coefficients of the dummy variable for attrition were as follows: −0.37 for barter (p=.30), −1.56 for sales (p=.21), and −1.25 for wage earnings (p=.67). Since attrition bore a negative association with both impatience and income, the sign of the indirect effect from omitting attriters in the 2004 comparison is positive, so the comparisons of Table 5 likely overstate the effect of impatience on the outcomes.

Bearing in mind the caveats, in Table 5, we show the results of t tests comparing various forms of income in 2004 between people who had been patient and people who had been impatient in 1999–2000, where patient and impatient refer to people at the bottom or top 30% in measures of time preference. We limit the analysis to a comparison of means because we did not have enough degrees of freedom to include controls. As expected, we find that patient people earned considerably more from wage labor (B=*bolivianos*; B$152) than impatient people (B$23) ($p$=.01) 5 years later, but the reverse was true with income from the sale of farm and forest goods. Impatient people made five times more from the sale of farm and forest goods (B$49) than patient people (B$9) ($p$=.20). Results were statistically insignificant, but they were economically significant since the higher amount represented about two daily wages.

In Table 5, we extend the analysis and compare indicators of well-being other than income between patient and impatient people. We find that patient people had access to twice as much credit as impatient people; had slightly better anthropometric indicators of short-term nutritional status, as shown by sex-standardized and age-standardized z scores of midarm muscle area (ZAM) and weight (ZWT); and had better self-reported health. Impatient people had accumulated more traditional assets. Even though we measured patience before anthropometric indicators of nutritional status, wealth, or self-perceived health, we cannot assume causality because the outcomes and patience could still be linked to each other through an unmeasured third variable. In other analyses (not shown), we found that the two groups did not show differences in emotions, such as happiness, sadness, or anger. In sum, we find preliminary evidence to suggest that differences in patience at baseline among adults were associated with several indicators of well-being 5 years later.

Table 5
Comparison of indicators of well-being in 2004 between patient and impatient participants during 1999–2000 (results of two-tailed t test)

Outcomes	Impatient (n=38)	Patient (n=25)
Income from		
Barter	6.55	6.82
Sales	49.63	9.88
Wages	23.68	152.24***
Credit	32.47	65.04*
Individual wealth		
Modern physical assets	538.55	652.04
Traditional physical assets	199.21	178.00**
Total physical assets	783.03	882.44
Nutritional status		
BMI	23.14	23.42
ZAM	−0.77	−0.42**
ZSF	−0.71	−0.56
ZWT	−1.02	−0.83*
Self-reported days ill	6.8	3.5**

* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

7. Discussion and conclusion

In this article, we have presented and tested an explanation linking patience, the accumulation of different forms of human capital, self-selection into different occupations, and the growth of monetary income inequality. We found some evidence that patient and impatient people differed in the type of human capital they acquire and in the occupations they pursue, but we do not find strong evidence that occupational differences are associated with noticeable divergence in rates of income growth. Results of the 1999–2000 analysis hold up mainly when using food, rather than money, to elicit patience; the use of an exponential or a hyperbolic discount rate did not affect the results.

Our findings support recent research in embodied capital: those choosing to invest in formal schooling trade off immediate productivity from engaging in traditional activities for delayed benefits from better-paid activities that require schooling, and those who choose not to attend school give up larger future benefits for immediate productivity (Bock, 2002).

Our explanation complements Kuznets' hypothesis about the growth of income inequality at low levels of income or during the formative stages of economic development. We have added an ethnographic layer to Kuznets' insight about the initial upsurge of income inequality at low levels of income. We have explained why there might be self-selection into different occupations during the early stages of economic growth. We have found positive associations between impatience and the type of human capital people accumulate, and between different types of human capital and the choice of occupations people pursue. We also found some evidence that patience is associated with higher quarterly growth rates of various forms of monetary income, but results were statistically insignificant. Five years after baseline measures, patient people had higher earnings from wage labor, better indicators of short-term nutritional status, and better self-perceived health than impatient people, but attrition bias might have accentuated the difference.

We end by posing a question for future study. Why would people in the early stages of market exposure allow monetary income inequality to rise from a presumably egalitarian initial base? At least two possible related explanations come to mind. One explanation says that income inequality in a society offends people's sense of fairness, producing anger and resentment (Brosnan & de Waal, 2003), but does not produce adverse effects on socioeconomic indicators of individual well-being, such as health or nutritional status, at least in the short run. If so, people in past foraging societies perhaps looked the other way and allowed income inequality to emerge because they sensed that it did not hurt them personally. The second related explanation traces the absence of mechanisms to curb inequality to myopia and social capital. The initial growth of income inequality might not have harmed visible indicators of individual well-being as long as strong forms of social capital, such as generalized reciprocity and gift-giving, acted as cushions to protect people (Kawachi & Kennedy, 2002; Kawachi, Kennedy, & Wilkinson, 1999; Wilkinson, 1996; Williams, 1998). The impatient were unlikely to detect the long-term consequences of emerging income inequality, both because local forms of social capital inoculated them against mishaps and because the impatient, in the short term, may have enjoyed higher levels of income than their patient peers. The myopia that made the impatient consume now rather than later would have also clouded their understanding of the possible adverse long-term effects of income inequality on their well-being. With a greater ability to see the future with clarity, patient people probably started to invest in other forms of self-insurance and to rely less on superannuated forms of social capital. There, then, might hang the tale about the origins of monetary income inequality.

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