CHAPTER

Behavioral development economics*

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1 Introduction

Modern development economics was born in part as a reaction against a widespread view among scholars that peasants in poor societies were bound by tradition and could not be subject to the same type of economic analysis as people in modern industrialized societies. From the work of Schultz (1964) through the early 1990s, most development economists instead took it as axiomatic that people in developing countries were "poor but efficient".

The field of development economics has been transformed since the 1990s in part by the growth in experiments. Most of these have focused either on issues of importance to development economics, such as the rate of return to capital for small enterprises, or policy issues, such as finding ways to increase use of fertilizer to increase agricultural production in Africa. Until recently, only a few were designed to test behavioral theories or to identify the parameters of behavioral models. Yet, in the past decade, development economics has increasingly come to incorporate theories and ideas from behavioral economics into the study of questions in development, giving birth to the subfield of *behavioral development economics*.

Our definition of "behavioral" economics hews closely to those in other chapters in this handbook. We view behavioral economics as consisting of systematic deviations from the standard economic model in terms of preferences, beliefs, and decision-making. These deviations are motivated by insights from psychology but are typically captured using economic models (Rabin, 1998; DellaVigna, 2009). In parts of this chapter, we extend this definition to include systematic deviations by firms from profit-maximization, even if the underlying psychology is not yet well understood.

We discuss several areas in which concepts from behavioral economics have proved useful in shedding light on issues in development economics. We focus on three types of non-standard preferences—present bias, reference-dependent preferences (loss aversion), and social preferences—and three key areas of non-standard beliefs—naïveté about present bias, projection bias and deviations from Bayesian learning. We touch upon other behavioral concepts related to non-standard decision-making, including limited attention and memory, mental accounting, and default effects. We also discuss the literature on the psychology of poverty, which argues that the conditions of living in poverty themselves have a causal effect on cognitive function and economic behavior.

We begin by examining a key puzzle in development economics. The Euler equation derived from intertemporal choice models directly relates consumption growth to rates of return on available investment opportunities. Calibrated versions of this equation using standard preference parameter values, rational expectations, and the high rates of return to investments identified in recent studies in developing countries predict high consumption growth of over forty percent annually. Observed consumption growth is much lower. We argue that the puzzle cannot be explained by credit constraints, non-concave production functions, or stochastic production.

Present bias can play an important role in resolving this puzzle, because it can explain impatient short-run behavior while maintaining realistic predictions about longer-run choices. The modified Euler equation implied by present-biased preferences can generate a significantly lower effective discount factor and thus substantially reduce the implied rate of consumption growth.

Under-investment in preventive health is a particularly striking and widely documented example of individuals' failure to take advantage of high-return investment opportunities. We argue that this underinvestment in preventive, as opposed to curative, health care is difficult to explain in a purely rational model. For instance, positing large disutility costs from preventive health activities would not be enough to explain the low levels of health investments, as this explanation is at odds with the high sensitivity of demand for preventive health to small differences in price or convenience.

We use the case of health to explore a more general issue: the role of **misprediction of future preferences** in shaping current mis-optimization and choices. A general insight from behavioral economics is that the distortions arising from non-standard preferences (such as present bias or loss aversion) can be greatly magnified by biased beliefs about these preferences. In the case of present bias, realistic param-

eter values of present bias alone can explain some failures to invest in high-return investments. However, explaining failures to invest in very high return investments (in preventive health or elsewhere) typically requires another ingredient: at least partial **naïveté regarding future present bias**.

A (partially) naïve individual underestimates the degree of their future present bias. Such naïveté can magnify the welfare losses associated with present bias since individuals may delay very high return investments with small short-run utility costs because they incorrectly anticipate making these investments later. Fully naïve individuals will not take advantage of commitment devices to overcome their self-control problems, while partially naïve individuals will mis-predict whether a given commitment device is likely to work for them. Naïveté and uncertainty in the environment (which increases the value of flexibility) are likely to drive down demand for commitment and may explain why commitment devices are not more widespread.

People in developing countries are often highly exposed to risk, enjoy little social insurance from governments, and live close to subsistence, giving them little margin of adjustment. Many also have limited scope for borrowing. Whereas standard theory suggests that risk-averse households without access to borrowing should build up buffer stocks to insulate themselves from risk, present-biased consumers will have difficulty saving and maintaining liquid assets and hence will wind up liquidity constrained. This will leave them exposed to shocks and unable to self-insure.

A standard finding in development economics is that demand for even actuarially-fair weather insurance or health insurance is surprisingly low. Present bias, by generating liquidity constraints, may also reduce demand for standard insurance contracts which require up-front payment of premia.

Another implication of these endogenous liquidity constraints is that it will be difficult for present-biased agents to respond to surprise opportunities for investment without accompanying provisions for credit. This issue makes it difficult to interpret some standard tests for willingness to pay that are common in the health and environmental literatures.

Loss aversion may help explain why many apparently high expected return investments in developing countries remain unexploited. Just as present bias yields much larger distortions when combined with naïveté, loss aversion can have much more negative effects on investment when combined with narrow bracketing, the tendency to consider decisions in isolation from each other. Loss aversion may generate stickiness of assets, which arguably better matches some of the dynamics of assets than many poverty-trap models based on increasing returns. In contrast, loss aversion has ambiguous theoretical effects on the demand for insurance.

Individuals may mis-predict their future preferences in various ways. As discussed above, naïveté may greatly exacerbate the consequences of present bias. **Projection bias**, the tendency to overestimate the degree to which one's future tastes will resemble one's current tastes, may reduce investment in preventive health and insurance, to the extent that people find it difficult to imagine that they may become sick in the future and the extent to which they will need resources if they or their family might be hit by a health shock.

Beyond mis-predicting future preferences, individuals may hold **non-standard beliefs**, which might interfere with many important decisions, including technology adoption, health investments, or insurance and savings decisions.

Individuals may exhibit a **failure to correctly interpret information** for various reasons, among them redundancy neglect, belief in the law or small numbers, and selection neglect. For instance, under redundancy neglect, people may overweight information from others because they do not consider the possibility that multiple apparently independent signals may all ultimately stem from a common source. Theory suggests the possibility of potentially dramatic equilibrium effects on social learning, in which people become confident in false beliefs about the efficacy of technologies or health investments, and society becomes locked in to an incorrect choice.

Failures to seek or share valuable information can also cause biased beliefs to persist in large shares of the population. On the supply side of information, envy or pride may hinder people from sharing valuable information with others. On the demand side, fear of shame or stigma could inhibit learning by preventing individuals from asking questions that might make them look ignorant or stupid. **Limited attention and memory** may also distort learning and thus interfere with technology adoption. Beyond interfering with learning, these factors could also cause underinvestment in preventive health or savings choices.

Finally, beliefs might also be biased due to **motivated reasoning**. Individuals may derive utility from thinking of themselves highly (ego utility) or from foreseeing a bright future for themselves (anticipatory utility), which may distort decisions to acquire valuable information as well as the processing of received information. Such biased beliefs could be particularly important for choices involving protection of health or other disaster risks.

In addition to non-standard preferences and beliefs, we consider **non-standard decision-making**, i.e. failures to optimize, given preferences and beliefs. We consider non-standard decision-making in the context of savings choices, including mental accounting, susceptibility to default effects, and limited attention and memory. While these topics have received less attention in recent development economics research, they provide opportunities for relatively minor policy and product design choices to have major impacts on individuals. For instance, labeling savings accounts as "health savings", setting default choices to desired options, or providing reminders to adhere to medication can powerfully impact behavior at minimal costs.

Most of this review, like much of the behavioral development economics literature, treats **behavioral distortions as universal features of human behavior**, and examines the ways in which behavioral biases interact with features of developing societies or play out differently given the differing circumstances and institutions of the developing world. The same psychological forces often seem to be at play in developed and developing countries. For instance, present bias has been shown to explain how individuals allocate work over time in both the United States and in India (e.g. Augenblick et al., 2015 and Kaur et al., 2015); the endowment effect exists both in labs in college students in Canada and in the field in dairy-farmers in Kenya (e.g. Knetsch, 1989 and Carney et al., 2018).

Similarly, default effects powerfully affect savings choices in the US and Afghanistan (Madrian and Shea, 2001; Blumenstock et al., 2018), while DellaVigna and Pope (2018) show that the treatment effects on worker effort of ten different behavioral treatments, leveraging social preferences, time preferences, probability-weighting, crowd-out and other ideas from psychology, are very similar in Indian and US samples of online workers.

However, differences in institutions and markets imply that the same behavioral factors that are at play in developing and developed countries have different implications for behaviors. For example, present bias may impact preventive health investments less severely in a society in which most people receive clean water through a municipally managed system than in a society in which people need to make active choices to boil water or treat it with purchased supplies of dilute chlorine solution. Similarly, in the section on "behavioral labor", we argue that behavioral factors such as present bias and reference dependence may matter more for labor supply and work-effort decisions in developing countries, where labor markets are characterized by high levels of self-employment and informality. Self-employment and informality mean that workers in developing countries often do not face the commitment and monitoring provided by the formal firms common in rich countries.

To take another example of how the features of institutions and markets interact with behavioral factors, note that developing countries typically have much smaller firms than rich countries, arguably because large firms are open to predation, and that those large firms which do exist often enjoy considerable market power. This implies that selection pressures that might drive out managers or firms that systematically fail to maximize profits might be weaker in poor countries. Hence, one should expect more "**behavioral firms**" in poor countries. While in rich societies the consequence of wide-spread present bias and naiveté may be some workers failing to take advantage of employer match programs for retirement savings, in poor countries, this may lead to unexploited high-return investment opportunities for a wide range of firms.

In the final sections of the chapter, we go beyond considering such "universal" psychology to discuss two more speculative literatures which raise the possibility that behavioral factors themselves may operate differently across societies or levels of income. Many forms of **social preferences** may be fairly universal. Thus, for example, work on fairness norms in developing countries suggests that wages may be constrained by fairness norms even independent of some of the institutions, such as unions, that are thought to play a major role in developed societies, suggesting more similarity across societies than one might have expected. However, even if social preferences are based on universal psychological building blocks, the very fact that they are social creates more scope for them to be shaped by the cultural environment. To take a trivial example, humans may be susceptible to creating in groups and out groups, but who is in what group will be defined by culture.

In fact, there might be systematic differences between developed and developing societies in social preferences and attitudes such as trust, reciprocity, and the ability to cooperate. Indeed, some go so far as to argue that the cultural ability to cooperate

outside of small kin-based groups is rare and key to development. In this view, the scarcity of large firms in developing societies, and hence the potential role for behavioral factors in firm behavior, is not driven simply by policy mistakes such as state predation on large firms, but rather reflects fundamental cultural features of societies that make cooperation difficult outside of the extended family. Similar factors may interfere with state capacity. We discuss the evidence for differences in social preferences across societies, and the extent to which these differences may be thought of as causes or consequences of development, and how they may be shaped by policy.

Finally, we discuss the nascent literature on the **psychology of poverty**, which investigates whether poverty itself affects cognitive function and economic decision-making in meaningful ways. The main argument of this literature is that the conditions associated with poverty, such as the constant worries about money, greater exposure to factors such as pain, sleep deprivation, noise and malnourishment, and less access to mental health care, may influence cognitive function (largely negatively). Worse cognitive function may in turn affect decision-making and productivity in ways that generate a psychological poverty trap. While the literature provides some evidence of effects on cognitive function, studies evaluating effects on economic outcomes and behaviors remain scarce.

This chapter complements several **existing review articles** on behavioral development economics. An accessible and thorough review of empirical research in behavioral development economics is provided in World Bank (2015). While that report is aimed at policy makers, this chapter is written for researchers and graduate students, and is thus somewhat more technical. Schilbach et al. (2016) and Dean et al. (2018) cover in detail the relationship between poverty and cognitive function, which we touch on in Section 10. Datta and Mullainathan (2014) describe principles of behaviorally-informed design of development policy. Finally, Demeritt and Hoff (2018) provide a history of the rise of behavioral development economics. While our chapter concentrates on "universal" behavioral models such as present bias, reference-dependence and limited attention, Demeritt and Hoff point to a different strand of behavioral development economics, which emphasizes the importance of the "cultural mental models" – categories, concepts, identities and worldviews – that individuals use to interpret situations and make decisions.

Before proceeding, we discuss a few **caveats and critiques of behavioral development economics.** First, just as behavioral economics seeks to build on and improve upon existing neoclassical models, behavioral development economics seeks to augment existing theories of development economics by capturing systematic and relevant aspects of human behavior, often using parsimonious extensions of existing models (Rabin, 1998).

Second, behavioral development economics does not deny the importance of institutions or economic policy in economic development. Instead, it takes local economic environments seriously, and studies how universal behavioral factors play out in the context of the choices, markets and institutions common in developing countries. Rather than diverting attention from the study of important structural issues, behav-

ioral development may sometimes help better identify and understand these issues and potential reforms.

Third, a critique of behavioral development is that such work is too quick to abandon the possibility that apparently irrational actions by people may reflect real economic incentives and constraints. For example, Rosenzweig and Udry (2014) argue that it is difficult to generalize about the effectiveness of agricultural inputs even from several seasons, because agricultural production is highly stochastic and returns to inputs may vary across seasons. This view implies that one should not too quickly jump to the conclusion that certain behaviors (such as not using more fertilizer) are irrational. We see merit in this view. One way that behavioral economists can address this critique is by designing experiments to more precisely identify specific behavioral mechanisms and to test for those, rather than to simply reject a single rational model and label any residual as "behavioral". We believe that the best work in behavioral development economics takes precisely such an approach. The solution to the problem of bad behavioral-development research is more careful and rigorous behavioral-development research.

Fourth, some see behavioral development economics as blaming the poor for their poverty. In fact, behavioral development is largely concerned with universal psychological factors and does not generally attribute poverty to having greater behavioral biases. Moreover, we do not view having behavioral biases as in any way deserving blame, since there is no reason whatsoever to believe that they are freely chosen.

Fifth, behavioral economics is often seen as opening the door to paternalistic policies and restrictions on individual choice. While we believe that understanding the role of behavioral factors in a scientific way does not automatically translate into any policy or political implications, we also argue that misunderstanding human behavior can also lead to bad policy outcomes.

Policymakers are sometimes enthusiastic about behavioral economics due to the perception that it promises inexpensive but effective interventions, and want to apply it to policy right away. However, behavioral economics should arguably make policy makers more cautious for two reasons. One is the subtlety of thinking about **welfare** in a behavioral world, a topic which we do not cover, and for which we refer readers to the chapter by Bernheim and Taubinsky (2018) in this handbook. In addition to philosophical issues involved in conducting welfare analysis with behavioral agents, in the case of behavioral development, behavioral biases will often interact with multiple market failures, potentially leading to second-best issues and making welfare analysis more challenging. Another reason for humility in policymaking is precisely because behavioral economics demonstrates that small details can matter for people's choices. Consequently, unintended consequences may be more likely in a world with behavioral agents.

Finally, while we have argued that many behavioral phenomena are relevant for development economics, it is worth noting that other ideas, which have been found to be important in laboratory experiments, and in some cases in some real-world developed-country contexts, have not turned out to play an important role in popular applications in development. Research provides little support for some views

widely espoused by development practitioners and NGOs regarding the alleged counterproductive behavioral effects of more favorable financial treatment of poor people. Rather, the growth of scientific behavioral development economics research has led to the formal testing and rejection of several of these hypotheses, and in some cases, this has arguably influenced policy debates.

For example, some have conjectured that reducing the cost of preventive health products such as mosquito nets or distributing them for free would lead people to value them less and use them less. Rigorous testing by Cohen and Dupas (2010) and Ashraf et al. (2010) yields no support for this conjecture. Broadly speaking, this evidence has moved the policy debate towards free distribution of preventive health goods such as mosquito nets. Similarly, while many practitioners have voiced concern that financial compensation for community health workers could crowd out intrinsic motivation or lead to selection of less motivated staff, and indeed in some laboratory experiments there is evidence of a tradeoff, most real-world experiments provide little evidence that extrinsic financial incentives crowd out intrinsic incentives meaningfully, and indeed provide evidence that recruiting community health workers in ways that emphasize career benefits leads to better selection. To take a final example, many development practitioners were concerned that unconditional cash transfers to the poor would be largely dissipated on alcohol and cigarettes, but evidence from Haushofer and Shapiro (2016) does not support this view.

Roadmap. The remainder of this chapter is organized according to topics in development economics, rather than by behavioral biases. Section 2 examines the puzzle of high rates of return without rapid growth. Section 3 examines behavioral factors that may contribute to low investment in preventive health. Sections 4 and 5 discuss how non-standard preferences, beliefs and decision-making can affect savings behavior and demand for insurance. Section 6 investigates how technology adoption decisions may be affected by limited attention and present bias, as well as by failures in learning.

Section 7 discusses behavioral labor economics in developing economies. We first consider how some characteristics of labor markets in developing countries may potentially exacerbate behavioral biases. We then discuss the labor supply and worker productivity, as well as the role of fairness norms in wage-setting, the selection of workers, and female labor-force participation. Section 8 discusses behavioral firms, arguing that firms in developing countries may be more subject to behavioral biases, since limits on the span of control in developing societies weaken the opportunities for market forces to eliminate behavioral firms, and imply that a greater proportion of the population in developing countries acts as managers or owners of firms.

Sections 9 and 10 discuss culture, social preferences, and the psychology of poverty. We first briefly review the intellectual history of this field and then cover questions regarding the existence of differences in social preferences across societies, whether these preferences matter for development, and the potential to change these attitudes through social contact across groups, or other deliberate policies. We then review the recent literature on the psychology of poverty, including the effects of scarcity on cognitive function and economic behaviors, the potential role of other

deprivations beyond lack of money, and mental health. Finally, we explore question around aspirations, hope, and religiosity.

2 High rates of return without rapid growth

A recent body of research in development economics finds that, although there is considerable heterogeneity, many potential investments in developing countries yield very high returns (Banerjee and Duflo, 2005).

Among the direct estimates, Banerjee and Duflo (2014) exploit exogenous policy-variation over time and estimate that the returns to capital in certain Indian firms must be at least 105%. De Mel et al. (2008) use randomized grants to generate shocks to capital stock for a set of Sri Lankan microenterprises and find the average real return to capital in these enterprises is 55% to 63% per year. Kremer et al. (2013) use administrative data on whether firms purchased enough to take advantage of quantity discounts from wholesalers and estimate a lower bound on rates of return for the median shop of well over 100 percent per year. Duflo et al. (2008) estimate an annual rate of return of about 70 percent for the most profitable quantity of fertilizer in their study.

High rates of return are also evidenced by high interest rates people are willing to pay to borrow (Aleem, 1990; Fafchamps, 2000). Individuals in developing countries often borrow at annual interest rates upwards of 70%. For example, many small-scale fruit vendors in Chennai borrow at a daily interest rate of 5% (Karlan et al., 2018). The authors payed off high-interest moneylender debt for a randomly selected subset of vendors. Most borrowers returned to debt as soon as six weeks after the payoff of their original debt obligations. Moreover, treatment individuals were again borrowing at the same rate as control households one to two years after intervention.

In this section, we demonstrate that such high rates of return are difficult to reconcile with the standard neoclassical model under reasonable parameter assumptions, even when considering that income and returns may be stochastic, people are risk averse, that individuals may face "taxes" either from the state or from family/social pressure, and that production functions are sometimes non-concave. We will then consider whether various behavioral factors can help solve this puzzle, focusing on present bias and loss aversion as potential explanations.

2.1 The Euler equation puzzle

In a standard dynamic optimization model, the Euler equation implies that high returns to capital predict rapid rates of consumption growth, even in the absence of any capital market. To see the underlying logic, consider first a simple deterministic discrete-time intertemporal consumption model, in which infinitely-lived households maximize their lifetime utility. Assume households solve the following optimization problem: $\max_{\{C_t\}} \sum_{t=0}^{\infty} \delta^t u(C_t)$, where $0 < \delta < 1$ is the annual exponential discount factor; C_t is the household's consumption in period t; $u(C_t)$ measures the utility

derived from consuming C_t in period t. $u(C)$ is increasing and concave and satisfies the usual Inada conditions: $u'(C) > 0$ and $u''(C) < 0$, $\lim_{c\to 0} u'(C) = \infty$ and $\lim_{c\to\infty} u'(C) = 0$.

The budget constraint of the household is $x_{t+1} = f'(K_t)(x_t - C_t)$, where x_t is household assets ("cash on hand") in period t, with x_0 given; $f(K)$ is the production function denoting the value of the output in the next period including any remaining value of the capital; $f'(K)$ is the gross rate of return to capital; $f(K)$ satisfies $f'(K) > 0$ and $f''(K) < 0$, $\lim_{K\to 0} f'(K) = \infty$, $\lim_{K\to\infty} f'(K) = 1$.

Solving for the optimal consumption path gives the discrete-time Euler equation:

$$u'(C_t) = f'(K_t)\delta u'(C_{t+1}) \tag{1}$$

Assume a constant-elasticity-of-substitution (CES) utility, $u(C) = \frac{C^{1-\sigma}}{1-\sigma}$ if $\sigma \neq 1$; $u(C) = \log(C)$ if $\sigma = 1$.[1] Then, the Euler equation implies that the growth rate of consumption is $(\delta f'(K_t))^{\frac{1}{\sigma}} - 1$. With standard values for discount rates and the intertemporal elasticity of substitution, it follows from that high returns to capital imply high consumption growth.

For example, suppose that the gross rate of return on capital, $f'(K) = 150\%$ (well within the range of estimated returns to capital in developing-country settings) and $\delta = 0.96$. Then, with log utility ($\sigma = 1$ and elasticity of intertemporal substitution equal to one), the implied growth rate of consumption is $\frac{\dot{C}}{C} = 44\%$. No country grows at anything like this rate. One does not observe sustained consumption growth rates of this magnitude even for the subset of the population that appears to have access to returns of this magnitude.

Alternatively, using a ballpark estimate from the macro literature for the elasticity of intertemporal substitution of 0.5 (and therefore $\sigma = 2$), the implied consumption growth is $\frac{\dot{C}}{C} = 20\%$ per year.[2] This number implies a 38-fold increase in consumption in 20 years, far higher than actual growth rates of consumption.[3] Working in reverse, a consumption growth rate of 5% implies that $f'(K) = 115\%$, i.e. net rates of return of 15%, which is much lower than the rates observed in many contexts.

The finding that many people in developing countries face high rates of return yet do not have dramatic growth in consumption thus poses a puzzle in the framework of the neoclassical model. Some would try to resolve this puzzle by arguing that

[1] Under CES utility, the elasticity of intertemporal substitution is equal to $\frac{1}{\sigma}$.

[2] A value of 0.5 is used in standard calibrations in macro studies (e.g., Hall, 2009, 2016). See Havránek (2015) for a review.

[3] Suppose individuals instead had a Stone-Geary utility function incorporating subsistence levels of consumption. Then, they would become unwilling to intertemporally substitute at very low levels of income. However, being close to such subsistence constraints does not seem consistent with the observed high-frequency variation in consumption even among the poor (Collins et al., 2009) and the high share of income spent on goods which are not necessities, such as low-calorie foods, alcohol, and cigarettes (Banerjee and Duflo, 2007). Moreover, high rates of return are observed not just for the ultra-poor, but also for some people who are not near that absolute consumption floor, for example, shopkeepers in Sri Lanka or Kenya.

households face a high implicit tax on the return on capital, for example, due to predation by corrupt government officials, or due to redistributive pressures from extended family members.

Allowing for realistic levels of such distortions, it is difficult to reconcile the data with standard calibrated values for an exponential discount rate. For instance, Jakiela and Ozier (2015) show with a lab-in-the-field experiment that women (but not men) face a "kin tax" of 4% when making an observable investment, which would not dramatically change the above calibration. Moreover, their experiment also includes men for whom the authors do not find such kin taxes. Further, marginally increasing inventories for a shopkeeper or marginally increasing fertilizer use by a farmer would not easily be observable either by the state or by kin outside the nuclear family, and as such would not be subject to such a tax. Finally, "taxes" by kin or other social groups are not pure taxes but would likely generate either some reciprocal obligations from those receiving the transfers or some utility benefits to the household making the transfers. It thus seems difficult to believe that such taxes would fully resolve the puzzle.[4]

It is worth noting that the same households who hold high-interest debt often hold low-return assets. For instance, Collins et al. (2009) report that every household they survey has both low-interest savings and high-interest debt at the same time. Anagol et al. (2017) estimate that cows and buffaloes earn large negative returns in India, and yet are owned by 45% of rural households. Similarly, the shopkeepers in Kremer et al. (2013) who leave unexploited inventory-investment returns of over 100% per year simultaneously deposit money in savings accounts returning a few percentage points. As discussed below, one interpretation might be that people hold these low return assets to diversify risk, while another is that they are seeking to manage liquidity.

Poverty traps. Could a non-concave production function help square such high rates of return with the lack of dramatic growth in consumption? Under the usual concave production function, poor households will have higher returns to investment, will accumulate wealth, and thus converge to richer households. With an S-shaped production function that is convex for low levels of capital and then concave at higher levels, there may instead be multiple steady states. Which of these steady states a household converges to may depend on its initial capital stock, and the long-run distribution of wealth may depend on the initial distribution. Such a model can feature poverty traps: households that fall below a certain threshold may be stuck at low levels of returns and be unable to accumulate wealth. In general, there is limited ev-

[4] A given percentage informal "tax" leveled by extended family could potentially be more distortionary if it was levied on capital itself rather than simply on capital income, especially if they were particularly high for certain types of investment, for example, on more observable capital goods, but in general there is no reason to assume that informal taxation systems would be more distortionary than formal taxation systems used in developed countries, and in any case, even a 4% tax on capital would not be a big deterrent if gross returns were on the order of 150%.

idence that such poverty traps are widespread, but they are likely to be present in at least some situations (Kraay and McKenzie, 2014; Bandiera et al., 2017).[5]

Yet even in models with poverty traps and non-concave production functions, the observed initial conditions still need to be consistent with the model. An S-shaped production function allows for a steady state with a low rate of return (at either low or high wealth), but it nevertheless also implies that individuals who face a high marginal rate of return to investment should exhibit fast consumption growth. Thus, even under a model with a non-concave production function, one would not observe households with high marginal returns and low growth. Even the presence of assets with increasing returns would not explain high returns to divisible fertilizer investments for farmers or inventory for shopkeepers or fruit sellers.

Lumpy investments with high rates of return can remain unexploited in the presence of credit constraints. Thus, households might not be able to purchase an asset, like a cow, even if it generated a high return. However, even lumpy investments with credit constraints are not a sufficient condition for unexploited high returns. For example, consider a household that has a discount factor of 0.96, a non-lumpy liquid investment opportunity offering a 10% return and a lumpy investment opportunity yielding a 50% rate of return on a discrete investment. The households would initially save in the liquid non-lumpy investment and then reallocate assets to the lumpy investment once a sufficient amount was accumulated. Even with a zero rate of return on the non-lumpy investment, the household would save up for the lumpy investment unless it required a very large investment.

Moreover, even if certain physical assets are lumpy, the financial returns to investment could potentially be smoothed with appropriate financial products, informal institutions, or government programs. Lumpy investments could be exploited using mechanisms such as ROSCAs, borrowing and lending contracts, or government programs that would either simply transfer resources to individuals stuck in poverty traps or would lend them resources and then use the power of the state to collect repayments. Lotteries and ROSCAs are indeed very popular, suggesting that there are ways to address potential non-concavities in the production function, but they do not seem to enable the rates of consumption growth one would expect with a gross rate of return to capital of 150% or more.

In any case, one should not observe high returns to non-lumpy investments without rapid consumption growth. Yet, research has documented high returns to fertilizer (Duflo et al., 2008) and to small increases in working capital for small firms (Beaman et al., 2014; Kremer et al., 2013). Moreover, extending credit to poor households does not result in transformative effects (Banerjee et al., 2015a; Meager, 2019). Credit constraints cannot in themselves explain high rates of return.

[5] One rarely observes multi-modal distributions of income; there is little evidence that temporary positive shocks lead to sustained increases in income over time; and unconditional transfers such as Give Directly and the Georgia land lottery did not provide evidence of poverty traps (Haushofer and Shapiro, 2016; Bleakley and Ferrie, 2016).

Stochastic returns and risk aversion. If returns are stochastic, risk aversion might deter individuals from making investments, even if expected returns exceed the discount rate. Can we explain the Euler equation puzzle with stochastic income and risk aversion? Suppose, for example, income in period t is:

$$Y_{it} = Y_0 + \varepsilon_t + \sum_{i=1}^{n} \mu_{it} f_i(K_{it}) \tag{2}$$

where there are n assets or capital goods and capital goods i has stochastic return μ_{it} in period t with an arbitrary pattern of correlation. In this setting, the stochastic Euler equation is:

$$u'(C_t) = \delta E_t\left[\mu_{it} f_i'(K_{it}) u'(C_{t+1})\right], \quad i = 1, 2, \ldots, n \tag{3}$$

Given an initial capital stock, risk aversion will decrease investment in assets that co-vary positively with consumption and increase investment in assets that co-vary negatively with consumption. In this framework, it will be optimal for risk-averse households to build a buffer stock of low-risk savings that they can draw upon when they experience negative shocks (Deaton, 1991; Carroll, 1997). In the ergodic distribution, few people will have a low buffer stock. Keeping a high buffer stock will allow most people to smooth consumption, so that consumption will be largely insensitive to high-frequency income shocks or predictable changes in income. It follows, for example, that most market traders in the ergodic distribution should be willing to invest in working capital and most farmers should be willing to invest in fertilizer.

All but those who recently experienced a string of negative shocks would have a sufficient buffer stock of relatively safe assets to allow them to invest in assets like fertilizer. Even if the returns to fertilizer investment in a season are highly correlated with harvest during that season, for example, because they depend on rainfall during the season, they should only be modestly correlated with lifetime income and thus consumption. Therefore, risk aversion should only modestly reduce investment, and cannot fully explain the Euler equation puzzle.

In fact, however, liquid buffer stocks are typically modest (Deaton, 1989). While consumption is smoother than income, it does still co-vary substantially with income shocks (Townsend, 1995; Collins et al., 2009). For instance, Jalan and Ravallion (1999) estimate that the pass-through of income shocks to consumption is 40% among the poorest decile of households in rural China. Kazianga and Udry (2006), studying a period of severe drought in Burkina Faso, find little evidence of consumption smoothing.

Moreover, consumption varies not just with shocks to income, but also with predictable variation in income, contrary to models with patient consumers. Both food and non-food consumption have been documented to vary seasonally with the harvest cycle: consumption is lower before harvest in the lean season, and higher after harvest, when farmers are cash rich (Mani et al., 2013; Kaminski et al., 2014; Basu and Wong, 2015). While some of this variation can be explained by seasonal price

fluctuations and lack of storage opportunities, consumption varies across the pay cycle also among the poor in rich countries, where markets are thick and food prices do not show similar fluctuations. For instance, Shapiro (2005) shows that caloric intake declines by 10–15% over the course of a month after delivery of food stamps. Stephens (2003) similarly shows that social security recipients in the United States fail to smooth consumption between checks.

A related finding is that investment decisions of farmers are affected by the timing of predictable variation in prices and expenditures. For instance, Burke et al. (2018) show that farmers fail to exploit arbitrage opportunities created by seasonal price variation in local grain markets. That is, they sell when prices are low, and buy for personal consumption when prices are high in the lean season. Providing access to credit reduces this failure to arbitrage and generates returns on investment of 29%. The question, however, is why farmers are not able to build up liquid buffer stocks to exploit this investment opportunity themselves, even in the absence of credit markets.

One could further enrich the model, for example, by allowing for illiquid investments. Households might indeed be more reluctant to invest in fertilizer or inventories if they might be subject to income shocks and thus require liquidity before the payoff on those investments was realized. However, the same basic approach of building up a buffer stock, for example, of cash or grain or other relatively liquid assets such as jewelry or livestock that could be sold in bad times could help address this problem.

In summary, we have argued that the high rates of return without rapid consumption growth, evident in many parts of the developing world, pose a puzzle that cannot be explained by the standard neoclassical model, non-concave production functions or risk aversion. We now discuss theories from behavioral economics that may shed light on this puzzle.

2.2 Present bias

Modest rates of consumption growth can be reconciled with high rates of return to capital if discount rates are high. For example, if the discount rate is approximately the same magnitude as the net return to capital, then one would not expect much consumption growth. High constant discount rates on the order of 50% per year, however, would generate implausible predictions for individuals' willingness to make long-run investments: people would not give up one dollar today for one billion dollars in 30 years. With such a high discount rate that was constant over different time horizons, no one would hold on to land or get an education.

A discounting model involving a high, constant discount rate makes unrealistic predictions because the model only has one parameter to fit two different empirical regularities: a high degree of impatience in the short run (to match high short-run rates of return and borrowing rates) and a relatively high degree of patience in the long run (to match relatively low longer-run returns to investments in land or education). Since the constant discounting model assumes that the short-run and long-run discounting parameters are the same, it cannot match both moments at the same time (Frederick et al., 2002).

Laibson's (1997) model of quasi-hyperbolic discounting posits that individuals discount all future periods by a present bias parameter β relative to the immediate present.[6] Discounting between all future periods follows the standard exponential model. Having a present-bias parameter β in addition to the exponential parameter δ allows this model to resolve some of the puzzles described above. The recent literature in behavioral economics provides structural estimates of β ranging from about 0.7 to 0.9 on average across studies, although with substantial individual heterogeneity.[7]

How can present bias be incorporated into the Euler equation we discussed above, and can plausible values of present bias help resolve the Euler equation puzzle? Harris and Laibson (2001) derive a hyperbolic Euler equation incorporating present bias:

$$u'(C_t) = f'(K_t)\left[\beta\delta C'(x_{t+1}) + \delta\left(1 - C'(x_{t+1})\right)\right]u'(C_{t+1}), \tag{4}$$

where $C'(x_{t+1}) = \frac{dC_{t+1}}{dx_{t+1}}$ is the marginal propensity to consume out of liquid assets.

Comparing the standard Euler equation in Eq. (1) to this hyperbolic Euler equation reveals that the standard exponential discount factor δ is replaced by an effective discount factor $[\beta\delta C'(x_{t+1}) + \delta(1 - C'(x_{t+1}))]$. This effective discount factor is a weighted average of the short-run discount factor $\beta\delta$ and the long-run exponential discount factor δ. Crucially, the weights are given by the (anticipated) marginal propensity to consume (MPC) out of cash on hand in period $t + 1$. If an individual expects high MPC in the next period (for example, if she expects low cash-on-hand), then her effective discount factor will be closer to $\beta\delta$, and she will appear impatient. In contrast, if an individual expects a low MPC in the next period (if she expects high cash-on-hand), then her effective discount factor will be closer to δ and she will appear patient.

Given that households in developing countries typically have low cash-on-hand and a high MPC, present bias might make them appear particularly impatient, even if they have the same time preferences as richer individuals (Dean and Sautmann, 2018; Cassidy, 2018). If the household expects to be liquidity-constrained in the next period, with an MPC out of liquid assets approaching 1, their effective discount factor, with $\beta = 0.8$ and $\delta = 0.95$, will be 0.76, compared to 0.95 for an exponential agent. Thus, incorporating present bias goes some way towards resolving the Euler equation puzzle posed above, although it does not eliminate it altogether. (As discussed below, naïveté can greatly increase the welfare cost of present bias.)

While heterogeneity in cash-on-hand and MPC themselves generate variation in patience in a present-bias model, there is reason to believe that there also exists sub-

[6] In this chapter, we discuss time preferences and self-control problems through the lens of the present-bias model, which has emerged as a workhorse model in this literature. However, numerous other models of limited self-control and intertemporal choice exist, some of which make similar (or even identical) predictions in the problems we consider. We refer readers to Ericson and Laibson (2018) in this handbook for a broader perspective on this literature.

[7] On estimation of time preferences, see Ericson and Laibson (2018) in this volume and Cohen et al. (2016) for details as well as a brief discussion further below in this section.

stantial heterogeneity in present bias itself. Augenblick and Rabin (2018) estimate that 78% of individuals are present biased, with the rest either acting as exponential discounters or even exhibiting future bias.[8] The mean estimate of β in their sample is 0.79, with a standard deviation across individuals of 0.29. The extent to which observed heterogeneity in the returns to capital or unexploited investment opportunities can be explained by heterogeneity in discount factors is an open question for future research.

The quasi-hyperbolic model can explain another important set of facts about the poor: low levels of precautionary savings in liquid form, and high covariance of income and consumption. Under standard lifecycle models, individuals will save up substantial buffer stocks of liquid savings. They will thus be able to self-insure against shocks, and income and consumption will not co-vary much. In contrast, present-biased agents will have low levels of liquid savings (e.g. Angeletos et al., 2001). When such agents are hit with shocks, their lack of buffer-stock savings implies that they will be unable to self-insure, and consumption will thus co-vary substantially with transitory income shocks.[9] In fact, consumption will also vary with perfectly predictable changes in income, as is the case with farmers over the harvest cycle. Standard lifecycle models typically cannot explain the sensitivity of consumption to predictable falls in income, even in the absence of credit markets (Jappelli and Pistaferri, 2010). Note also that these endogenous liquidity constraints generate the high MPC discussed above, which causes present-biased agents to appear impatient.

In contrast to their failure to build up liquid savings, sophisticated present-biased agents may build up substantial *illiquid* assets since they correctly forecast their future self-control problems (Angeletos et al., 2001). Such individuals may invest in education or hold on to land, rather than selling it, since land and human capital are both illiquid assets that provide valued protection against over-consuming. Thus, these agents will be willing to save up even in low-return illiquid assets (such as land or, to a lesser extent, jewelry and cattle), which may partly explain why households do not appear to equate marginal returns across assets.

In the case of completely naïve present-biased agents, who think they will be exponential discounters without self-control problems beginning tomorrow, illiquid assets will only be accumulated if they are perceived to be attractive, high-return investments. Apart from this feature, the level of naïveté or sophistication has been found to matter relatively little for quantitative predictions about savings and consumption paths in lifecycle consumption models (Beshears et al., 2015).[10,11]

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[8] Some of this estimated variation might be estimation noise.

[9] Karlan et al. (2014a) find that providing rainfall insurance increases agricultural investment and leads to riskier investment choices in Ghana. Present bias can explain why farmers did not self-insure by saving, despite substantial demand for insurance.

[10] In the case of the naïve hyperbolic Euler equation, the MPC term will be replaced by the agents (incorrectly) perceived MPC in the next period.

[11] As shown by O'Donoghue and Rabin (1999, 2001), the level of sophistication theoretically matters a great deal for procrastination and the demand for commitment. We will discuss this in detail in Section 3,

Given that present-biased agents are (endogenously) effectively liquidity constrained, how does providing access to credit affect their behaviors and welfare? Angeletos et al. (2001) show that present-biased agents will frequently use revolving credit. They will do so not just in response to shocks, but also to fund instant gratification, and for entirely predictable expenditure events. While the use of credit to smooth shocks enhances welfare, present-biased agents may be harmed by access to credit to fuel consumption binges.

Self-control and poverty traps. Banerjee and Mullainathan (2010) investigate the possibility that self-control (or, alternatively, time preferences) may depend on people's income. Specifically, their model introduces the possibility that specific goods such as sugar, fat, and alcohol are temptation goods. Such goods that are valued in the moment, but one does not want the future self to consume. The authors focus on the implications of assuming "declining temptations", i.e. that the fraction of the marginal dollar spent on temptation goods decreases with overall consumption. For instance, one can only eat so many donuts or so much ice cream, or drink so much alcohol or cups of chai on any given day. This model creates several novel and important predictions, including the possibility of temptation-based poverty traps. However, little existing empirical work provides rigorous tests of this model's assumptions and predictions. Experiments testing them—especially the ones that deviate from other models of discounting—would be valuable.

Measuring time preferences. Development economists are often interested in measuring time preferences, including present bias, using surveys or lab experiments in the field. Such measures have been used for parameter identification (Mahajan and Tarozzi, 2011), to test mechanisms by estimating heterogeneous treatment effects (Ashraf et al., 2006), or as outcome measures responding to some treatment themselves (Alan and Ertac, 2018). In principle, time preferences should be measured by identifying indifference points between units of utility in different time periods. For instance, a present-biased individual may be indifferent between 1 util today and 1.3 utils tomorrow and indifferent between 1 util in 300 days and 1.001 utils in 301 days. In practice, time preferences are difficult to measure, and the literature has not converged on a broadly accepted and easily implementable approach. Cohen et al. (2016) as well as Ericson and Laibson (2018) in this volume provide for thoughtful discussions.

The most common approach in the literature is to provide choices between monetary payments earlier or later in time. This approach has many benefits, including that it is relatively easy to implement using off-the-shelf experimental protocols (e.g. Andersen et al., 2008; Andreoni and Sprenger, 2012), and that choices elicited in this way have been shown to correlate, albeit weakly, with real-world behaviors such as exercise and smoking (Chabris et al., 2008), credit scores (Meier and Sprenger, 2011), income (Tanaka et al., 2010), and procrastination (Reuben et al., 2015).

in the context of preventive health behavior, another example of apparently under-exploited high-return investments.

This widely popular approach rests on shaky theoretical foundations. Cubitt and Read (2007), for instance, show that choices over money payments at different time horizons need not reveal anything about time preferences since individuals' marginal propensity to consume from such payments will likely deviate from one. Optimizing individuals should smooth consumption over their lifecycle. Thus, receiving $100 today (say, in experimental payouts) may only increase consumption today by pennies. Even with reasonable liquidity constraints, one would expect consumption to be smoothed over weeks or more, whereas present bias is thought to operate over a shorter time horizon of hours or days (e.g. McClure et al., 2007; Augenblick, 2018). Indeed, choices over money earlier or later may reveal more about effective interest rates faced by individuals, or about their time-varying liquidity and financial shocks, even among the poor in developing countries (Dean and Sautmann, 2018; Cassidy, 2018).

A promising recent alternative approach to measuring time preferences is to offer participants choices between actual consumption events or effort. For example, McClure et al. (2007) offer sips of juice to thirsty individuals, while Augenblick et al. (2015) ask participants to choose between different amounts of tedious work on different dates. This approach offers some distinct advantages, since the participant cannot as easily smooth away the (dis)utility associated with these tasks. Perhaps for this reason, present bias is more evident in tasks using such real rewards. Augenblick et al. (2015) estimate a mean β of 0.9 when using an effort task, compared to $\beta = 0.974$, much closer to exponential discounting, when using monetary payments with a parallel design. However, such approaches come with their own challenges, particularly the logistical difficulty of implementation, the practical problems of subject comprehension, and the remaining possibility that consumption or effort outside the experiment adjusts in response to consumption in the experiment.

Where does this leave development economists who would like to measure time preferences or present bias using surveys or experiments in the field? Unfortunately, there are no easy answers. If measuring time preferences is central to the research, implementing a real-effort task as in Augenblick et al. (2015) or Augenblick (2018) may be the best option. If not, utilizing a money-earlier-or-later task may still provide some signal of patience over monetary payments, even if it does not cleanly isolate time preferences.

Recent evidence suggests that hypothetical and incentivized choices over money provide fairly similar results (Ubfal, 2016; Madden et al., 2004; Falk et al., 2016), making hypothetical choices over money an even lower-cost approach. However, hypothetical choices over money may still fail to pin down present bias precisely for the reasons described above in the discussion of the incentivized cases. These questions may be supplemented with qualitative survey questions on self-assessed willingness to wait for larger rewards, as in Falk et al. (2018).[12]

[12] The Global Preference Survey of Falk et al. (2018) is worth highlighting here. The authors provide an accessible dataset of unincentivized survey measures of risk, time and social preferences from 80,000

2.3 Reference-dependent preferences

A large body of evidence in psychology and economics suggests that individuals evaluate and experience outcomes—such as consumption, wages, investment returns, or hours worked—not in terms of absolute levels, but relative to reference points (Markowitz, 1952; Kahneman and Tversky, 1979). Moreover, losses relative to that reference point loom larger than gains, a phenomenon termed loss aversion. Lab and field estimates provide estimates of loss aversion in the range of $\lambda = 2 - 2.5$, meaning that a loss of \$1 is weighted on average as much as a gain of \$2 to \$2.5.[13] We will now consider whether reference-dependence and particularly loss aversion can explain aspects of the Euler equation puzzle described above.

The first empirical fact motivating the Euler equation puzzle is the high estimated rate of return on a variety of investments among many small firms. A different way to frame this fact is that numerous high-return investments appear to be left unexploited at equilibrium. Loss aversion may help explain this fact, at least in part. The intuition is that high-return investments invariably involve some possibility of losses relative to forgoing the investment; loss aversion will make such investments less attractive. More generally, loss aversion can explain substantial risk aversion over small to moderate stakes, contrary to standard expected utility models.

Why turn to loss aversion to understand risk aversion over modest stakes, when the textbook already provides diminishing marginal utility of wealth as an explanation? The reason is that expected utility cannot explain small-to-moderate stakes risk aversion without implying nonsensically high levels of risk aversion over large stakes, a point eloquently made by Rabin (2000). Experiments show that many individuals will reject a gamble with equal chances of gaining \$2 or losing \$1, or of gaining \$200 or losing \$100. Rabin shows that being indifferent to such a gamble (at any wealth level) due to diminishing marginal utility of wealth would require such rapidly diminishing marginal utility of wealth that such an individual would reject a gamble with a 50% chance of a \$4 loss and a 50% chance of *any* level of gain (O'Donoghue and Sprenger, 2018). In contrast, a person with a loss aversion parameter $\lambda = 2$ would be indifferent to a gamble with a 50–50 chance of losing \$1 and winning \$2 but, much more reasonably, would accept a bet with a 50–50 chance of losing \$4 and winning \$10. Loss aversion can thus explain the rejection of positive expected-value gambles at small or moderate stakes. Expected-utility maximizers, in contrast, should be approximately risk-neutral over small stakes.

Consider the example of low take-up of fertilizer in Kenya, which was estimated by Duflo et al. (2008) to have an average return of just over 50%. Suppose a unit of fertilizer costs \$2, and its use increases output by \$6 with 50% probability and has no

individuals in 76 countries. Their measure of patience is a function of both answers to quantitative money earlier or later questions, as well as a qualitative self-assessment of patience. In a paper exploiting these data, Dohmen et al. (2018) document a positive correlation between patience and income, both within and across countries.

[13] O'Donoghue and Sprenger (2018) in the first volume of this handbook provide a detailed discussion of reference dependence.

effect with 50% probability. Then, the expected return of fertilizer is 50%. Given the relatively small stakes, an expected-utility agent would be approximately risk neutral, and would make the investment, since the expected value is $0.5 \cdot (\$6 - \$2) + 0.5 \cdot (-\$2) = +\$1$. In contrast, a loss-averse agent with $\lambda = 2.5$ who narrowly brackets returns for this investment would not invest, since $0.5 \cdot (\$6 - \$2) + \lambda \cdot 0.5 \cdot (-\$2) = -\$0.5$.

Despite the clear intuition for how loss aversion could cause individuals to forgo high-return investments, we have relatively limited field evidence of the importance of loss aversion in developing countries. Kremer et al. (2013) provide correlational evidence: shopkeepers in Kenya who exhibit greater small-stakes risk aversion in experimental tasks (presumably due to loss aversion) also maintain lower inventories, thus forgoing bulk-purchase discounts and increasing the probability of creating stock-outs.

Carney et al. (2018) provide field-experimental evidence on loss aversion, credit and technology adoption among dairy farmers in Kenya. The authors study the demand for collateralized loans to fund the purchase of durable assets (both domestic and productive assets). They show that the endowment effect—a canonical implication of loss aversion—causes borrowers to dislike taking loans in which the collateral is an asset they already own, since already-owned assets (such as land, jewelry, or cattle) are already in the borrower's reference point. The prospect of losing such assets in case of loan default (say, due to a negative income shock) makes such loans unattractive. In contrast, the authors show that loans collateralized using the new asset being financed by the loan itself, as in mortgages or car loans, are more attractive to borrowers, since the new asset is not yet in the reference point at the time of loan take-up, and borrowers do not anticipate experiencing as great a sense of loss in case of default.

To isolate this effect, the experimenters endow potential borrowers with a randomly-selected durable asset. A week later, individuals are offered a loan to finance the purchase of a second randomly-selected asset, varying whether the collateral required is the endowed asset, or the new asset itself. The authors find that borrowers are willing to pay approximately 9 percentage points per month higher interest rates to collateralize using the new asset. Interestingly, the same-asset collateralized loans do not result in higher default rates, despite the higher take-up. This suggests that, after taking possession of the new asset, borrowers' reference points update such that they come to develop a comparable endowment effect over their new asset, even before it is paid off. Crucially, individuals systematically under-estimate their future endowment effect before possessing an asset, an example of naïveté or projection bias.

Carney et al. illustrate a general theme of this chapter, the interaction between universal behavioral phenomena and institutions that differ across societies. To the extent that people are reluctant to use goods they already own as collateral, creditors operating in markets with institutions that make it easy to repossess collateral will simply ask them to collateralize loans with the new items they are buying with the loan. On the other hand, where the institutional environment is weak enough that

it's hard to collect certain types of collateral, lenders may accept only the easiest to collect forms of collateral.

For example, in the environment studied by Carney et al., the financial institution making the loans, like most of its type, normally required that one-third of each loan be collateralized with the borrower's own deposits held in the financial institution, and the remaining two-thirds be guaranteed by deposits by co-signers. Work by Jack et al. (2016), suggests that substituting the ability to collateralize loans with newly purchased assets, rather than with deposits in the financial institution, increased take-up of loans for rainwater harvesting tanks used by dairy farmers from 2.4% to 44%. This is thus an example of how in the context of developing country institutions, loss aversion may prevent individuals from undertaking potentially high return investments, since financing these investments requires putting existing assets at risk.

The above discussion is all based on either static decisions, or on models with limited dynamics. Unlike the literature on present bias, we only have a limited understanding of the implications of reference-dependence in life-cycle models. One exception is Pagel (2017) who studies life-cycle consumption with expectations-based reference dependence. We conjecture that dynamic models with reference dependence may yield more reasonable dynamic predictions, with a fair amount of stickiness in asset levels, but without the dramatically different dynamic behavior around a threshold asset level than poverty trap models.

Loss aversion is less directly helpful in understanding the second empirical fact underlying the Euler equation puzzle: borrowing at high interest rates without a corresponding increase in consumption over time. One way in which loss aversion may increase demand for credit is if credit is used to insure against consumption losses or losses of assets in case of negative income shocks. Of course, the question remains why individuals are not able to self-insure by building up liquid buffer stocks, which could be due to present bias as described in the previous subsection.

Narrow bracketing. The effects of loss aversion on choices involving risk are particularly likely to be important when individuals engage in narrow bracketing. Narrow bracketing refers to an individual considering each choice or source of uncertainty they face in isolation, failing to integrate it with other choices and risk from other sources (Tversky and Kahneman, 1981). Narrow bracketing is implicitly assumed in a range of economic models and analyses. It has bite in the case of loss aversion, due to the importance of the sharp kink in the utility function at the reference point, which would effectively be smoothed out if individuals were considering many sources of uncertainty simultaneously.

Narrow bracketing can also reduce dynamic problems to repeated static problems if individuals bracket, for instance, daily income or annual stock-performance. Bracketing also helps explain the so-called Samuelson bet problem: an individual may turn down a single 50–50 gamble of losing $100 or gaining $120 but would be willing to accept a hundred such gambles if offered together (Haigh and List, 2005; Bellemare et al., 2005). Such choices are not compatible with expected utility but are easily explained by the decision-maker bracketing the bets more broadly when a hundred bets are presented together.

Lab evidence suggests narrow bracketing is in fact common and leads individuals to make first-order stochastically dominated choices (Tversky and Kahneman, 1981; Rabin and Weizsäcker, 2009). Field evidence on reference-dependence also presents cases of narrow bracketing, from taxi drivers bracketing daily labor supply and earnings (Camerer et al., 1997; Crawford and Meng, 2011; Thakral and Tô, 2018) to investors bracketing realized financial gains or losses from each asset (Barberis and Xiong, 2012). Many open research questions remain in this area, including determining in which cases individuals narrowly bracket, how these brackets are formed, whether individuals can be taught to bracket more broadly, and whether such interventions translate into reduced risk aversion in investment decisions in the field.

Narrow bracketing may be particularly relevant in developing countries. Many households run small firms and face a host of potentially risky decisions. For example, a shopkeeper might have to make decisions of how much inventory to buy on each of many different products and in each case if they are loss averse, they might be concerned about the potential that some of the types of goods might go unsold, creating a loss. A farmer makes decisions every growing season about whether to use each of several different agricultural inputs, as well as whether to invest in livestock, farm equipment such as irrigation pumps, etc. If the manager of a shop or a farm treats each of these decisions in isolation, they may wind up turning down gambles that are very attractive. Loss aversion combined with narrow bracketing could help explain the high unrealized rate of return on additional inventory investment in Kremer et al. (2013).

Reference-point formation. Models of reference-dependence come with an important degree of freedom: the assumption about what constitutes the reference point. The literature has taken different approaches to selecting the relevant reference point: the status-quo level of wealth or assets (e.g. Kahneman and Tversky, 1979) and rational expectations of consumption (Kőszegi and Rabin, 2006, 2009) are the most common. Other papers have chosen different reference points, such as the average of lagged outcomes (DellaVigna et al., 2017) or salient targets such as round-number finishing times among marathon runners (Allen et al., 2016).

Different assumptions about reference-point formation can generate important differences in predicted behavior. Assuming a status quo reference point can predict staying in place, and sticky asset allocations, as well as a high degree of local risk aversion. With expectations-based reference points, multiple equilibria are possible (Kőszegi and Rabin, 2006, 2009). If people have a stochastic reference point (and are already anticipating uncertainty in outcomes), they will often be somewhat more willing to take risks. We conjecture that both types of reference points are relevant and important in different contexts. When people face decisions that they have much experience with (e.g. planting usual crops), expectations will likely determine their reference points. In contrast, if they face new choices (e.g. trying new technologies), the status quo may be more likely to determine their reference point. Investigating this question and the formation of reference points more generally remain important areas for future research.

2.4 Other behavioral factors

There is no reason to think that present bias and loss aversion are the only behavioral factors affecting individuals' consumption and investment choices over time. As we discussed above, quantitative estimates of present bias can explain why high-return investments are not exploited, but not failure to exploit very high return investments. Biased beliefs, in particular, naïveté about present bias, can dramatically distort behavior, as discussed in Section 3. Similarly, narrow bracketing can dramatically increase the consequences of loss aversion.

Other behavioral concepts might also help explain some of the facts described above. We will not discuss these in detail here but refer to the remaining sections of this chapter. For instance, pessimistic beliefs about the returns to various investments may provide an explanation for why high-return investments remain unexploited. Beliefs may be biased due to inattention, as argued for the case of the seaweed farmers by Hanna et al. (2014), as discussed in Section 6.

Moreover, beliefs may be biased due to failures of social learning, as discussed in Section 6.3 (Eyster and Rabin, 2014). Entrepreneurs and CEOs in rich countries are thought to display overconfidence (e.g. Malmendier and Tate, 2005), but we have little evidence on whether owners of small businesses in poor countries do the same. Indeed, it is possible that the poor display under-confidence and low self-efficacy (McKelway, 2018). Individuals may also feel shame or stigma from asking others for information (e.g. Chandrasekhar et al., 2018), or may dislike standing out from others and risking public failure by attempting to adopt a new technology or acquire new skills.

All the above factors might interact in important ways. Present-biased individuals might also have biased beliefs, possibly precisely because present bias prevents them from engaging in costly information-acquisition and correcting their beliefs.

3 Health

Low investment in preventative health is one specific case of apparently underinvestment in high-return opportunities.[14] The neoclassical model has difficulties explaining such behavior, especially when paired with the high sensitivity of this investment to price and convenience. We argue that present bias combined with at least partial naïveté can help explain some cases of low investment in preventive health due to procrastination and liquidity constraints. However, other cases remain unexplained by present bias alone. We argue that biased beliefs could play an important role in explaining other cases of low investment.

[14] Behavioral economists have also studied other aspects of health economics, such as health insurance. We do not cover those topics here, in part due to less evidence on those topics from poor countries, and refer readers instead to the chapter by Chandra et al. (2018) in this handbook.

3.1 Underinvestment in preventive health

The recent literature has established several stylized facts regarding health behavior in developing countries. These have been extensively discussed in recent reviews by Dupas (2011a), Kremer and Glennerster (2011), Dupas and Miguel (2017). After briefly summarizing some of these facts, we explore the extent to which potential behavioral explanations can help explain them.

Health is both a consumption and an investment good. It influences people's utility directly, but also impacts their productivity and ability to generate income in the near and distant future. Medical advances made over the past century have greatly expanded the ability to treat infectious disease and have dramatically decreased the costs of doing so. Today, many highly effective life-saving technologies that prevent and treat disease, such as insecticide-treated bed nets, deworming pills, and chlorine treatment for water are available for a few dollars or less.[15] While adoption of these technologies has driven massive health improvements in the developing world, and generated life expectancies much higher than those historically achieved by currently developed countries when they were at similar levels of income, there is still apparent under-adoption of preventive health and treatment for chronic conditions. Take-up rates of many health investments are surprisingly low considering their low costs and immense long-term benefits.

One way to see this is as a special case of the more general problem of under-exploitation of apparently high-return investments highlighted in the section on the Euler equation puzzle. An alternative interpretation could be that people have a low value of health, but demand for treatment (rather than prevention) of health conditions seems much higher (e.g. Cohen et al., 2015) and this is inconsistent with that alternative interpretation. Indeed, there is considerable evidence of relatively ineffective health expenditure (e.g. Das and Hammer, 2007). In fact, Banerjee et al. (2015a) and Dupas and Robinson (2013b) find that out-of-pocket health expenditure among Indian slum dwellers and rural Kenyan households comprises about 10% and 8% of total household expenditure, respectively. While the data are not broken down into acute and preventive spending in their studies, it is unlikely that these households are spending these sums on cheap prevention products.

Low willingness-to-pay for preventive health. Fig. 1, taken from Dupas and Miguel's review chapter on field experiments in health, illustrates this point. In different demand experiments offering individuals in developing countries health-investment goods, a significant fraction of individuals decided not to purchase the goods, even at low prices well within the budget constraint of most poor households. Such choices are remarkable given that the large expected future benefits of these health goods exceeded the investment costs, sometimes by orders of magnitude.

[15] Taking deworming pills is not prevention but treatment. However, from a behavioral perspective, treatment for chronic conditions is more similar to prevention than acute care: (1) acute conditions are salient, but the worm load builds up over time and people don't see a sudden worsening of health; (2) there is a short-run disutility of taking deworming medicine as the worms are expelled. Any nutritional or other gains take place over time.

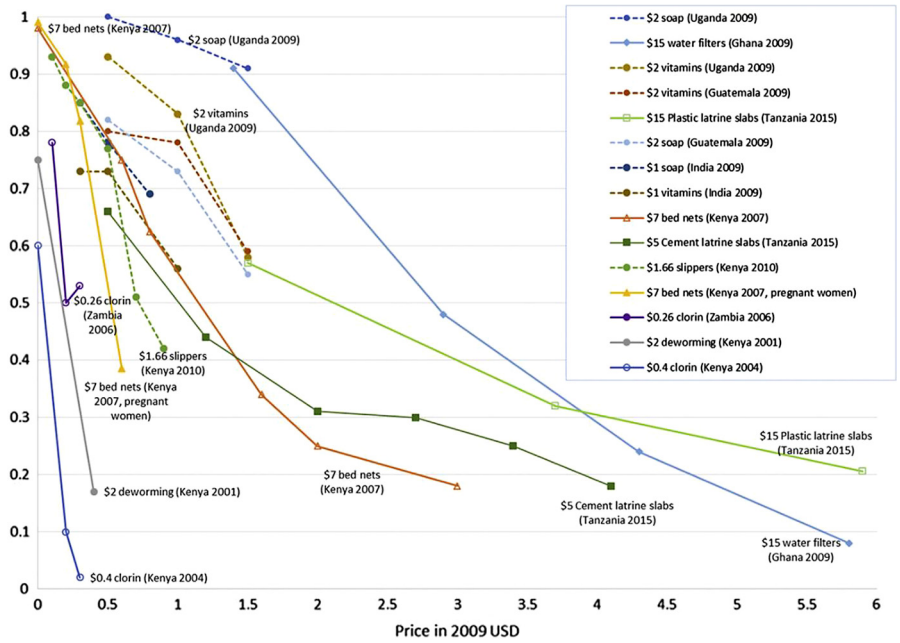

FIGURE 1

Demand for preventative health products. The y-axis plots the share of individuals or households taking up the product.

From Dupas and Miguel (2017).

For example, deworming has a large impact on a variety of outcomes, including future school attendance, work hours, and education, with an estimated private NPV financial benefit of deworming of $142 (Baird et al., 2016). However, only 18% of parents purchased medication when they had to pay a small fee of about $1 (Kremer and Miguel, 2007). Similarly, Berry et al. (2018) find that individuals' willingness to pay for clean water technology is less than 15% of production costs. Kremer et al. (2011) show that households in Kenya have low willingness-to-pay for cleaner water, implied through the additional distance they are willing to walk to use an exogenously cleaner water source. Their calculations imply a WTP to avert one disability-adjusted life year of $23, while policy-makers typically apply much higher values.

(Un)healthy behaviors. In addition to investing in their future health via purchasing bed nets, getting immunizations, or deworming, individuals can choose to lead a healthier lifestyle by limiting or avoiding certain behaviors. Such behaviors include eating unhealthy food options (e.g. high intake of fat and sugar), consuming addictive substances such as alcohol and cigarettes, or not sleeping or exercising sufficiently. In both developed and developing countries, significant fractions of the population express a desire to engage in a healthier lifestyle in the future, while hav-

ing difficulties to do so in the present. The health consequences of such behaviors can be severe, and their importance has been strongly on the rise in developing countries (Bloom et al., 2011). Non-communicable diseases such as hypertension, cancer, and, diabetes are the leading cause of death worldwide (Islam et al., 2014; WHO, 2015), yet, until recently, have received less attention by researchers and policymakers compared to acute conditions with similar burdens of disease.

High sensitivity of health investments to price and convenience. In addition to illustrating low levels of demand, Fig. 1 also displays high demand elasticity for preventative health investments. Even small price increases seem to lead to precipitous declines in demand for products such as water treatment (Ashraf et al., 2010), deworming (Kremer and Miguel, 2007), insecticide-treated bed nets (Cohen and Dupas, 2010), and vitamins (Meredith et al., 2013). Take-up of health investments is also sensitive to convenience in some cases. Thornton (2008) finds that whether people pick up HIV test results is very sensitive to relatively small differences in walking distance to obtain results.

A mirror image of these large effects of small price increases is the finding that providing small incentives for healthy choices can have large effects on healthy behaviors and investments among the poor. For instance, providing small, time-limited non-financial incentives for child immunization leads to large increases in immunization (Banerjee et al., 2010), and small, time-limited financial incentives greatly increase the proportion of people who pick up their HIV test results in Malawi (Thornton, 2008).

Lower price-sensitivity for acute care. In contrast to high price-sensitivity for preventive-health products, households appear to have a relatively low price-elasticity for acute care. Cohen et al. (2015) look at price sensitivity for antimalarial treatment. In this study consumers are offered vouchers for subsidized anti-malarials to be redeemed at the closest drug shop. Increasing the price of an antimalarial treatment course for young children by 250 percent, from \$0.30 to \$1.5, does not reduce the share of households buying the treatment (about a third). However, as expected, demand does fall at much higher prices. Only 4 percent of households buy the treatment at \$3.

Knife-edge interpretation. One story might be that people who do not take up preventive health goods perceive large benefits from preventive health investments, but they perceive even higher costs, and hence make a rational decision not to take up the preventive health measures. Thus, for example, they might worry that vaccines carry side effects or have religious objections to vaccination; they might be worried about the unpleasantness associated with expelling worms in response to taking deworming medication; they might find mosquito nets inconvenient and uncomfortable, and they might prefer not to know if they are HIV positive.

It would be difficult to reconcile this type of story with the high sensitivity to price and convenience observed across several different preventive-health items and services, however. In a standard optimizing model, with individuals comparing the (discounted) costs and benefits of the action, observing a large mass of consumers

change their decision in response to a small change in prices has a clear interpretation: a large share of consumers must be very close to indifferent between taking up the health investment or not. Therefore, the small incentive could easily tip the balance between costs and benefits and change their decision. That is, the costs and benefits associated with investing in their health must have been nearly equal, such that they were making decisions balanced on a knife's edge. While possible for a single product, it appears extremely unlikely that this situation would occur for so many different households (at the same price), and across a range of different technologies and settings.

This reasoning suggests that households which do not adopt these preventive behaviors either do not perceive large benefits, or that decisions are not being made in the way conventionally modeled by economists. Of course, some health investments (e.g. vaccination against rare diseases) likely indeed have small private benefits. However, there are also cases of low take-up of health investments with large private benefits. In at least some of these cases, individuals report believing in the effectiveness of health investments (Kremer et al., 2011). A careful investigation of such beliefs, including rigorous ways to address social desirability bias, and potential other explanations for low demand would be a highly valuable contribution to this literature.

3.2 Present bias

Present bias might explain some of the findings described above through two channels.

First, many health behaviors feature tradeoffs either between immediate costs and delayed benefits, or alternatively, immediate gratification and delayed costs. Such behaviors include getting vaccinated, seeing the doctor for a check-up, taking medication, purchasing a bed net, and avoiding potato chips, risky sexual activities, or smoking. Immediate costs often include hassle and psychological costs, for instance, of going to the doctor, walking to a water source farther away than the nearest one, taking medication, or other health-promoting behaviors. Present bias can cause individuals to procrastinate indefinitely on taking such healthy actions, as we explain in detail below. Time-limited incentives and discounts may help reduce procrastination, as can reducing hassle costs and providing individuals with commitment devices.

Second, as discussed in Section 2 above, present bias can generate endogenous liquidity constraints for households. These liquidity constraints may, in turn, cause households to leave high-return investments unexploited, including preventive-health purchases. They may also generate high price-sensitivity in the take-up of such investments.

3.2.1 Procrastination and health behaviors

Many preventive-health behaviors involve a utility cost in the present, paid in return for health benefits in the future. For instance, treating one's water, walking to a farther-but-cleaner water source, getting a vaccination, getting more exercise, improving one's diet, drinking less alcohol all involve utility or hassle costs (as dis-

tinguished from purely financial costs) in the present, with benefits potentially years in the future.

The degree to which present bias hinders the take-up of such behaviors depends crucially on two factors: (a) how sophisticated an individual is about their present bias (O'Donoghue and Rabin, 1999, 2001), and (b) whether the task involves clear deadlines.

Naïveté and sophistication. A naïve, present-biased individual prefers and expects to do a painful but worth-doing task tomorrow but fails to account for the fact that they will also be present-biased then. The naïveté required for present bias is usually thought of as overconfidence about future self-control.[16] Sophistication, on the other hand, makes the individual realize that if they do procrastinate today, they will also likely do so tomorrow, increasing the cost of putting off the difficult task today. In this way, naïveté can greatly amplify the impact of present bias on behavior and lead to large distortions and welfare consequences (O'Donoghue and Rabin, 2001).

To better understand the extent to which present bias can explain low take-up of preventive-health behaviors and the extent to which the explanation depends on naïveté, we distinguish between the following categories of health behaviors:

Case I: Health investments without deadlines

Consider first a health investment good or action without a deadline for take-up. Theory tells us that a sophisticated present-biased individual might delay taking up such an investment good for a few time periods (say, days or weeks) due to present bias. However, she will take up the good eventually, since she will foresee her future present bias and thus avoid lengthy and costly delays. More generally, sophisticates have rational expectations, so they anticipate correctly what they will do it if they wait. For them, delaying from period t to period τ is a single decision to procrastinate. Therefore, small self-control problems cannot cause severe welfare losses in such investment decisions for sophisticates (O'Donoghue and Rabin, 2001).

In contrast, (partially) naïve individuals do not (fully) understand their future self-control problems. Such individuals may think every day that they will incur the cost investing on the following day, and never actually follow through with their plans. Naïveté can compound the impact of self-control problems by inducing individuals to make repeated decisions to procrastinate, each time believing they will do it next period.[17] The welfare costs arising from procrastination can become arbitrarily large since a naïve individual never compares the immediate costs to future benefits. Instead the individual keeps comparing the costs of taking up the good today to the costs of doing so tomorrow, wrongly anticipating that she will take up the good regardless of the choice of doing it immediately (O'Donoghue and Rabin, 2001).

[16] Sometimes, however, this is observationally equivalent to overconfidence about future availability of time, or even overconfidence about not forgetting in the future.

[17] This also holds for partial naïveté. Any degree of naïveté is sufficient to generate procrastination and can cause much more severe welfare losses than complete sophistication.

Many of the lifestyle choices with important health consequences involve habits that could at least in principle be changed every day. On any given day, a smoker or drinker may decide to quit. An individual may start improving their food intake, sleep, or exercising behavior on any day. In such situations, the structure of costs and benefits is the same as for take-up decisions without deadlines. A change in habit often causes short-run costs for a limited time and yields significant benefits in the often-distant future. While the short-run costs of such behavioral change can be substantial (e.g. quitting smoking), they are arguably far outweighed by the long-run benefits in many cases (e.g. avoiding lung cancer). There is typically no enforced deadline that determines when to start changing a habit. As discussed above, while a sophisticated person may delay changing their habits for a few days, present bias cannot lead to large costs caused by the delay for this person. In contrast, a (partially) naïve person may procrastinate for a long time, possibly forever telling themselves that they will start developing virtuous habits soon but never actually following through.

The above discussion highlights the importance of considering naïveté in models of present bias. For instance, if an individual is observed to never get a flu shot despite being well-informed about the benefits and perhaps even displaying some stated intention to do so, they may be procrastinating. If a researcher were to attempt to fit a model of sophisticated present bias to the data, they would conclude that the individual has such pathological levels of present bias, that they simply don't care about the future. If instead they allowed the individual to be naïve about their present bias, plausible values of present bias may be able to fit the data quite well. While evidence of demand for commitment suggest at least some sophistication (Schilbach, 2019; Casaburi and Macchiavello, 2018), the best direct estimates of individuals' sophistication suggest that individuals are largely naïve on average (e.g. Augenblick and Rabin, 2018).

Similarly, it is important to make sensible assumptions about the length of a time period when modeling choices under present bias. A naïve present-biased individual deciding whether to get a flu vaccination today or tomorrow may be tempted to wait until tomorrow, since the expected cost of delay (i.e. the chance that he may get the flu this evening) will be small compared to the lower discounted cost of getting the vaccination tomorrow (which is down-weighted by the present bias factor). The cost of delay might instead appear quite large if the choice is between going now and going next month. The empirical literature suggests that the "present" in present bias is a matter of hours or, at most, a day (Augenblick, 2018). Thus, it will often be appropriate to model daily decision-making, unless the opportunity to take the costly action truly only occurs once a month.

Impact of small incentives. In the absence of other issues, present bias will not lead to large distortions for fully sophisticated present-biased individuals (O'Donoghue and Rabin, 2001). As a result, there is only limited potential for small incentives to alter take-up behavior of sophisticated agents, nor is there much need for them to do so. Small incentives might accelerate take-up by sophisticated present-biased individuals, but they are unlikely to cause large shifts in the extensive margin of demand. In contrast, small but time-limited discounts can have large effects for naïve present-

biased individuals facing costly actions without deadlines. The time limit on these incentives is crucial: on the last day of the incentives (or at some sooner date, in case of uncertainty), the choice is between making the investment today at a lower price or in the future at a higher price. The time limit makes acting immediately more attractive and can thus inhibit procrastination. In contrast, this reasoning does not apply for permanent incentives. Essentially, time-limited discounts provide a deadline, which can help overcome procrastination problems, as we discuss below.

Case II: Health investments involving deadlines (but no or small monetary costs)

Consider next a one-shot decision of an investment good that is otherwise not available. An example could be a one-time visit by an NGO that offers to provide you with deworming pills free-of-cost, or a vaccination camp at a local health clinic where age-sensitive vaccines are provided for free. For realistic parameter values and in the absence of other behavioral biases, present bias cannot explain the lack of take-up of such high-return, time-limited investment goods. Present bias induces individuals to put less weight on future benefits relative to current costs. However, realistic estimates of present bias find values of $\beta \approx 0.7$, which implies a 30% reduction in weight on future periods relative to the present. Even a present-biased individual with $\beta = 0.5$ or $\beta = 0.3$ (on the low end of empirical estimates) would take up the deworming or vaccination for their child (assuming they care about them sufficiently) since the associated benefits outweigh costs by orders of magnitude. This insight does not depend on the level of sophistication about present bias, since individuals do not need to make predictions about their future behavior to make this one-shot decision.

The present bias model similarly has difficulty explaining individuals' lack of take-up of investment behaviors that are available for a longer but still finite time with a clear deadline. Essentially, on the day of the deadline, the individual's choice problem reduces to the one-shot decision as described in the previous paragraph, and the present-biased individual will take up on that day if he has not done so already, regardless of naïveté or sophistication.

The above conclusion is not greatly affected by the presence of shocks to the cost of taking the action on any given day (subject to the deadline), provided the individual has accurate beliefs about the distribution of shocks. For example, on any given day, individuals may find it particularly costly to go to the clinic to get an immunization since they may be busy or unwell. If they are forward-looking and think through the optimal stopping problem, they will have in mind a reservation cost below which they will take the action on each day, with the reservation cost rising over time. Naïve and sophisticated agents may have different reservation costs on any given day, since the naïve agent expects to be more patient in the future. But, again, both will do the task on the last day if not done already, barring an extreme or unlucky shock. The welfare losses from present bias in this case are thus bounded by the cost of delaying until the deadline. Naïve individuals are, however, more likely than sophisticates to delay the task up to the deadline before finally completing it.

If individuals have biased beliefs about the probability of future shocks, even deadlines may not ensure take-up. For instance, suppose individuals have imperfect

memory, with a probability of simply forgetting about the task on any given day. If they are sophisticated about this imperfect memory, they will act similarly to a sophisticated present-biased individual and will not delay for long, since they realize they might forget to do the task in the future. If they instead underestimate their chances of forgetting in the future, they might put off the task until tomorrow, and then forget to complete it despite the deadline.

3.2.2 Low willingness to pay and high price sensitivity

Above, we considered cases in which costly health behavior did not involve substantial monetary costs. We discussed that present bias with naïveté can generate low adoption of healthy behaviors due to procrastination problems, at least in the absence of strict deadlines. However, many health investments involve some monetary cost up front (in addition to any hassle costs), for example, purchasing bed nets, paying for deworming pills, and buying water filters or chlorine tablets. We discuss how present bias can drive down demand for such goods, and cause high price-sensitivity, through the mechanism of liquidity constraints.

However, many health investments involve some monetary cost up front (in addition to any hassle costs). For example, purchasing bed nets when they are offered for sale rather than given away for free, paying for deworming pills, buying water filters or chlorine tablets, etc. Next, we discuss how present bias can drive down demand for such goods, and cause high price-sensitivity, through the mechanism of liquidity constraints.

Case III: Health investments involving significant financial costs (with or without deadlines)

Present bias has been invoked as an explanation for the overall low willingness-to-pay and high demand-elasticity for preventative health goods (Dupas, 2011a; Kremer and Glennerster, 2011). The empirical facts of low WTP and high price-sensitivity are not directly related to the mechanism of procrastination described above. That is, even when a researcher unexpectedly shows up at a household's door and offers a preventive-health good for purchase with a one-time-only offer, demand is low, and price-sensitivity is high, despite no possibility of procrastinating over the purchase. However, present bias may still curb demand by generating liquidity constraints.

Liquidity constraints. Although the related empirical evidence is mixed, liquidity constraints are an often-cited reason for individuals' low demand for health investments (Dupas and Miguel, 2017). Some studies have found that offering preventive health products with a line of credit greatly increases take-up (e.g. Devoto et al., 2012 on piped water connections and Tarozzi et al., 2014 on bed nets). Offering savings technologies such as safe-boxes labeled as being specifically for health savings increased health investments (Dupas and Robinson, 2013b). On the other hand, unconditional cash transfers (Haushofer and Shapiro, 2016) and the ultra-poor graduation program, which may each ease liquidity constraints, did not have detectable effects on health or health expenditures.

While at any given point in time, lack of liquidity may explain why individuals do not invest in their future health, liquidity itself is endogenous. As described in Section 2, risk-averse non-present biased people living in an environment where they are subject to shocks, should build up buffer stocks over time, even if they are initially very poor. However, present-biased individuals will find it difficult to build up substantial buffer stocks and hence will be much more liquidity constrained (Angeletos et al., 2001). As such, evidence of liquidity constraints preventing individuals from making investments in their health can be interpreted as evidence *in favor* of the importance of present bias rather than evidence against it.

Moreover, once an individual is effectively liquidity-constrained, present bias can further reduce their demand for an investment good, since the monetary cost of the investment will reduce immediate consumption more severely in the presence of liquidity constraints (since consumption smoothing is hampered by liquidity constraints). Such a reduction in immediate consumption to finance the health investment will be particularly unattractive to a present-biased agent.

Demand estimation. An important frontier in this area is how to estimate demand for health investments or other goods in the presence of liquidity constraints.[18] Unannounced visits to study participants, offering to sell a good, will not measure long-run demand under liquidity constraints. Several approaches have been pursued. One is to endow people with money first. However, it is unclear how much money is needed in a buffer stock world. In a model in which people are subject to shocks and hold buffer stocks, WTP is likely to rise smoothly with the amount of money that people are given in the experiment. Demand will only level off with a high buffer stock. Separately from this issue, endowing individuals with cash and then offering them items for sale is likely to result in experimenter demand effects. A second approach is to allow individuals time to purchase the good or to allow them to pay with their time (Dupas, 2009). Offering coupons to purchase the good at a local shop may reduce demand effects (Duflo et al., 2018). A third approach is to allow individuals to pay using credit (Devoto et al., 2012).

Present bias and liquidity constraints complicate welfare calculations using willingness-to-pay estimates. Welfare may be underestimated for at least two reasons. First, present-biased individuals are likely to face liquidity constraints, which will lower demand estimates. Second, even in the absence of liquidity constraints, present bias may lower demand estimates for durables and long-run investments if costs are upfront and not smoothed over the lifetime. Of course, behavioral models including more generally some challenges to using revealed preference to infer welfare (Kőszegi and Rabin, 2007; Bernheim and Taubinsky, 2018 in this handbook).

3.2.3 Commitment devices

Demand for commitment devices can provide decisive evidence revealing present bias, or more generally, self-control problems, contributing to certain behaviors.

[18] We refer the reader to Dupas and Miguel (2017) for a detailed discussion of this topic.

Commitment devices are arrangements entered into by an individual with the aim of helping fulfill a plan for future behavior that would otherwise be difficult owing to intrapersonal conflict stemming from, for example, a lack of self-control (Bryan et al., 2010). Demand for such devices is often interpreted as "smoking-gun" evidence of time-inconsistency and self-control problems. It is difficult to rationalize why someone would elect to constrain their future choice set in the absence of time-consistent preferences. Laibson's (1997) model of quasi-hyperbolic preferences features time-inconsistent preferences (induced by present bias) and can thus generate demand for commitment. Alternative models of self-control are equally consistent with demand for commitment (Thaler and Shefrin, 1981; Gul and Pesendorfer, 2001, 2004; Fudenberg and Levine, 2006).

Ashraf et al. (2006) provide a proof of concept that offering commitment devices can cause important changes in behaviors, as discussed in Section 4.1. More recently, development economists have documented demand for commitment to achieve health-related goals. Giné et al. (2010) offered smokers a voluntary commitment product to support their attempts to quit smoking. Eleven percent of individuals who were offered the commitment device took it up, with modest but significant impacts on smoking six months later, which persisted in surprise tests at 12 months.

Schilbach (2019) explores the relationship between alcohol consumption and self-control among rickshaw drivers in Chennai. As part of the experiment, participants were offered a choice between receiving an unconditional payment of a fixed amount or a conditional payment that had a high payoff for sobriety (measured using a breathalyzer) and a lower payoff otherwise. The amount of the unconditional payment varied, such that one of the unconditional options weakly dominated the conditional option and another strictly dominated the conditional option. Schilbach (2019) finds substantial demand for costly commitment to sobriety: more than half of those offered the choices chose the weakly dominated option that incentivized sobriety over the unconditional payment, and more than a third chose the strictly dominated conditional incentives over the larger unconditional payment.

Despite this promising evidence, commitment devices have not taken off as a policy tool or in real-world markets. Two weaknesses are at the heart of this issue. First, while Schilbach (2019) and Casaburi and Macchiavello (2018) find high take-up for costly commitment, demand for commitment devices is relatively low in many other settings (Laibson, 2015).[19] Second, many of the individuals who demand commitment fail to follow through with their plans despite the commitment device, such that they ex post appear to be made worse off by being offered commitment (John, 2018; Bai et al., 2017).

Does the mixed (at best) success of commitment contracts imply that self-control problems are not an important driver of preventive health behavior? To answer this question, it is important to keep in mind determinants of commitment demand. A key requirement for generating demand for commitment is a sufficient level of sophistication about self-control problems. A completely naïve present-biased individual

[19] See Table 1 in Schilbach (2019) and Table 1 in John (2018) for overviews of the existing evidence.

would never demand commitment, since they believe they have no self-control problems beginning in the next period. Thus, demand for commitment is a one-sided test for self-control problems: finding demand for commitment indicates self-control problems (in the absence of confusion or social pressure to sign up), but absence of demand does not necessarily mean self-control problems do not exist or are not important in that domain or in other domains. It could instead be that (a) individuals are not sufficiently sophisticated to demand commitment, (b) that the commitment device is perceived as being ineffective, or (c) that uncertainty in the environment makes commitment unattractive despite self-control problems (Laibson, 2015).

The variation in take-up across settings could partly be explained by variation in the extent of individuals' present bias, as well their awareness of such problems. While standard models of present bias assume that both the level of present bias β and the level of sophistication about it ($\hat{\beta}$) are the same across all dimensions, it could be that individuals are more aware of their self-control problems in some dimensions than in others. Of course, it is surely the case that much of the variation is simply explained by difference in beliefs or long-run preferences: many people may simply not think the task is worth doing and would not want their future selves to do it either. People may also have varying beliefs about the likely effectiveness of the contract, which in turn might be related to individuals' experience with the device. Better understanding the role of individuals' beliefs in commitment decisions remains an important area for future research.

Individuals' failure to follow through is a second reason why commitment has not become a more successful policy tool (John, 2018). If people are only partially aware of their present bias, there may be systematic failures of commitment, with plausibly negative effects on welfare. Those who are partially naïve may accept a commitment contract without realizing the true extent of their present bias, resulting in them incurring the cost of the commitment device without its intended benefit.

Bai et al. (2017) show how people may be willing to take out commitment contracts that are ultimately welfare harming. They study attendance at "Hypertension Day" health camps organized by a healthcare provider in rural India. In partnership with the provider, they offer contracts in which individuals make a large up-front payment, which reduces future attendance fees or, in the case where the payment exceeds the visit fee, provides a conditional payment for each future visit to the camp. The authors find low demand for the commitment contracts, but among those who do take up a commitment contract, a large proportion do not follow through with their future visits to the camp. These people lose the paid up-front fee and do not gain the health benefits that the contracts were intended to facilitate. This behavior is consistent with partial naïveté, where individuals demand some commitment, but not enough to overcome their present bias, which they do not fully anticipate.[20]

[20] The authors also design a contract intended to appeal to naïve individuals: they bundle together price discounts and commitment. The idea is that naïve individuals who expect to attend the health camp in any case might sign up to take advantage of the discount, but then be helped ex-post by the commitment aspect of the contract. Yet, even for this contract, follow-through rates are disappointing.

Future research on commitment devices might fruitfully focus on how to improve their success rates and increase their demand. One approach might be to attempt to de-bias individuals about the extent of their self-control problems, say by drawing their attention to the gap between their intentions and actions, or similar gaps among others. Another would be to facilitate learning by providing individuals with guided experience with selecting commitment devices.

Finally, even if agents are fully sophisticated regarding their present bias and have accurate beliefs regarding costs and benefits, commitment may not be optimal if there is uncertainty about the future (Amador et al., 2006; Laibson, 2015). In environments with uncertainty that will be resolved in future periods, commitment becomes less valuable insofar as it limits the agent's ability to act upon any new information. Therefore, with uncertainty or (partial) naïveté, a more promising approach may be to reduce hassle costs, provide direct time-limited incentives, or ease liquidity constraints. Another approach in the face of uncertainty is to utilize "soft" commitments, as discussed in Section 4.1.

In summary, present bias appears to have explanatory power for some of the low demand for health investments described above, through two channels: procrastination (in the case of health behaviors without deadlines, and naïve agents), and liquidity constraints (in case of naïve or sophisticated present-biased agents who endogenously create liquidity constraints). The classic tool in the literature to deal with self-control problems—commitment devices—have shown some promise but have yet to overcome important shortcomings to become an important policy tool.

Present bias on its own is by no means sufficient to explain all the patterns observed in the data. However, it is important to keep in mind that the different behavioral explanations we discuss in this chapter are by no means mutually exclusive. For instance, present bias and biased beliefs may well jointly explain some of the behaviors that cannot be explained by each of these factors on their own. However, some of the above patterns in behavior cannot be explained by liquidity constraints, for instance, individuals' high sensitivity to convenience as documented by Thornton (2008). Explanations involving biased beliefs appear more plausible in such cases.

3.3 Biased beliefs

To make good decisions regarding their health, individuals must form accurate beliefs about several variables. What is the likelihood of falling sick with different conditions in the future? How severe would the consequences of falling sick be? What is the causal effect of different interventions on the likelihood of falling sick, or of being cured? How good are various providers and should one trust their recommendations?

Learning the right answer to these questions is difficult even for a fully rational (Bayesian) agent who has perfect memory and the ability to process complex information. There are many reasons why it is difficult for an individual to form accurate beliefs, including fundamental uncertainty and heterogeneity across individuals in risks and responses to treatment, the self-limiting nature of many diseases, externalities, long time-horizons, and the complicated nature of many medical conditions.

Indeed, this point was made by Arrow (1963) in a paper sometimes considered the founding work of modern health economics.

In addition to the general difficulty of learning about health, individuals often face additional challenges to learning, especially in developing countries. For instance, sometimes they may simply not have access to relevant information, and there may be few trained experts around to learn from. Once we additionally account for the fact that human beings systematically depart from the Bayesian learning benchmark (see Benjamin, 2018 in this volume), the likelihood that individuals have inaccurate beliefs—and perhaps systematically biased beliefs—becomes even greater.

Below, we discuss how inaccurate beliefs may explain some patterns in health behavior in developing countries. We describe reasons for inaccurate beliefs including simple lack of access to information, as well as specific biases in learning and beliefs which may be important, including information avoidance and motivated reasoning, incorrect mental models, and non-Bayesian social learning.

Inaccurate beliefs. Misperceived returns to health investments could help explain the stylized facts described in Section 3.1. Underestimating returns will drive down the demand for preventive health investments. Perceived returns close to zero could also help explain the high demand elasticity for such investments. Surprisingly little work directly elicits individuals' beliefs regarding the returns to different health investments. While quantitative belief elicitation is challenging, methods have been developed to elicit even probabilistic beliefs meaningfully in low-literacy populations in the developing world (see Delavande et al., 2011 and Delavande, 2014 for reviews).

One example is Delavande and Kohler (2009), who elicit subjective probabilities of HIV infection in Malawi. Compared to the actual HIV prevalence of 6.9% in Sub-Saharan Africa at the time, 67% of respondents report that their likelihood of being currently infected with HIV is 0, while only 1% think the likelihood is 100 percent. Godlonton et al. (2016) elicit men's beliefs about male circumcision and HIV transmission risk and find that only 36% correctly believe circumcision is related to lower HIV transmission risk.

It remains to be seen whether inaccurate beliefs, by themselves, can help explain under-investment in preventive health. It could even be that eliciting beliefs heightens the puzzle in some contexts, if many individuals over-estimate the returns to healthy behaviors or the risks involved in unhealthy behaviors such as for the risks associated with smoking in the US (Viscusi, 1990) and the risks of HIV transmission in Malawi (Anglewicz and Kohler, 2009). However, our lack of understanding of these beliefs constitutes a glaring gap in the literature at present. More systematic elicitation of beliefs—including quantitative beliefs—in the health domain will be a valuable agenda for future research.

Information interventions. A substantial body of work has studied the effects of information interventions on health behaviors (although often without measuring beliefs themselves). These have been treated as tests for whether information is a binding constraint on preventive health behaviors. Put differently, providing information and measuring changes in health behaviors is an indirect way of testing for errors

in beliefs in the baseline. However, this approach depends on numerous assumptions which are rarely tested: that the information treatment was effective in changing beliefs in the intended direction, and that the information intervention did not impact behavior in other ways such as through increased salience or demand effects.

Dupas and Miguel (2017) provide a thorough review of this literature and point to the mixed overall findings. While some information interventions such as informing students about how to avoid worm infections (Kremer and Miguel, 2007) and providing information about HIV/AIDS to students (Dupas, 2011b) had no effects on behaviors, other cases show more promising results, especially when providing personalized information. Madajewicz et al. (2007) show that informing households about well safety regarding arsenic levels causes large switches from unsafe to safe water sources. Dupas (2011b) finds that teenage girls in Kenya falsely believed older men would expose them to lower HIV risk than younger partners, an informing them about the higher risk of infection of older men led to changes in behavior.

Several other well-known examples of effective information campaigns exist, for instance, Egypt's campaign on oral rehydration for diarrhea treatment (Levine and Kinder, 2004). However, similar information campaigns implemented over a long period of time have not had a transformative effect on infant death rates from diarrhea (Rao et al., 1998). Other examples show more mixed results of information campaigns. For instance, while health warnings on packaging have been shown to decrease tobacco use in some settings (Borland et al., 2009), similar warnings have been less effective at decreasing alcohol consumption (Anderson et al., 2009).

We only have a limited understanding why information interventions can have large impacts in some contexts, but small to null impacts in others. Dupas (2011a) points to several determinants that could be important of the success of information campaigns. One possible explanation is that it matters who receives the information, due to individual-level differences in returns to health investments. An alternative hypothesis is that multiple behavioral biases are jointly affecting individuals' decisions and only addressing one of them is insufficient. For example, in the case of alcohol consumption, information interventions could play a role, but only if individuals also receive help in overcoming potential self-control problems. A different hypothesis is that in cases of motivated beliefs, information interventions will not be successful since individuals are actively trying to avoid updating their beliefs, as discussed below.

Motivated reasoning. Information avoidance and motivated reasoning may arise when beliefs enter directly into an individual's utility function, in addition to their instrumental value. A variety of theoretical concepts can capture this phenomenon, including anticipatory utility (utility from anticipating the future; Kőszegi (2003), Mayraz (2011), Caplin and Leahy (2001, 2004), Brunnermeier and Parker (2005)) or news/realization utility (utility from learning good or bad news; Kőszegi and Rabin, 2009). In these models, acquiring more information does not necessarily make individuals better off, such that they will sometimes eschew seemingly useful information.

One compelling example from the developed world is Oster et al. (2013) who study genetic testing among individuals at risk for Huntington's Disease (HD). While Huntington's is a degenerative neurological disorder without cure, it may still be very useful to learns one's HD status as it can inform important life decisions regarding childbearing, retirement plans, savings, or education. However, despite the relatively low economic cost, pre-symptomatic testing is rare. Moreover, actions among untested individuals are strongly skewed toward the optimal action of those who do not carry the HD mutation. Finally, individuals often get tested when their symptoms paired with their genetic disposition predicts a positive result with near certainty.

The standard neoclassical framework has difficulties explaining this set of results. Oster et al. (2013) explain the patterns in the data using a model of anticipatory utility. Untested individuals have the option to choose their beliefs about the future, at the cost of increasing the probability of choosing the wrong action. Avoiding information may be optimal if the increase in anticipatory utility outweighs the costs associated with making choices based on wrong beliefs. Oster et al. (2013) explain the patterns in the data using a model of anticipatory utility. Untested individuals have the option to choose their beliefs about the future, at the cost of increasing the probability of choosing the wrong action. Avoiding information may be optimal if the increase in anticipatory utility outweighs the costs associated with making choices based on wrong beliefs.

Work on this topic in developing countries is scarce, but there is little reason to think that a similar psychology might not apply also in poor countries, and with respect to important health conditions ranging from HIV to hypertension and diabetes. Indeed, Li et al. (2018) provide suggestive evidence on information aversion in the case of diabetes blood-testing at a rural hospital near Beijing.

Although Oster et al. (2013) and Li et al. (2018) both use the same model of anticipatory utility to rationalize their results, anticipatory utility alone cannot fully explain people's preferences over medical testing. In line with the evidence for other health products, Li et al. (2018) and Thornton (2008) show that demand for medical test results can be highly sensitive to small changes in prices, even among relatively high-risk populations. It is hard for anticipatory utility by itself to drive this result: it would require individuals to be close to indifferent, once accounting for both the total expected benefits and costs of getting tested, and the change in anticipatory utility from being tested. It seems unlikely that this would occur by chance for many individuals.

Incorporating present bias into models of information preferences might help explain this behavior. If people are averse to learning medical test results, say due to news utility or simply because they dislike focusing their attention on their health status, then a present-biased person could forgo testing because they put disproportionate weight on the immediate welfare costs of learning the test's result.[21]

[21] News-utility is different than anticipatory utility. In the case of news utility, the utility cost of receiving news is at the moment that the news is received. By the next period, once the information has been incor-

Especially in the case of naïve present bias, small psychological costs of learning new information may cause individuals to procrastinate indefinitely on obtaining their test result, as in Thornton (2008).

Redundancy neglect. Individuals may learn about health choices—such as which provider to go to—by observing their peers' decisions and experiences. To interpret peer behavior, they must employ some theory as to how and why others made their own decisions. For example, an individual who observes her two neighbors go to a local witch doctor needs to think through what information their choice reveals. One possibility is that both those neighbors chose to visit the witch doctor due to independent private information. Another is that one of those neighbors simply observed and imitated the other. In the latter case, the signal in support of visiting the witch doctor is weaker—despite observing two neighbors, there is effectively just one information source.

Eyster and Rabin (2010) provide a model of naïve social learning in which people fail to appreciate the redundancy in their predecessors' actions by naively interpreting their actions as independent. The authors show that societies which behave in this way can converge to confident and wrong beliefs, an outcome that is impossible in standard rational-actor economics. Eyster et al. (2018) run a lab experiment in which student subjects act in precisely this way: by failing to account for the redundancy in one another's actions, subjects do worse than they would do without the possibility for social learning. While we do not have tests of this from the health domain, social learning about health behaviors and providers might be a promising domain in which to study these biases. We discuss applications related to technology adoption in Section 6.

Sampling and statistical biases. People often generalize from small amounts of information—they tend to exaggerate the extent to which a small sample of outcomes represents the distribution of outcomes they will face in the future (Tversky and Kahneman, 1971; Griffin and Tversky, 1992; Rabin, 2002). For example, an individual who recovered from an illness after visiting a health provider and following their instructions may be excessively confident that the provider is highly able.

Furthermore, summary statistics about a health behavior or product might not be sufficient to correct beliefs: people also display a tendency to under-infer from large samples (Griffin and Tversky, 1992; Benjamin et al., 2016). Information campaigns that provide scientific evidence supporting a new treatment may thus have limited effect, since individuals might continue to overweight individual negative experiences or anecdotes relative to seemingly conclusive statistical evidence that runs counter. Countering these statistical biases is potentially critical for more accurate beliefs and better health behaviors.

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porated into the reference point, the past news no longer "hurts". In contrast, in the case of anticipatory utility, news once learned will continue to affect one's anticipatory utility in future time periods.

3.4 Incorrect mental models

Individuals may interpret what they see through the wrong causal model or theory, as investigated by Schwartzstein (2014). Gagnon-Bartsch et al. (2018) show theoretically that, if individuals have in mind the wrong theory, and they use that theory to direct their attention to information, they may fail to correct their beliefs despite repeatedly observing outcomes which are inconsistent with their beliefs.

One potential source of mistakes in causal inference in health behaviors is that many health conditions are self-correcting. That is, most individuals will naturally recover, given time, from most illnesses. Individuals may misattribute their recovery to any health care choices they made while sick.

Relatedly, an incorrect mental model which seems important in health behaviors in poor countries is a belief in magical theories of sickness such as curses, witchcraft, the evil eye, and superstitions. If individuals see the world through such beliefs, then they may mis-infer from observing episodes of sickness, recovery or even death by updating about irrelevant variables while not attending to causally relevant factors.

Ashraf et al. (2017) provide another example in the context of traditional beliefs about maternal risk in Zambia. The authors describe a wide-spread traditional belief that marital infidelity is a primary cause of health complications during childbirth. This superstition discourages women from sharing their experience with others, and even from seeing medical help when complications arise during delivery, since revealing difficulties would cause stigma for the pregnant woman. In addition, the authors argue, the traditional mental model causes the community to misattribute maternal deaths to infidelity, making it harder for social learning about the true risk factors to occur.

Beliefs regarding diarrhea can cause dehydration and is fatal for more than half a million infants annually. Oral Rehydration Solution (ORS) made of sugar and salts is highly effective at preventing dehydration and decreasing fatalities from diarrhea. Yet in many areas it is not widely used, despite its low cost. While one could come up with behavioral explanations that could arguably limit ORS take-up, evidence suggests that a key constraint is simply access to information about its effectiveness, which is in part not demanded or valued since many parents have the wrong mental model of diarrhea.

Parents observe their infant's watery stools and infer that they should *decrease* their child's fluid intake (which is exactly the wrong thing to do, but is an intuitive conclusion). In India, when poor women were asked how to treat an infant's diarrhea, 30 to 50 percent recommended decreasing fluids to keep the infant "dry" (Datta and Mullainathan, 2014). In fact, reducing fluid intake is a common response to infant diarrhea in many regions of the world (Carter et al., 2015). In this case people are not merely unsure of the right course of action, but instead confidently hold utterly false beliefs.

3.5 Other behavioral factors

Emotions and decision-making. Making rational economic decisions is difficult even in the best of times. Decisions regarding health care must often be made in very difficult times. When an individual or a family-member is sick, emotions of sadness, fear, and anger are likely to be prominent. While behavioral economics has not studied the role of emotions in as much detail as phenomena like present bias or loss aversion, evidence exists in psychology that emotions systematically affect decision-making (Loewenstein and Lerner, 2003; Lerner et al., 2015). Health behaviors may be a valuable application of those ideas to studying economic behaviors.

Salience. Incentives for health behavior might operate not only due to the incentive-effect itself, but because the incentives make the importance of the behavior salient to individuals. Such salience effects could increase individuals' perceived benefits from investing in their health or they could serve as reminders in situations that necessitate repeated actions, for instance, vaccinations or medical adherence. The role of salience in the context of health investments remains to be investigated in future work.

Social image. In an innovative study in Sierra Leone, Karing (2018) studies how social image concerns can be leveraged to increase vaccination rates. She provides mothers with colored bracelets that allow them to signal to others whether their child is vaccinated. The author cleverly designed her study to enable her to disentangle social-image motives from memory and salience (for instance, by providing placebo bracelets that do not communicate information about the number of vaccinations completed, but which plausibly still remind the mother about vaccinations). Karing finds that the intervention increases timely and complete vaccination at a cost of 1 USD per child.

Zero-pricing and the absence of sunk-cost effects. Policy-makers often want to encourage take-up of preventive health, sometimes due to behavioral internalities, but also due to straightforward epidemiological externalities or social concerns for children or fiscal externalities from increased labor supply and taxation (Baird et al., 2016). From a policy perspective, the above discussion suggests that charging a low price is not likely to be a good solution, since it deters many people from purchasing, while not raising much revenue. Demand is sensitive enough to price that it will typically make sense to go all the way down to a zero price. This argument does not depend upon arguing for any special psychology around zero pricing.[22] Logistical costs of dealing with any payment provide another argument for a zero price instead of a small positive price.

In tension with the desire to increase take-up, development organizations, including international financial institutions such as the World Bank, have at times

[22] One might argue even for negative prices, but these create obvious incentives for people to take the good, accept the subsidy, and then not use it.

advocated charging users for preventive health products and services. The main motivation for this is the pursuit of financial sustainability. However, another reason that is often cited in support of positive prices is that higher prices may stimulate higher usage through a sunk-cost effect. The sunk cost effect describes a direct effect that price has on use: it predicts that paying a price for a good makes an individual more likely to use it (Thaler, 1980; Eyster, 2002). These effects have been demonstrated in evidence from the field and the lab in rich countries. For instance, Arkes and Blumer (1985) experimentally offered discounts to season ticket holders at a theater and show a positive relationship between the effective price paid for a ticket and performance attendance.

In the context of preventive health products in the developing world, there is good evidence that higher prices (or even positive relative to zero prices) do *not* cause greater product use. Ashraf et al. (2010) use a field experiment to estimate the impact of the price of a drinking water disinfectant on its use. Their experimental design uses a two-stage randomization procedure as in Karlan and Zinman (2009) to distinguish between a screening effect, through which prices limit take-up to buyers who are more likely to use the product, and a sunk-cost effect. Conditional on a household's willingness to pay, they randomize surprise price-discounts to obtain variation in the actual price paid by a household. The authors find a strong screening effect, but no evidence of a sunk-cost effect on ultimate usage of the product. While willingness to pay sensibly predicts usage, the actual transaction amount paid does not. Those who paid a positive price were no more likely to use the product at endline than those who received it for free.

Cohen and Dupas (2010) use a similar two-stage price randomization design to study the influence of prices on use of insecticide-treated bed nets. Conditional on purchase of a net at a posted price, they surprise buyers with a randomly determined discount and estimate the relationship between the discount size and net use. Consistent with the results of Ashraf et al. (2010), they find no significant effect of effective price on usage, suggesting that the sunk cost effect is not an important determinant of usage of health products.

Overall, therefore, the evidence suggests that a policy-maker looking to increase usage of preventive-health products should avoid small positive prices, as they lead to large reductions in take-up without increasing utilization.

4 Savings

In recent years, an active field-experimental literature has studied savings in developing countries.[23] At the individual level, as described in Section 2, savings are

[23] See Karlan et al. (2014b) for an excellent recent review of neoclassical and behavioral constraints on saving in developing countries.

necessary to self-insure against risks and to finance lumpy investments. Barriers to savings might thus reduce welfare and opportunities for growth.

One part of the recent literature on savings has studied "standard" barriers to saving, such as a lack of access to formal savings products, for instance, due to prohibitive costs of opening a bank account. Several papers randomize subsidies for opening various types of bank accounts or other savings products, with mixed results. Dupas et al. (2018a) conduct experiments in three countries and find only small effects of providing bank accounts to poor individuals. Many participants in these experiments do not actively use their newly-opened bank accounts. The authors conclude that merely expanding access to bank accounts is unlikely to lead to noticeable welfare improvements among the poor. In contrast, other papers find increases in productive investment (Dupas and Robinson, 2013a), savings (Prina, 2015), and even income (Schaner, 2018). One interpretation is that a subset of individuals has high returns to access to formal savings products, while for most poor individuals, access is not the only constraint on saving.[24]

What other constraints may be important in reducing savings among the poor? In this section, we discuss various behavioral factors which may play a role in reducing savings, as well as behavioral tools which have been used by policy-makers to increase savings.

4.1 Commitment savings devices

Commitment savings. Present bias can greatly influence savings decisions. A key prediction of the present-bias is that households accumulate few liquid savings over time, while building up substantial illiquid wealth. This prediction seems broadly consistent with savings patterns in both rich and poor countries (Angeletos et al., 2001; Banerjee and Duflo, 2007; Collins et al., 2009). For more detail, we refer the reader to Section 2 of this chapter and the discussion of time preferences in Ericson and Laibson (2018).

Present bias paired with at least some level of sophistication implies demand for commitment, as discussed in detail in Section 3.2 in the context of health behavior. If present bias reduces savings, individuals might have demand for commitment devices to increase their savings. There is evidence of such demand for commitment in the domain of savings. In a founding paper in this literature, Ashraf et al. (2006) offered a commitment savings account to a random subset of study participants through a bank in the Philippines. About a quarter of respondents took up this offer, electing to restrict their future access to their savings until a savings goal was met, or until a target date. A year later, those offered commitment savings had substantially higher average bank account savings than those in the control group.

A subsequent literature has investigated how different types of commitments impact savings. An important contribution by Dupas and Robinson (2013b) compared

[24] This evidence raises the question of why the individuals with high returns to savings accounts do not borrow or save enough to pay the fees (typically a few dollars) associated with opening these accounts.

different types of commitment devices of varying strength. They compare the effects, relative to a control group, of providing participants with either a safe box in which to store money at home (to which the participants have the key) or instead a lock box (whose key is held by the research staff). The idea is that the former provides a softer commitment than the latter treatment. Both treatments were motivated as targeting saving to cover health expenses. A year later, the authors find high sustained use of both products, but only the more flexible, softer commitment of the safe box led to increased spending on preventive care.

The findings of Dupas and Robinson (2013b) connect to a key open question surrounding the usefulness of commitment devices: the optimal tradeoff between commitment and flexibility (Beshears et al., 2017). A commitment that is too weak will not overcome self-control problems, while one which is too restrictive will drive down take-up due to the real costs of commitment in uncertain environments (Amador et al., 2006; Laibson, 2015).

The tradeoff between weak and strong commitment is complicated by the existence of partial naïveté. John (2018) studies savings commitment accounts in the Philippines (in the same context as Ashraf et al., 2006) and shows that many of the individuals who demand commitment savings fail to follow through with their commitment and incur financial penalties. As a result, these individuals are (ex post) made worse off by being offered the commitment device. Partial naïveté about present bias can explain this result: partially naïve individuals realize that they have a self-control problem, so they will have demand for commitment. However, they might under-estimate the needed strength of the commitment, so they might sign up for commitment contracts that do not provide sufficient incentives to follow through.

It is worth noting that savings commitments are not restricted to formal savings accounts. Instead, social networks and savings groups such as ROSCAs may effectively provide commitment. Kast et al. (2018) show large impacts of public goal-setting and group monitoring on savings, emphasizing the potential for social ties to pay a role in motivating individuals to save. Breza and Chandrasekhar (2015) randomly assign "monitors" to savers within the same village and show that monitors cause an increase in savings of over 40% a year later, with some evidence of a social image or reputation channel driving the effects.

We speculate that such socially-provided commitment might also be able to more flexibly deal with uncertainty and shocks. While it is difficult for a formal provider to contract on and verify shocks which may affect savings, others in the same social or economic network may be better placed to do so.

Another potential weakness of commitment savings accounts is that they merely prevent individuals from withdrawing money that they have already deposited. However, present-biased individuals might have difficulties depositing money into their savings account in the first place. Alternative designs that include automatic payments into savings accounts (e.g. using M-Pesa in Kenya) could prove to be highly effective.

4.2 Designing financial products for behavioral agents

Numerous behavioral factors beyond present bias can impact individuals' savings decisions, including mental accounting, default effects, limited attention, and memory issues. Some of the existing evidence in support of the importance of these factors for savings decisions is limited, especially in developing countries. Better understanding these factors could uncover cheap and highly effective ways to impact savings behavior (Chetty, 2015). Further evidence would greatly improve policymakers' ability to design savings accounts and financial products to better serve the poor.

Mental accounting. Money from different sources and in different accounts should be fungible and is treated as such in standard economic models. However, in practice people may have "mental accounts" for different types of expenditures, which makes money effectively non-fungible across accounts (Thaler, 1985; Shefrin and Thaler, 2004; Hastings and Shapiro, 2013). Such mental accounts may in part be used to avoid overspending and thus deal with self-control problems. The existence of mental accounting implies that small details in the specific design of financial products can powerfully impact behavior. For instance, an individual might use unconditional transfers labeled as "health resources" primarily on health expenditures, simply because the label causes these resources to become part of the individual's "health" mental account.

Dupas and Robinson (2013b), discussed above, find evidence of the importance of mental accounting. For instance, earmarking expenses for health emergencies increased individuals' ability to cope with health shocks. Similarly, in a horse race between a hard and soft commitment savings account, Karlan and Linden (2018) find that the weaker commitment account causes stronger increases in savings for educational supplies, which in turn increased test scores, in contrast to the stronger commitment account. The authors argue that the labeling of the resources for educational purposes was a strong enough commitment while also allowing some flexibility for individuals.

Default effects. Setting default choices is a cheap but often highly powerful option in the behavioral-economics toolbox, as shown in the context of retirement savings (Madrian and Shea, 2001) and organ donations (Johnson and Goldstein, 2004) in rich countries. For instance, setting the default to automatic enrollment (wherein individuals are enrolled unless they explicitly opt out) as opposed to a non-enrollment default option can have enormous impacts on individuals' retirement choices, with impacts lasting over a decade (Chetty et al., 2014; Choi et al., 2002).

In a starkly different developing-country context, Blumenstock et al. (2018) find similar results. They take advantage of rising financial inclusion and show large impacts of setting opt-in defaults on savings behavior among workers in Afghanistan who receive their salaries using mobile money. Moreover, the authors provide evidence of the underlying mechanisms driving default effects and argue that present bias and the hassle costs of thinking through different options play an important role, while other factors such as limited memory are less important.

These findings highlight the importance of the economic environment and institutions in shaping savings behaviors. In contrast to developed countries, most

individuals in developing countries do not have the option to automatically save for retirement (such as using 401k savings vehicles) or to have their salary paid into their bank account monthly. Instead, many workers are paid daily or even hourly, which may increase individuals' susceptibility to temptation. For instance, Casaburi and Macchiavello (2018) argue that farmers may prefer to sell milk to the dairy where they get paid monthly, rather than to sell it on the spot market for a higher price because this creates a form of savings since they get paid at the end of the month.

Memory and attention. Limited memory and attention might distort individuals' decision-making in various ways, ranging from medical adherence to savings behavior. Memory constraints might be particularly important for the poor since low literacy levels make it difficult to effectively use of written reminders or similar technologies. Karlan et al. (2016) study the impact of reminders in a field experiment with three different banks in Bolivia, Peru, and the Philippines. Their idea is that, when making consumption decisions in the moment, individuals may forget or not attend to their future consumption of investment goals. They find that reminder messages which increase the salience of the savings goal help individuals follow through on their weak-commitment savings plan, suggesting important interactions between memory and self-control (as in Ericson, 2017).

Exponential growth bias. Financial literacy can greatly impact individuals' savings choices (Lusardi, 2009). For instance, individuals may also underestimate the returns to savings due to a systematic under-estimation of the power of compound interest (Stango and Zinman, 2009). Song (2015) provides evidence consistent with exponential growth bias using a field experiment in China. A treatment group which is taught the principles of compound interest contributes substantially more to a government pension plan.

New technologies. The development of new technologies such as mobile money creates great opportunities for the financial inclusion and empowerment of the poor (Jack and Suri, 2014, 2016; Suri, 2017). Such technologies can greatly help individuals with behavioral biases, for instance, through automatic payment schemes or reminders (Cadena and Schoar, 2011). A thorough understanding of the above behavioral biases can greatly improve the design of adequate financial products. However, new technologies also create potential for behavioral agents to be targeted and exploited, raising important questions of consumer protection (Ru and Schoar, 2016). For instance, recent increases in sports-betting using mobile phones in East Africa, and the growth of an industry making small loans at very high interest rates are important topics for future research.

5 Risk and insurance

Risk plays a central role in the lives of the poor (Collins et al., 2009). Poor households are simultaneously exposed to numerous risks, including market risks (e.g. prices), production risks (weather shocks, pests), health risks, asset risks (e.g. theft),

and even political risk (e.g. civil conflict) (Hazell, 1992; Dercon, 2005). Under most plausible utility functions, the sharply diminishing marginal utility of income at very low consumption levels implies a particularly strong need for insurance. Yet, little social insurance (whether health or income insurance) is provided by governments in poor countries. Poor countries also have less well-developed markets for dealing with risk through private insurance.

Instead, societies have developed non-market institutions for coping with risk (Besley, 1995; Townsend, 1994). A large literature studies informal risk-sharing in developing countries, and how risk considerations affect crop choice, migration choice, and marriage, and other decisions. Evidence on the extent of risk sharing within villages (or other networks, such as sub-caste networks in India) is mixed. In some cases, one cannot reject the hypothesis that consumption moves only with village-wide income shocks, not idiosyncratic shocks, but in other cases consumption and even mortality and long-run health outcomes move with idiosyncratic shocks (Paxson, 1992; Townsend, 1995; Yang and Choi, 2007; Rose, 1999; Maccini and Yang, 2009). There is also evidence that consumption moves with health shocks, sometimes dramatically (Gertler and Gruber, 2002; Collins et al., 2009).

Since people in poor countries are often exposed to weather risk, and since such risk is not generally subject to asymmetric information, it is a puzzle that rainfall insurance is not more common. Weather risk is different from other risks (e.g. illness or death in the family) because it is not idiosyncratic, but correlated within regions, and therefore cannot be easily insured away within villages or even across villages. These reasons make rainfall insurance a particularly interesting context to study behavioral biases, since other reasons for market failures or low take-up may be less relevant here.

Weather insurance remains uncommon despite subsidies from governments and NGOs. In India, rainfall-indexed insurance was introduced in 2003, but despite monsoons being notoriously unpredictable, and a large share of the population being dependent on rainfall, take-up has been disappointing (Stein, 2016). Several field experiments have found low levels of take-up, despite heavy subsidies and significant marketing efforts (Giné et al., 2008; Cole et al., 2013). Some of this low take-up may be explained by standard reasons, e.g. basis risk (Clarke, 2016) or fear of contractual non-performance (Doherty and Schlesinger, 1991).[25]

Below, we focus on potential behavioral reasons that might contribute to inefficiently low take-up levels of insurance. We first consider existing evidence of non-standard preferences affecting the demand for insurance. We then investigate the role of non-standard beliefs.

[25] Lack of trust is more generally correlated with low levels of participation in financial markets (Guiso et al., 2006). Low social trust may have deep historical roots and be culturally-determined, as discussed in Section 9.

5.1 Non-standard preferences affecting insurance demand

Present bias. In textbook models of insurance, resources are transferred only across states of the world. In practice, however, insurance almost always additionally entails shifting resources over time. That is, in period t, individuals need to decide whether they would like to purchase insurance that pays out in a pre-specified bad state in period $t + 1$. This time structure of decisions and payments allows for the possibility of time preferences affecting lowering individuals' demand for insurance.

Casaburi and Willis (2018) test this idea by offering Kenyan farmers crop-insurance in which the premium is charged only when uncertainty is resolved, that is, at the time of harvest. Their unusual insurance product thus purely distributes resources between future states. They find that demand for such insurance is dramatically higher than for standard contracts with upfront payments of insurance premia, even at highly subsidized levels. The authors argue that this result is driven by present bias. They also find that offering farmers a commitment to purchase insurance a month later increases take-up by 21 percentage points, suggesting present bias and liquidity constraints as important inhibitors of demand for standard insurance contracts.

The authors could enforce post-harvest premium payments due to the contract-farming setting they study. Their insight suggests a comparative advantage in insurance provision for entities which have the power to enforce contemporaneous transfers from those experiencing good states to those receiving bad shocks. In rich countries, governments have a major role in providing social insurance. In poor countries, social groups such as kinship networks, villages, or sub-caste groups may play a key role, and formal sector jobs may be desirable in part because of the capacity of large firms to provide such insurance.

Reference-dependent utility. Loss aversion can have ambiguous impacts on demand for insurance (Eckles and Wise, 2011). On the one hand, reference-dependence increases risk aversion over small and moderate stakes, as argued by Sydnor's (2010) study of home-owner insurance in the US. On the other hand, if up-front insurance premia are bracketed separately from insurance payouts and considered as losses, loss aversion could curb demand for insurance by making the premium payment particularly unattractive. In fact, loss aversion could play some role in explaining the results by Casaburi and Willis (2018) described above. This highlights the importance of understanding what reference-point individuals use when evaluating their insurance choices, as well as how they bracket their decisions.

Finally, Kahneman and Tversky's (1979) Prospect Theory argues that individuals overweight small probability events in their evaluation of risky gambles. Such overweighting would tend to increase demand for insurance against low-probability but high-risk events, potentially heightening the puzzle of low insurance demand in developing countries.

5.2 Non-standard beliefs affecting insurance demand

Projection bias and recency effects. Individuals may exhibit projection bias when evaluating insurance products. In good states of the world, they may have difficulty appropriately valuing bad states of the world, i.e. they may underestimate their marginal utility in potential bad states if the present state is good (Loewenstein et al., 2003). Relatedly, individuals might place disproportionate weight on observations from the recent past or extrapolate recent trends, and thus overestimate the probability of their current state occurring in the future (Hogarth and Einhorn, 1992; Fuster et al., 2010).

Such individuals value future insurance less than when they are currently in a good state (holding everything else equal), thus curbing insurance demand for individuals who are currently in good states. In contrast, individuals in bad states may overvalue insurances, but bad states are more likely to generate liquidity constraints, which could reduce take-up despite a high valuation.[26] Moreover, if bad states are rare, projection bias will systematically depress demand for insurance (since demand will typically be elicited during a good state). This is ironic because insurance offers its largest benefit for low-probability high-loss events.

Recent work in developing countries provides evidence that the current idiosyncratic state of the world does affect individuals' demand for insurance.[27] Chang et al. (2018) find that fluctuations in daily air pollution levels predict individuals' decision to purchase or cancel health insurance in China. Since these fluctuations are hardly predictive of future pollution levels and thus the value of insurance, such effects are difficult to reconcile with the neoclassical model. Instead, these demand patterns are consistent with individuals over- and under-weighting future pollution-related health risk depending on the state of pollution on the day of their purchase or cancellation decision.

Karlan et al. (2014a) find evidence consistent with recency bias in their study of agricultural decision-making among small-scale farmers in Ghana. They find that demand for insurance is higher for farmers following a payout to themselves or someone their network. In contrast, demand is lower for previously insured farmers who did not receive payouts due to good rain. Such demand patterns are consistent with projection and recency bias, and salience, though they might also be explained by limited trust in the insurance agency, with observed payouts increasing trust.

Motivated reasoning and over-optimism. As discussed in Section 3.3, motivated reasoning could explain individuals' lack of health investments. If individuals directly derive utility from beliefs about their future wellbeing, they may seek to maintain biased beliefs about their current health status or the future. Such biased beliefs might

[26] Bad states may also fail to come to mind or be salient when times are good, and vice versa (Bordalo et al., 2012).

[27] Further evidence on recency effects in insurance choices includes a body of work by Slovic et al., 1974; Kunreuther et al., 1978; and Gallagher, 2014.

lower demand for insurance. To the best of our knowledge, no existing evidence considers this hypothesis.

Beliefs in higher powers. Individuals' beliefs might deviate in more dramatic ways from standard probability assessments, including beliefs in higher powers, witchcraft, and magic. In a clever lab-in-the-field study in Ghana, Auriol et al. (2018) find that enrolling individuals in a commercial funeral-insurance policy lowers individuals' investment behavior in religious goods, as measured by choices between payments for themselves and contributions to church. The authors interpret their results as evidence of individuals perceiving the church as a source of insurance, derived from beliefs in an interventionist god. Such beliefs could be relevant barriers to demand for formal insurance in other settings as well.

6 Technology adoption

The development literature has identified various instances of seemingly sub-optimal technology choices. In Pakistan, Atkin et al. (2017) showed that take-up of a new technology that reduced waste in the production of soccer balls was surprisingly low, despite its potential to increase profits.[28] Other examples of apparently non-optimal technology choice in the development literature include fertilizer use in Kenya (Duflo et al., 2008) and textile factories in India (Bloom et al., 2013).

Below, we discuss two behavioral factors that could potentially either interfere with technology adoption: present bias, and limited attention. We then argue that behavioral social learning could produce badly distorted social outcomes.

6.1 Limited attention

Hanna et al. (2014) provide an explanation why individuals might not take advantage of apparently useful and readily available information. Given that attention is limited, individuals can only focus on and process a small subset of all the potentially available information. Rational attention theories predict that individuals focus on what they think is most important, and their beliefs about what is important are assumed to be accurate (Sims, 2003, 2010). Therefore, such theories predict only limited inefficiencies and welfare losses due to limited attention.

In contrast, Schwartzstein's (2014) model of attention argues that current beliefs about what is important in the world guide individuals' attention and learning, which in turn shape individuals' beliefs in the future. If individuals have incorrect beliefs about the importance of different aspects of the world, they might pay less than optimal attention to them, and thus might never learn that their beliefs were wrong. Therefore, wrong beliefs can persist indefinitely even in the presence of data which

[28] The authors point to the role of agency problems within the firm.

would otherwise lead to revision of beliefs. In such models, inattention can create significant inefficiencies and lead to large welfare losses.

Hanna et al. (2014) apply this insight to technology adoption among seaweed farmers in Indonesia. Given the complex production function with many possibly important dimensions, the authors argue that farmers will only pay attention to the dimensions of production they think are important. Hanna et al. (2014) track the relationship between the size of planted seaweed pods and farmers' output, arguing that larger pods lead to greater output. Farmers, when asked, did not suggest that pod size is an important determinant of output. 86% of farmers did not even know the pod sizes they themselves planted, even though 83% of them were literate and the average farming experience amongst the sample was 18 years.

Moreover, natural variation in pod size created numerous quasi-experiments that farmers could have learned from. Hanna et al. (2014) argue that despite large amounts of data being available for free on their own farms, inattention appears to have prevented farmers from noticing this relationship. Hanna et al.'s (2014) data is based on only a single season and there is significant cross-sectional variation in optimal pod size. Since the authors did not collect impacts of their intervention on subsequent profits, some questions remain whether optimal pod sizes for given farms vary over time and whether the intervention indeed increased profits. Additional data to shed light on this issue would be valuable.

If attention is limited, providing simple information with tips about optimizing production may be more effective than providing full information. In an RCT to test the above theory of inattention, Hanna et al. (2014) find that presenting farmers with summaries that draw their attention to the importance of pod sizes changed their farming techniques and increased output, but simply providing them with data on initial pod size and eventual yield from each of their pods did not induce learning and did not change farming behavior.

Similarly, Bennear et al. (2013) find in Bangladesh that a simpler message (providing red versus green labels) about whether a well has dangerous levels of arsenic is more effective than providing more continuous information. In the Dominican Republic, Drexler et al. (2014) find that a simple "rule-of-thumb" training significantly improved the financial practices of participating firm relative to a fuller training about accounting. This evidence suggests that there are cases when limited attention may lead to sub-optimal decisions and providing well-chosen limited information may be more effective than providing the full set of available information.

There are also potential downsides of presenting simplified information. First, there may be heterogeneity in the population and some individuals may benefit from fuller information. Second, external analysts may not understand the decision problem as well as the people to whom they are trying to transmit information, or they may pursue different objectives. They may therefore offer inappropriate advice. For example, in an agricultural context, agricultural scientists or government departments may seek to maximize agricultural production rather than profits and thus may not appropriately value farmer time.

6.2 Present bias

Duflo et al. (2011) study the extent to which present bias influences agricultural technology adoption and how policy can mitigate its effect. In previous work with small-scale maize farmers in Western Kenya, Duflo et al. (2008) find high returns to top-dressing fertilizer in Western Kenya if used at the right quantity. However, despite these potentially high returns at the time of the study, only about 20 percent of farmers used fertilizer in any given season, which suggests mis-optimization.

Farmers have money around the time of harvest and report plans to purchase fertilizer before planting begins. However, few farmers then follow through on their plans. Duflo et al. (2011) posit a model of stochastic present bias and partial naïveté. A partially naïve, present-biased farmer may put off purchasing fertilizer until the last minute, expecting to purchase the fertilizer later. Then, having underestimated how likely she is to be impatient in the last period, the farmer may also be impatient in the last period that buying is possible, and thus end up not purchasing the fertilizer.

This sort of model of decision-making has important implications for debates over fertilizer subsidies. Agriculture experts sometimes feel that farmers are using too little of particular inputs and they sometimes advocate heavy subsidies to encourage adoption. Economists have historically been more sceptical, arguing that this may distort input use away from the optimal level, potentially with negative environmental consequences. The model suggests that while heavy subsidies could help present-biased farmers overcome any immediate utility costs of purchasing fertilizer, they could induce overuse of fertilizer by farmers who are not present biased.

Duflo et al. (2011) argue that the tradeoff could be improved through better policy design: smaller, time-limited subsidies offered just after harvest could mitigate present bias while causing only second-order distortions among farmers without time inconsistent preferences. If farmers have more cash on hand in the period immediately following the harvest, then offering small, time-limited subsidies could lead to an increase in fertilizer use among present-biased farmers while limiting other distortions. These early discounts would only need to be large enough to overcome the utility costs of purchasing fertilizer if offered after the harvest, whereas discounts offered later, when the farmer is poorer would also need to cover part of the out-of-pocket fertilizer costs.

Based on these predictions, Duflo et al. (2011) designed a program to offer time-limited discounts for fertilizer that allowed farmers to purchase a voucher for fertilizer immediately after the harvest at the regular price, with free delivery around planting time. Time-limited discounts around the time of harvest substantially increased take-up of fertilizer. Moreover, this program was more effective than offering a 50 percent discount on fertilizer later in the season.

This evidence suggests that time-limited discounts around times when individuals have money available could be an efficient policy tool to increase fertilizer use or other desirable behaviors. However, as always, scaling any given policy presents challenges. In the case of time-limited discounts for fertilizer use, a specific scaled-up version of the program led to positive yet significantly smaller impacts on fertilizer adoption than the original study (Schilbach, 2015).

We hypothesize that present bias may also induce procrastination in learning about new technologies. If adoption requires costly experimentation and costly attention, present-biased individuals might procrastinate over conducting such experimentation. Such individuals would benefit, again, from decreasing the costs of learning through the provision of simplified information. Moreover, commitment devices for future experimentation could help overcome such procrastination problems. Agricultural extension services that incorporate self-help groups and encourage public commitments to attempt experimentation with new technologies may, in addition to solving failures of social learning, help solve such self-control problems.

Finally, present bias may induce non-adoption through the usual mechanism of generating liquidity constraints, as described in previous section. Lee et al. (2016) experimentally estimate the demand curve for an electricity connection in rural Kenya and conclude that consumer surplus—as revealed by willingness to pay—is considerably lower than the cost of provision. However, liquidity constraints may contribute to their estimates of low demand. The authors present evidence that credit constraints are indeed binding, which may influence welfare calculations and induce low adoption of even desired technologies.

6.3 Behavioral learning

For individual farmers, identifying the best technologies to adopt and how to use them is challenging, given that experimentation is costly, and outcomes are noisy. Thus, learning from the experiences and knowledge of others—social learning—may promote adoption of useful technologies (e.g., Munshi, 2004; Bandiera and Rasul, 2006; Conley and Udry, 2010).

Behavioral economics suggests several ways in which individuals may misinterpret information. For example, individuals may neglect the extent to which the pieces of information they hear from multiple sources are "redundant", in that they themselves derive from a common source (Eyster and Rabin, 2010). They may also over-generalize from small amounts of information, such as the recommendations of a handful of neighbors (Tversky and Kahneman, 1971), and underestimate how much can be learned from a large sample, such as the aggregated recommendations of hundreds of farmers (Benjamin et al., 2016).

Below, we discuss these behavioral factors in more detail, discuss the existing evidence, and argue that theory suggests they may interact to seriously distort.

6.3.1 Barriers to sharing or seeking information

On the demand side, social learning in agriculture requires farmers to actively seek, or at least be receptive to, information and recommendations from others. On the supply side, social learning similarly requires farmers who have some information or experience to be willing to share it with others. Certain behavioral which might make farmers hesitant to seek or share information with others.

Distributional preferences. Whether and whom farmers are willing to share information with may depend on social preferences such as altruism and envy, and how

these apply to others within the farmers' social networks. For example, if farmers' have envious or competitive preferences towards their peers, they may avoid sharing information to remain or become relatively more successful. Farmers might even choose to share false information to maintain an advantage. In contrast, individuals are likely to be altruistic towards others from their own extended families, kin or ethnic groups, and might therefore be willing to provide advice to such individuals.

Existing research from Uganda provides some evidence for such differential effects: agricultural extension workers target information towards farmers from their own social group, while withholding information from others (Bandiera et al., 2018). This evidence suggests that accounting for the structure of social networks and distributional preferences across those networks may help explain patterns of social learning and allow for the design of more efficient methods to seed and transmit information.

Social-image concerns. Social-image concerns may keep farmers from asking others for information or advice, since doing so may signal ignorance or low ability on the part of the asker. An experiment conducted by Chandrasekhar et al. (2018) in rural India provides some evidence for such an effect. They design a field experiment in which "seekers" must acquire information from a paired "advisor". In one arm of the experiment, the seeker's need for the information is (artificially) correlated with their ability from a baseline test, such that choosing to ask for advice may signal low ability. In the other arm, ability is revealed to the advisor regardless of the seeker's choice to ask for information, such that the signaling channel is shut down, although low-ability seekers may still feel some shame from interacting with an advisor who has learned of his low ability. The authors find that signaling is the dominant force overall and that low ability individuals do face large stigma inhibitions: there is a 55% decline in the probability of seeking when the need for information is correlated with cognitive ability.

If such mechanisms are more broadly relevant—that is, if asking for information about technology signals low ability even without artificially creating a correlation between low ability and need for information—then interventions to reduce the stigma of asking for information, for instance by using technology to make accessing such information private, could increase the demand for social learning.

Social image concerns might also affect the supply of social information. On the one hand, if acquiring the image of being a helpful community member is valued, then social-image incentives such as publicly acknowledging those who share information might increase the supply of information. On the other hand, social-image motives might instead reduce the supply or quality of information. For instance, farmers may want to selectively share positive experiences that create an image of success, while suppressing their failures, thus providing biased information. Similarly, farmers may fear unfairly acquiring an image of being either incompetent or malicious, if accurate information they share leads a peer to make a decision that ends poorly due to chance.

6.3.2 Barriers to correctly interpreting information

A literature in psychology and economics documents several biases in learning and errors in probabilistic reasoning (see Benjamin, 2018 in this volume for a thorough review). Little research on these biases, however, has occurred in field settings or in developing countries. Biases in learning could be important to technology adoption, causing people to put too much or too little stock in available information. This could influence their willingness to experiment and take risks, potentially slowing learning and adoption of productive technologies.

Redundancy neglect. Section 3.3 discussed redundancy bias extensively in the context of health choices. Recall that redundancy neglect describes a failure of Bayesian learning wherein an individual trying to learn by observing others' actions does not account for the fact that other individuals are also engaged in social learning. For instance, an individual may observe multiple neighbors behaving in the same fashion. He may take those separate actions as independent signals of private information whereas, in fact, those neighbors might have in turn have been basing their choice on a single signal from a common source.

This concept is relevant in the context of technology adoption as well. Take, for instance, the context of input adoption amongst smallholder farmers. To correctly interpret the observed behavior of their neighbors, and thereby enhance social learning, farmers must correctly account for these potential "information redundancies" in the network structure of information in their village, for example. Failure to do so could have an outsized effect on how followers value technology. If initial farmers choose suboptimal practice by happenstance, then this inefficient practice may grow entrenched amongst those that follow, creating a situation in which a population is locked into confidentially held false beliefs.

Eyster et al. (2018) and Enke and Zimmermann (2019) conduct lab experiments in which subjects act in precisely this way: by failing to account for the redundancy in signals, subjects do worse than they would do without the possibility for social learning. Murfin and Pratt (2019) provide field evidence that finance professionals exhibit redundancy neglect when pricing loans, as well.

Sampling and statistical biases. In Section 3.3, we discussed sampling and statistical biases and that generalizing from small samples is a widespread phenomenon in a variety of contexts.[29] This evidence is relevant to behavioral development economics since farmers, for instance, might form excessively strong negative opinions about the value of a new technology based on a few unlucky experiences of his own. Agricultural outcomes have high variance, and the inference drawn from a small sample of observations is likely to be misleading. Furthermore, over-inference from small samples might be particularly relevant in rural contexts where farmers' information is often limited to their own experience and that of their neighbors

Moreover, even summary statistics about a technology's profitability based on ample data might not be sufficient to remedy statistical biases: people also dis-

[29] This has been termed "Belief in the Law of Small Numbers" by Tversky and Kahneman (1971).

play a tendency to under–infer from large samples (Griffin and Tversky, 1992; Benjamin et al., 2016). Information campaigns that provide scientific evidence supporting a new technology may thus have limited effect, since farmers might continue to overweight individual negative experiences or anecdotes relative to seemingly conclusive statistical evidence that runs counter. This bias prevents farmers from growing confident when they should, meaning that their beliefs are too easily swayed by new data. Such a bias, along with other statistical errors that give undue weight to recent outcomes (e.g., base-rate neglect; see Kahneman and Tversky, 1973 and Benjamin et al., 2018), may therefore underlie why some farmers seem to switch in and out of using a new technology over time (e.g. Suri, 2011). Countering these statistical biases is potentially critical for sustained adoption.

Selection neglect. Above, we highlighted several ways that farmers may selectively transmit information (e.g. due to distributional concerns or for social image motives). For those who receive this information to properly interpret its content, they must properly account for the selection process underlying when and why farmers share information in the first place. Farmers might, for instance, be excited to tell their neighbors and friends when a newly adopted technology works well but say nothing when it works poorly. Alternatively, competitive farmers may decide to keep information about profitable technologies to themselves.

In each of these scenarios, rational inference requires special attention to the selection rule: in the first case, taking recommendations at face value would lead farmers to become overly optimistic about the technology; in the latter, it would lead them to be overly pessimistic. Enke (2017) provides laboratory evidence that many individuals completely neglect the fact that the signals they receive are selected, especially when the environment itself is somewhat complex. However, nudging participants by drawing their attention to the bias leads to much better inference.

7 Labor

This section discusses behavioral issues in labor markets in developing countries. First, we highlight how work patterns in poor countries differ from those in rich countries. Instead of 9-to-5 work in the formal sector as in rich countries, labor markets in developing countries are instead characterized by three features that might potentially increase the importance of behavioral biases: high levels of informality, casual labor, and self-employment.

We discuss evidence on worker productivity and labor supply in developing countries, including female labor-force participation; wage-setting and incentives with behavioral workers; and the selection of workers.

7.1 Labor markets in developing countries

Many economists assume that the natural default type of labor-force participation is full-time employment on a regular schedule (e.g. 9 to 5, Monday to Friday), with

time during those hours being devoted to work, and other time being devoted to domestic responsibilities. We typically assume impersonal employment norms and laws governing interactions between workers and their managers during the work period. Such work patterns are far from the historical norm or the current situation in developing countries, where many individuals work in family firms without a sharp delineation of work and domestic time; and others are subject to sometimes coercive, multi-stranded relationships, for example, working as domestic servants or for feudalistic landowners with de facto political authority.

Some historians of the Industrial Revolution argue that it is not at all natural for people to work regular hours in factories under factory discipline, and that peasants had to be turned into workers through pressures like enclosures and through devices like factory bells and provisions to lock out workers who showed up late. Many historians and some economists (e.g., Thompson, 1967; Marglin, 1974) have argued that the introduction of the new management technology of factory discipline was as important to the Industrial Revolution as any purely technological innovation. Such scholars tend to see factory discipline as imposed on workers by capitalists, and perhaps as made possible only by the dispossession of farmers by enclosure of the commons.

Clark (1994) turns this interpretation on its head, with a much more benign view of the role of factory discipline. He argues that workers themselves preferred the introduction of factory discipline as a commitment device. He notes that under the older putting-out system, workers "frequently kept irregular hours, often taking off Monday ('St. Monday') and even Tuesday and working long hours on Thursday and Friday" (Clark, 1994). Clark posits that workers valued the constraints imposed on their behavior by factory discipline because this helped mitigate their self-control problems.

Informality and self-employment. Labor markets in developing countries are characterized by high levels of informality and self-employment. Most people in developing countries are self-employed. The majority of the rural population operates a farm in most developing countries, while many additionally operate a non-agricultural business. The poor are highly likely to be self-employed entrepreneurs, potentially running multiple microenterprises or juggling casual labor and business (Banerjee and Duflo, 2007). In contrast, only 12% of employment in OECD countries is self-employment.

Some standard explanations for the lack of large firms, and the prevalence of self-employment in developing countries, are agency problems, credit constraints and predation. A potential additional explanation is that regular employment may simply be costlier for workers in poor countries. First, it may be harder to hold a formal job simply because of the likelihood of unpredictable demands on one's time. For example, you may have to go to the hospital with family members when they get sick to ensure they receive quality care, or you may yourself be more likely to get sick. Second, preferences for work schedules may feature strategic complementarities, which make fixed scheduled unattractive when others do not also have them.

In the United States, Mas and Pallais (2017) show that workers place little value on work-hours flexibility, and instead have a strong preference for Monday–Friday 9-to-5 jobs. In contrast, in developing countries, where most others are self-employed or engaged in casual day-labor, having a fixed schedule may be unattractive. Social expectations for participation in events like weddings and funerals may be shaped by the fact that most adults have flexible schedules. This fact may partly explain why formal-sector jobs in poor countries often come with a wage premium. Such a premium may in part be a compensating differential and not simply reflect a higher marginal product of labor in the formal sector. It is also consistent with the documented high absence rates of employees even in the private sector in developing countries (Kremer et al., 2005).

In standard models of development such as the Harris and Todaro (1970) model, factory jobs are highly desirable and provide large rents. Many economists assume that distortionary unions, or state-owned firms, or labor legislation provide these rents. An alternative perspective is that these jobs are not particularly desirable. Blattman and Dercon (2018) randomly assign industrial jobs in Ethiopia and find that workers quickly quit and move to different sectors.

One implication of self-employment and informal employment is that workers often set their own work hours and effort, without the structure, commitment and norms provided by formal employers. This feature makes behavioral phenomena such as limited self-control and income-targeting potentially more important in labor markets in developing countries. Consistent with this hypothesis, Fafchamps (1993) and Baird et al. (2016) find very low hours worked in agriculture in some parts of Africa: just 9.8 hours per week among young Kenyan adults employed in agriculture. In contrast, Bick et al. (2018) harmonize survey evidence from 49 countries (although missing India, China and large parts of Sub-Saharan Africa) and conclude that people in poor countries work *more* hours on average than those in rich countries. While we do not yet have a full understanding of labor supply differences across rich and poor countries, we discuss direct evidence on self-control problems at work in Section 7.2 below.

Casual labor in agricultural labor markets. The share of the population employed in agriculture is much higher in poor countries than in rich countries. While most agricultural production in poor countries occurs on smallholder farms, with family labor as an input, there is also a highly active agricultural labor market. Most farms employ outside workers for short spells using informal contracts; providing labor in such markets is an important source of earnings, especially for the poorest amongst the poor (Kaur, 2019).

How efficient are these labor markets? At first glance, agricultural labor markets in poor countries would appear to satisfy many of the conditions for competitive markets: many small buyers and sellers of labor, without formal unions or enforced minimum wages. Yet, surprisingly, such markets exhibit several features such as wage rigidity and limited wage dispersion. We discuss these in Section 7.3 below.

Role of the public sector. Formal employment in developing countries is often dominated by the state. The public sector in poor countries is an attractive employer.

It provides a large wage premium over the private sector (much more so than in rich countries), provides job security with few chances of being fired, and rarely utilizes incentives or performance pay (Finan et al., 2017). This public sector typically does quite poorly at providing public services such as education, health, sanitation and law-and-order, relative to rich countries. A recent literature in development economics has used field experiments to study the personnel economics of the state, including topics related to behavioral labor: the selection of prosocial workers, and the response to monetary and non-monetary incentives. We discuss some of these issues in Section 7.4 below.

While many have seen the high absence rates among government social service employees like teachers and health workers as evidence of weak incentives and poor accountability in the public sector, it is worth noting that absence rates of teachers in private schools are also very high (e.g., 22.8% in Indian private schools, Kremer et al., 2005). One interpretation of this fact is that high absence rates are in fact part of an efficient contract because employees find a regular 9-to-5 schedule to be very costly.

Social norms and networks. Social norms and networks play an important role in labor markets in developing countries, just as in rich countries. However, the nature of the norms and social pressures may differ. For instance, many developing countries have strong norms against female labor force-participation. In India, the caste system prescribes norms regarding appropriate occupations for individuals based on their inherited caste (although surprisingly little recent work in economics studies how this distorts occupational choice). Given the importance of kin or caste networks in poor countries, job search and referrals often flow along these networks, leading to potentially inefficient matching of workers with jobs (Beaman and Magruder, 2012). The barriers to the efficient allocation of workers to jobs—such as due to norms against women or other disadvantaged groups working—may have large aggregate effects on growth, as has been studied in the case of the United States (Hsieh et al., 2018).

In addition, life for workers and even employers in poor countries features many deprivations: the scarcity of money, the prevalence of environmental factors such as noise and heat, and health issues such as chronic sleep deprivation among the urban poor. While we discuss these factors in detail in Section 10 on the psychology of poverty, they may also have implications for worker productivity.

7.2 Labor supply and worker productivity

Self-control problems. One implication of informal work is that productivity may be more influenced by behavioral biases. Given the lack of direct or indirect supervision by workers in informal labor markets, the consequences of workers' self-control problems could be particularly pronounced. Someone who is self-employed will likely not face the same consequences of arriving late at work or of not showing up at all, for example, as someone with a fixed schedule and a supervisor to report to. The Indian rickshaw drivers and other low-income workers studied in Schilbach

(2019), who often work while inebriated, are only able to do so because they are self-employed.

Kaur et al. (2010) study whether workers prefer contracts that help them commit to working more to overcome self-control problems. Such self-control problems at work may be different than in other domains because, in addition to reducing the worker's welfare, they can hurt profits. The existence of self-control problems fundamentally changes the nature of the contracting problem, in that both parties have interests in incentivizing the worker to exert more effort in the future. Furthermore, whereas in other contexts commitment mechanisms will only arise if agents are sophisticated and demand them, employers may elect to design contracts that mitigate self-control problems even if the employee is naïve or does not demand them explicitly. The authors speculate that this may be the reason why employers often impose contracts with production minimums, such as the forty-hour work week, where employees have little authority over how much they work, and instead must elect to either work the designated amount or risk being fired.

Using evidence from a 13-month field experiment in India, Kaur et al. (2015) investigate whether commitment contracts can help workers tackle their self-control problems and increase their productivity. Study participants were hired as full-time data-entry workers and paid a piece rate for output, without restrictions on their hours, so that they could largely determine themselves how much they would produce and be paid. Then, on randomly selected days, the experimenters gave workers the option to set a target output level for the day. If their realized output fell below the chosen target, workers received a piece rate that was half of the usual rate; if their output exceeded the target, they receive the usual piece rate. Choosing a positive target creates a dominated contract, in that the contract punishes low output but does not reward high output relative to a contract with no target. Crucially, apart from potential boosts in productivity and labor supply, there is no reason for workers to choose a positive target since doing so can only reduce workers' pay for any given worker effort.

Workers set a positive target 36% of the time when offered the option to choose a target level, thus selecting a dominated contract that incentivized reaching the target. Workers also exerted more effort as the randomly assigned payday approached, suggesting high levels of worker impatience and the existence of self-control problems.[30] The authors argue that workers chose these dominated contracts to overcome self-control problems and commit themselves to working a certain amount. Indeed, choosing such a contract increased worker output, with an effect of the same size as an 18% increase in the piece rate. Those who had greater payday effects were more likely to choose positive targets when offered and had larger increases in output under these contracts relative to the standard contract. As some workers may be naïve about their level of self-control, and thus may not choose commitment despite having self-control problems, these estimates may be a lower bound on the extent of time inconsistency and the potential of these kinds of contracts to increase productivity.

[30] Although note that a standard model of present bias would not imply higher effort closer to the payday, unless workers are severely liquidity-constrained.

This result is consistent with the explanation that the workers with the greatest self-control problems benefited the most from the dominated contracts. However, if there is heterogeneity among workers in the extent of self-control problems, workers who do not have strong self-control problems may be made worse off by the fact that other workers have self-control problems. This insight stands in sharp contrast to other equilibrium settings in which, for example, the gym membership setting in which agents with more standard preferences effectively benefit from the firm's efforts to exploit the preferences of behavioral agents since firms are subject to a zero-profit condition in equilibrium. In this context, there is an adverse selection problem in which firms may be forced to offer contracts with draconian work rules to avoid selecting undesirable workers, even if those draconian work rules are not appropriate for most workers.

Reference-dependence and income targeting. Another implication of self-employment with flexible schedules is that workers may engage in various forms of income or effort targeting. In his book, *The Protestant Ethic and the Spirit of Capitalism*, Weber argued that peasants in traditional societies have what modern economists would label a backward-bending labor supply curve and contrasted this to what he saw as the predictions of models of rational economic actors.

In a static labor-supply model, there are opposing income and substitution effects, so the response to a wage increase is theoretically ambiguous. However, in a dynamic model in which there are high-frequency wage shocks, and individuals have a constant exponential discount factor, for any plausible parameter values, labor supply would increase in response to temporary wage increases (e.g., Lucas and Rapping, 1969). Backward bending labor supply could be generated under at least two behavioral stories: reference-dependent preferences and present bias. First, we discuss reference-dependent labor supply, which has received a great deal of attention in the behavioral literature.

An active literature has studied whether workers such as taxi-drivers, who can set their own hours, respond to wage shocks as neoclassical models would predict (by increase labor supply when wages are high), or if they instead exhibit income-targeting due to reference-dependence (such that fewer hours of work are supplied when the wage is high, since the reference point/income target is attained sooner on high-wage days).[31] While there remains a debate in this literature, most evidence points towards some role for income targets and reference dependence, with negative daily wage elasticities (e.g. Thakral and Tô, 2018).

The literature on reference-dependent labor supply has largely been used to provide sharp tests of reference-dependence in the field, rather than because of the inherent economic importance of daily labor supply in rich countries (O'Donoghue and Sprenger, 2018 in Volume 1 of this handbook). In poor countries, given the high share of self-employment, this phenomenon could be rather more important.

[31] See, for instance, Camerer et al. (1997), Farber (2005, 2015), Crawford and Meng (2011), and Thakral and Tô (2018).

Economists studying developing countries have begun to apply this idea to studying labor supply (Giné et al., 2017; Andersen et al., 2014; Dupas et al., 2018b). Below, we discuss one such paper in detail.

Dupas et al. (2018b) study the labor supply of Kenya bicycle-taxi drivers. They depart from the existing literature in two ways. First, instead of estimating the reference point, or using the typical earnings as the reference point, they collect daily data on the worker's "cash needs" for the day—unexpected (until recently) expenses such as repairs or entirely anticipated needs such as a savings-club payment coming due. Second, instead of relying on instruments for the wage, they use experimental cash drops on workers to generate variation in how quickly the cash needs for the day may be reached.

The authors find evidence of income targeting, in that labor supply responds positively to cash needs, even entirely anticipated needs. However, a cash drop at the beginning of the day does not decrease labor supply, implying that the reference point is over earned income, rather than over total daily income.[32] Finally, Dupas et al. (2018b) develop a model in which being below the reference point reduces effort costs (rather than the usual assumption that being below the reference point induces a sense of loss). The authors calibrate this model to conclude that in the absence of such income targeting, workers would earn 19% *less*, even in the absence of factors like present bias. Since their model does not feature the exogenous wage shocks (as opposed to cash drops) considered by the previous papers, they do not capture a potential opposite effect of income targeting: that income-targeters will earn less for the same total number of hours supplied, since they will work too long on low-wage days, and too little on high-wage days.

Dupas et al. (2018b) thus implicitly connect the literature on reference-dependent labor supply with a potential alternative or complementary explanation: liquidity constraints caused by present bias. In a standard model, individuals should not react sharply to predictable daily expenditure needs, since they would be building up savings over time. If people are severely present-biased, as discussed in Section 2, then they may hold no liquid assets and may also be incapable of saving funds from the period with high wages and using them in periods with lower wages. In this case, the dynamic labor supply problem approximately reduces to the static problem with opposing income and substitution effects and the theoretical impact of a temporary positive wage shock on labor supply is again ambiguous.

Environmental factors. Heat and noise are ubiquitous features of developing countries, especially in large cities. Dean (2018) conducts an ingenious set of experiments in Kenya with factory workers who are accustomed to working in a noisy environment, recruiting them to work in an environment where the experimenter can control noise levels. The author shows using a randomized intervention that a 10 dB increase in ambient noise (akin to the increase in noise from running a vacuum cleaner compared to a dishwasher) leads to a 5% decline in output of textile workers. Using lab

[32] The literature studying cab-drivers has implicitly made the same assumption, since those papers only consider a single source of income.

measures, he shows that the increase in noise also causes a worsening of cognitive function. Specifically, executive function (also known as cognitive control), a set of higher-order cognitive functions which direct one's attention and manipulate working memory (Diamond, 2013), declines by 0.07 standard deviations. While the decline in cognitive function cannot be directly linked to the decline in the textile-production output, some alternative channels such as direct effects on health can be ruled out. Moreover, noise has no effects on a cognitively unchallenging effort task (the a–b task of DellaVigna and Pope, 2017).

Importantly, Dean (2018) finds that workers seem unaware of the effect of noise on their productivity, despite having frequently experienced exposure to such noise. Stated beliefs about the productive effect of noise were generally inaccurate, and workers were not willing to pay more for a quiet work environment when pay depended on productivity compared to when pay was fixed (although the latter comparison is somewhat under-powered). This evidence suggests that while the amenity value of quiet was valued to some extent, its productive value was not appreciated. Workers are thus unlikely to take steps by themselves to sufficiently insulate themselves from noise.

Adhvaryu et al. (2018a) show similar effects for the consequences of heat in the workplace. They work with 26 textile factories in India and show that replacing incandescent bulbs with LED lighting reduced temperature on the factory floor, boosting output substantially, and particularly on hot days. Daily variation in temperature similarly affects output. While the authors do not formally elicit workers' or managers' beliefs about the effect of heat, they note that the managers were unaware of the productivity benefits of lowering temperature, and that the change in lighting was implemented to reduce lighting costs. We return to this point when we discuss behavioral firms in Section 8.

7.3 Wages and behavioral workers

We now turn to understanding aspects of wage and incentive-setting in labor markets in developing countries. We discuss wage rigidity in markets for casual agricultural labor, the absence of pay dispersion across workers, and evidence on gift exchange at work.

Wage rigidity. Many analysts of labor markets in developed countries assume that features like downward nominal wage rigidity and wage compression are driven by labor market institutions such as unions, labor market regulation and the threat of union or regulatory action. Looking at sectors of the labor market of developing countries where both unions and effectively enforced government regulations are close to absent, such as agricultural labor markets, suggests that behavioral factors play an important role.

Kaur (2019) revisits nominal wage rigidity in the context of Indian agricultural labor markets. First, she documents that nominal wages appear sticky from year-to-year. Next, she finds that positive rainfall shocks, which increase the marginal product of labor temporarily, increase nominal wages. In contrast, negative shocks do not re-

duce wages. Moreover, transitory positive shocks lead to *persistently* higher nominal wages, even when the marginal product of labor has returned to a lower level. The asymmetry in response to positive and negative shocks is precisely what is predicted with nominal rigidity. Such rigidities distort employment: agricultural employment is 9% lower in the year following a positive shock. Consistent with the importance of fairness motives, Kaur shows survey evidence that nominal wage cuts are widely perceived as being unfair, as in the classic findings of Kahneman et al. (1986) and Bewley (1998).

Breza et al. (2018a) provide field-experimental evidence on how such nominal wage rigidities persist in the absence of enforced minimum wages or formal institutions such as unions. The authors partner with small employers to offer jobs to workers in spot labor markets in India during the lean season, when unemployment is high. They vary both the wage offered to the worker—either the prevailing market wage, or 10% below the wage—as well as the observability of the wage offer (either inside the worker's home, or on a public street). Offers below the market wage are often accepted when made in private (18%, compared to 26% acceptance at the full market wage). However, acceptance of low offers drops to only 2% when the low-wage offers are made publicly. In contrast, offers made at the market wage are equally likely to be accepted in the private and public conditions. Workers thus appear to be subject to social pressure to prevent them from accepting job offers below the prevailing market wage. Nearly a quarter of workers are willing to forego a day's work to avoid being seen as a "scab".

The authors provide indirect evidence that the wage floor is enforced through social sanctions: when playing a costly punishment game in the lab, players impose large penalties on their partners when they are informed that the partner previously accepted a job at below-market wages. Interestingly, players impose these punishments even on scabs in other villages, whose labor supply does not affect their own outcomes, implying that punishing scabs is an internalized social norm. The paper leaves one puzzle unanswered: why are employers not able to make such offers in private themselves, especially given the repeated nature of the employment relationships, and the potentially substantial efficiency losses?

Pay equality. An existing literature in behavioral labor studies the consequences of pay inequality in the workplace. Card et al. (2012) show using a field experiment at a large employer that disclosing information on peers' salaries reduces job satisfaction among workers with below-median salaries in their work unit and makes them more likely to look for a new job. Breza et al. (2018b) build on this literature by studying how social preferences over pay inequality affect not just satisfaction and job-search, but also workers' labor supply and productivity. The authors set up a manufacturing workshop, in which 378 workers are randomized into small units of three workers each, for one month of full-time employment. Workers are paid a flat daily wage for attendance but select their own effort levels.

Breza et al. (2018b) randomly assigned work units to one of four different pay structures. In the "pay disparity" treatment condition, each worker in the unit is assigned to a different wage (w_{low}, w_{medium}, w_{high}), based on their own baseline pro-

ductivity levels, with the most productive worker receiving the highest wage. The pay differences between the three levels are modest (less than 5%). In three control conditions, all workers in a unit were paid the same—either w_{low}, w_{medium}, w_{high}, depending on the group. This design allows the authors to compare two individuals earning the same daily wage, with one being in a group with pay inequality (the treatment group), and the other in a group with homogeneous pay (the control conditions). Importantly, the design allows the authors to identify the effects of pay inequality separately on high earners and on low earners.

The key finding is that when coworker productivity is hard to observe, introducing pay inequality reduces output by 0.45 standard deviations, driven largely by an 18-percentage point reduction in attendance. Somewhat surprisingly, while the reduction is largest for the workers who are paid the least in their group, even those receiving the high or medium pay reduce their attendance, suggesting that pay inequality makes the workplace a less attractive environment. Overall, workers appear to give up 9% of their earnings to avoid a workplace where they are paid differently than their peers. Interestingly, these negative effects on worker morale vanish if the wage inequality is more clearly justified: when output is more observable, or when coworkers' baseline productivity levels are further apart, pay disparity does not reduce output.

Kaur (2019) and Breza et al. (2018a, 2018b) help explain why even decentralized informal markets in developing countries have high levels of nominal wage rigidity and little dispersion in wages across workers.

Incentives in the public and non-profit sectors. Developing countries often have poor provision of public services such as education and health. An active area of research in development is thus on how to improve the productivity of workers in the public and allied non-profit sectors. Recent work has evaluated financial incentives for performance, with mixed results. Some papers find positive effects: for instance, financial incentives for teachers can reduce teacher absence (Duflo et al., 2012) and improve student test scores (Muralidharan and Sundararaman, 2011). However, providing incentives to multi-tasking agents is well known to be difficult (Holmstrom and Milgrom, 1991). Indeed, some papers show that incentives are gamed when employed, and argue they are of limited utility (Glewwe et al., 2010). Perhaps the bottom line is that such financial incentive programs, whether effective or not, are often politically unpopular and are rarely adopted and scaled up by governments (Finan et al., 2017).

One alternative, lower-cost strategy is to provide non-monetary incentives such as social recognition and awards. The idea is to increase and harness prosocial motivation, to provide social-image or competitive motives to exert effort, and to align the worker's identity with the employer's goals. Despite a great deal of interest in such interventions, and evidence that social incentives broadly matter in organizations (Ashraf and Bandiera, 2018), there is relatively little evidence on their effectiveness in the field in poor countries, especially with the public sector or over an extended period.

An exception is Ashraf et al. (2014), who compare financial and social incentives for the sale of condoms by agents of a non-profit organization in Zambia. The authors find that a simple non-monetary incentive—providing agents with a publicly-displayed "thermometer" display and awarding stars based on sales—outperforms even providing them with a 90% margin on selling condoms. However, in this case, even the largest financial incentives were modest, given the low cost and demand for the condoms. It is unclear what role the prosocial nature of the task played in making the thermometer display effective. More research remains to be done on whether such non-monetary incentives are more broadly effective, on which types of such incentives are most promising, and what the underlying mechanisms are. The same challenges with providing incentives to multi-tasking agents that apply to financial incentives will also likely apply to non-monetary incentives.

Crowd-out of intrinsic motivation. One question that has garnered much interest in both development policymaking and in behavioral research is whether extrinsic incentives crowd out intrinsic motivations. Influential lab evidence from social psychology has shown that extrinsic rewards *can* reduce individuals' intrinsic motivation to do a task. A famous paper by Deci (1971) shows that after a temporary incentive for solving puzzles in the lab is withdrawn, effort in a subsequent unincentivized round is lower than in a group where incentives were never offered to begin with. Several lab experiments provide similar evidence of crowd-out of intrinsic motivation, and theoretical work in economics provides potential explanations for this phenomenon: e.g. incentives can signal information such as task difficulty and extrinsic rewards can muddy the self- or social-signaling value of a prosocial task (Bénabou and Tirole, 2003, 2006).

Yet, there is little field evidence that extrinsic incentives crowd out intrinsic motivation substantially.[33] Lacetera et al. (2013) review field studies on incentives for blood donation—an example of a prosocial task in which policy makers are concerned about potential crowd-out—and conclude that in 18 out of 19 cases, providing incentives increase donation, without evidence of long-run reductions in donations if incentives are removed. Some papers also find that more pro-socially motivated workers respond more to financial incentives, perhaps due to the correlations of prosociality and other omitted variables in the underlying population (e.g. Ashraf et al., 2014).

Overall, there seems little reason to think that extrinsic incentives systematically crowd out intrinsic motivation in practice in real-world situations. This result is relevant, for instance, for the ongoing policy debate about whether community health workers should be paid more. In the following section, we describe evidence that paying higher wages does not generally lead to increased select of less prosocial workers.

[33] An exception is Gneezy and Rustichini (2000), who find that introducing a small fine for late pickup of children from day-care centers in Israel increased the incidence of late pick-ups.

Gift exchange. Incentives are often limited in real-world workplaces, particularly when output is multi-dimensional or hard to measure (Holmstrom and Milgrom, 1991). Theories in labor and behavioral economics suggest that workers' identities, alignment with the employers' missions, and their social preferences towards their employers may all play an important motivating role (Akerlof and Kranton, 2005; Besley and Ghatak, 2005). The theory of gift exchange argues that employers can benefit by paying workers above market wages, since workers may respond by working harder, even absent repeated-game motives (Akerlof, 1982). A recent field-experimental literature in behavioral economics uses one-shot employment opportunities to evaluate whether workers reciprocate by working harder (or less hard) when employers surprise them with higher (or lower) pay. The findings are mixed, with recent studies mostly finding small, if any, gift-exchange effects, particularly in response to pay increases (Gneezy and List, 2006; DellaVigna et al., 2016; Esteves-Sorenson, 2017).

Two recent field studies from developing countries study gift-exchange in entirely natural settings in real organizations, although with repeated-game incentives in play, since they consider long-term employment relationships. Both studies find little evidence of gift exchange. de Ree et al. (2018) conduct a large-scale randomized experiment with a representative sample of schools in Indonesia and find that a *doubling* of base pay for teachers led to no improvement in measures of teacher effort or student learning.

Jayaraman et al. (2016) study a government-induced contract change for tea pickers in an Indian plantation. For most workers, the contract changes led to increased base pay with constant or reduced piece-rate incentives. The authors find that, in the first month after the more generous contract is introduced, output increases by 20 to 80%. Yet, this effect dissipates over subsequent months, and eventually output is reduced below the original level. The results are consistent with an initial "behavioral" response, but a longer-run adjustment to the neoclassical prediction. This result highlights one benefit of studying incentives and wages in the field with longer-run studies, even at the risk of failing to isolate precise mechanisms.

7.4 Selection of workers

Given the lack of incentives, and often even accountability, in the public sector in developing countries, there has been a great deal of policy interest in selecting prosocial and intrinsically motivated workers into the public sector. The optimal selection of workers for the public sector, or for other pro-socially oriented professions, has been a subject of a recent field-experimental literature in development economics.

One question has been whether offering higher wages, which might attract more talented workers, will negatively select on the prosocial motivation of workers. Dal Bó et al. (2013) work with the Mexican federal government to randomize wage offers across 167 municipalities to fill 350 positions. Applicants complete a battery of tests of ability, personality traits and prosocial motivations. The authors find that higher wage offers attract a higher-ability applicant pool in terms of fluid intelligence, better

personality traits, and experience. Yet this increase in applicants did not come with a cost in terms of lower public-service motivation (measured using survey questions). Ashraf et al. (2018) find similar results with a field experiment in Zambia, where they vary across locations whether job postings to recruit health workers emphasized either career prospects or instead the possibility of helping one's community. Emphasizing career prospects led to recruiting applicants with higher high-school grades, but no lower prosocial motivation. Moreover, those recruited under the career concerns condition have much better job performance.

In contrast, Deserranno (2018) finds that posting job notices with a higher implied pay attracts candidates who donate less money in dictator games, and who perceive lower social benefits to the job at the time of applying. Such candidates subsequently have higher turnover on the job. However, one important way this experiment differs from the others is that Deserranno studies applicants to an entirely new position, such that the advertised wages may communicate a great deal more information about the position that will typically be the case. This feature makes it perhaps more likely that the theoretical mechanism of Bénabou and Tirole (2006) applies, but it is not clear that such an effect would persist once information about the jobs is more widely diffused.

While paying less and yet recruiting more motivated workers is no doubt an attractive proposition for governments and non-profits, the bulk of the evidence suggests that this is unlikely to be the case. This evidence is consistent with the underlying correlation of cognitive ability and pro-sociality in the population: Falk et al. (2018) find in their Global Preference Survey that altruism and reciprocity are both strongly positively correlated with cognitive ability within countries. In addition, the previous section argued that crowd-out of intrinsic motivation is similarly not typically found in the field. Clearly, one should not generally expect to find that higher wages will select out prosocial motives.

7.5 Female labor-force participation

Another striking aspect of labor markets in some low-to-middle income countries is the low rate of female labor force participation (FLFP). Only 52% of women in poor countries participate in the labor force, compared to 78% of men (Duflo, 2012b). However, there are large differences across cultures and regions. Labor force participation seems more equal by gender in sub-Saharan Africa where, in 2017, World Bank data suggest that the labor force participation rate of women was 63%, compared to 74% of men (ILO, 2018).

In contrast, female labor market participation is particularly low in South Asia, the Middle East and North Africa. For instance, FLFP in India has hovered below 30% in recent years, with some evidence of a decline since 2005, despite economic female education growth (Fletcher et al., 2017). Low FLFP is worrying to policy makers, both because of the aggregate effects of likely misallocation of talented women (Hsieh et al., 2018) and because working outside the home increases female empowerment (Heath and Jayachandran, 2016).

Why is female labor-force participation so low in some countries? A standard economic answer would involve gender specialization in home and wage work, possibly due to biological reasons such as women's role in childbearing and nursing. However, standard economic answers do not explain much of the variation in FLFP, even conditional on GDP per capita. A literature in cultural economics, described also in Section 9 below, provides evidence on the historical roots of FLFP. And two recent papers in behavioral economics provide evidence of specific behavioral mechanisms which depress FLFP.

Self-efficacy. McKelway (2018) studies internal psychological constraints on women's employment in India. She implements a field experiment with women and their families in partnership with a large firm which offers employment opportunities to women. The key treatment is an intervention to increase women's self-efficacy—beliefs in one's own ability to attain one's desired outcomes. The author finds large and sustained increases in women's employment due to the treatment. In a second experiment, the author randomizes job offers to women, and finds that receiving a job offer increases self-efficacy months later. Thus, living in a setting with low female labor-force participation may reduce women's self-efficacy, which in turn depressed women's employment.

Social norms. Bursztyn et al. (2018) provide evidence for the importance of social norms in suppressing female labor force participation in Saudi Arabia. The authors show that most young married men in Saudi Arabia privately support women working outside the home. However, these men underestimate the level of such support among similar men in their neighborhoods. Correcting these beliefs—that is, informing men about the true rates of private support—causes men to become substantially more likely to sign their wives up for a job-search service.

Four months after this intervention, the wives of treated men are more likely to have applied and interviewed for jobs outside the home. The paper thus provides evidence that social norms may suppress female labor force participation, and how those norms may remain sticky, since individuals who support the taboo behavior may be hesitant to reveal their views to others for fear of social sanction. However, it is not clear if there are many such situations in which second-order beliefs are biased. For instance, men in conservative communities in India might well be accurate in thinking that their neighbors will judge them harshly if their wives work outside the home. Measuring such second-order beliefs systematically in areas where norms may be important could be a promising avenue for future research.

While the above two studies provide careful evidence on specific mechanisms constraining FLFP, they do not in themselves explain variation in FLFP across societies. Preferences and cultural transmission might play an important role. Fernandez and Fogli (2009) show that the labor supply decisions of second-generation American women depend on the FLFP rates in the country of familial origin, despite presently facing the same economic environment. This result suggests a role for cultural transmission of attitudes or values regarding FLFP. Alesina et al. (2011) show that regions with a history of the use of the plough in agriculture—in which men had a comparative advantage—are associated with more gender inequality in present-day attitudes,

and with less female participation in the labor force. Thus, at least to some extent, FLFP appears to be driven by sticky cultural and preference factors.

8 Firms

Behavioral economics investigates how *individual* decision-making, preferences, and beliefs systematically depart from standard economic models. It is thus not surprising that even behavioral industrial organization (Heidhues and Koszegi, 2018) has mostly assumed sophisticated, profit-maximizing firms responding to behavioral consumers.

Is it reasonable to assume that firms successfully maximize profits? There are numerous justifications for this assumption. First, one longstanding argument for treating firms as neoclassical actors is that market forces should weed out firms that systematically deviate from profit-maximizing behavior. Therefore, at equilibrium, surviving firms will be profit-maximizers.

Second, applying the same argument to competition within firms and building on Lucas's (1978) span of control model, even if a significant share of individuals exhibits behavioral biases, individuals without such biases may rise to become the key managers and decision-makers in firms. In contrast, workers with particularly severe behavioral biases might get fired. Of course, forms of principal-agent problems within firms can attenuate this advantageous selection.

Third, many important decisions in large firms are made jointly by several actors and often under intense scrutiny by stakeholders and the company's board, potentially limiting the scope for persistent mistakes, to the extent that groups are more rational than individuals (Cooper and Kagel, 2005; Charness and Sutter, 2012; Kugler et al., 2012). Moreover, workers typically receive considerable training and operate within structures that are designed to limit the impact of behavioral factors.

8.1 Are firms in developing countries more "behavioral"?

Given these arguments, there are several reasons to think that firms in developing countries are more likely to deviate from the neoclassical benchmark than firms in rich countries. First, competitive pressures may be lower in poor countries. Imports are often restricted by high tariffs and the entry of new firms as well as the expansion of existing firms may be restricted for various reasons including financing constraints, agency problems, and regulations. High travel costs, especially in rural areas, mean that buyers may have only a limited number of firms available to choose from, providing firms with some amount of local monopoly power. Prices are sometimes fixed by manufacturers, preventing price competition. State ownership of large enterprises in countries such as India and China, weak anti-trust regulations and a higher importance of political connections, cronyism, and corruption may also contribute to lower levels of competitiveness in developing countries.

Second, firms in developing economies are small. Hsieh and Olken (2014) find that about 90 percent of firms in Mexico employ less than 10 workers. In India and

Indonesia, the corresponding number is close to 100 percent. This firm distribution is in sharp contrast to rich countries (Tybout, 2000). Thus, firms in poor countries involve a limited span of control: decisions are often made by one person only, the owner-operator. There is little scope for within-firm competition that might cause non-behavioral agents to rise to the top of the firm via an efficient selection process. Nor are firm owners necessarily highly selected. As described in the previous section, self-employment rates are much higher in poor than in rich countries: a large share of individuals operate some sort of firm.

A classic theme in development economics is the lack of separation between household economics and firm economics for smallholder farmers. Under the conditions for the separation theorem, family labor supply or risk preferences of household members would not affect the type of agricultural production chosen. In reality, they seem to have an impact (e.g., Lopez, 1984; Grimard, 2000; Le, 2010). Given this finding in development economics, it is only natural to expect that behavioral factors, like other household factors, would have important impacts on production in family-run firms.

Behavioral issues might also be particularly powerful due to limited training and education, and limited potential to learn from co-workers or to receive on-the-job training. While new workers in a large firm are thoroughly instructed and trained, such training does not exist in small firms in developing countries. Few owner-operators have much business-training or adequate schooling, such that making optimal decisions might be more challenging.

Some factors instead point in the opposite direction. One might argue that behavioral issues are less likely to have bite since the stakes are a lot higher for self-employed individuals and owners of small firms—their consumption is directly tied to profits. Moreover, within any given marketplace in Kenya or India, one can often observe many seemingly identical retail shops that offer nearly identical products, suggesting high levels of local competition. Yet, none of these shops appear to grow rapidly and few go out of business. Nor do behavioral issues only matter for small decisions: even high-stakes decisions such as retirement savings choices or decisions to take one's potentially life-saving medications seem to involve behavioral biases, as described in other chapters in this handbook. Moreover, some behavioral factors such as present bias and loss aversion could have more bite precisely because firm profits and individual consumption are so intimately linked.

The topic of behavioral firms departs from an emphasis on the classic behavioral biases such as present bias, loss aversion, etc. By "behavioral firms", we simply mean firms that depart from profit-maximization in systematic ways. We do not yet have enough research on this to be sure if these cases are due to the same psychological factors studied in consumer behavior or if other biases and behavioral phenomena are more relevant in the case of firm decision-making. Almost surely, limited attention, salience, failures of Bayesian learning, and self-control issues can matter for firms too.

8.2 Behavioral firms: evidence and applications

Once we start considering firm decision-making, many unexplored and potentially important areas of research arise.

Trust, firm structure, and missing firm growth. Behavioral economics may provide some insights into why firms in developing countries are small and typically run as a family business with little decentralization in decision-making. Standard explanations for small firms include taxation, regulation (e.g. labor regulation), and predation. While these factors may well play some role, many firms are even smaller than these thresholds (e.g. Hsieh and Olken, 2014), suggesting there may be additional reasons for firms to fail to grow. Credit constraints again likely play some role, but even with incomplete credit markets, profitable firms should grow over time and increase their market share.

Low levels of trust may play an important role in keeping firms small is. As described in detail in Section 9, developing countries have systematically lower levels of social trust than rich countries (Falk et al., 2018). Lower levels of trust have been shown to be associated with smaller firm sizes and less decentralization of decisions made within firms, both between and within countries (Cingano and Pinotti, 2012; Algan and Cahuc, 2014). Non-Western countries are also more likely to have moral values emphasizing the importance loyalty to one's group and respect for authority (Haidt, 2012). This in turn might make firm owners less likely to hire or cooperate with out-group members, and less likely to decentralize decision-making, potentially inhibiting firm growth. Moreover, these differences are driven at least in part by deep historical factors (Enke, 2018; Schulz et al., 2018), and might thus causally explain variation in firm size across countries.

This argument echoes an existing literature on agency issues in firms in developing countries. Ilias (2006) argues that some managers decide to hire only family members as an organizational way of dealing with agency costs. Consistent with this hypothesis, Ilias shows that there is a positive relationship between family size and firm size in the surgical-instrument industry in Pakistan. Firm founders with more brothers (and therefore a larger pool of potential managers) end up with larger firms. Similarly, Bertrand et al. (2008) study 93 large business families in Thailand and find a positive relationship between family size and family involvement in the company. When the founder dies, sons play a larger role in the company, and their increased involvement following the founder's death is associated with lower firm-level performance. The authors' interpretation of these results is that the sons engage in a "race to the bottom" to tunnel out company resources.

Bloom et al. (2013), discussed below, argue that the mid-sized firms they study were constrained from taking up high-return management practices due to a lack of management time. They implicate a low level of trust: firm owners do not trust non-family members to make important decisions or occupy important managerial

slots. Managerial human capital even in these relatively large firms in India is thus constrained by the number of male children in the owner's family.[34]

Objective function. Standard producer theory assumes that a firm's goal is to maximize expected profits. When firms are instead run as a small (family) business, the objective function of the firm might be quite different. For instance, the owner's risk preferences likely matter, making risk-neutrality and thus expected-profit maximization not a safe assumption. Firm owner-operators might not even desire growth, given the increased effort and lifestyle changes firm growth might entail. Their objectives may include providing employment to their family or descendants. They may operate microenterprises as a coping strategy to diversify risk, given the potential for shocks to other sources of household income such as agricultural output (e.g., Adhvaryu et al., 2016). Yet, at present, we have a limited understanding of what the actual objectives of firm-owners in developing countries are and the extent to which the preferences and skills of household members affect firm decisions.

Pricing. Firms might make suboptimal pricing or product choices. They may have trouble estimating consumer demand accurately, leading to suboptimal pricing or product choices. Even if firms perfectly understand demand, they might deviate from optimal pricing decisions. Recent work has begun to document substantial failures of profit-maximization among even large and highly sophisticated firms in rich countries. For instance, DellaVigna and Gentzkow (2017) show that a large grocery-store chain in the US prices its products uniformly within large geographical zones, despite substantial variation in the incomes of shoppers across stores. The authors calculate that the firm gives up 7% of profit by failing to price optimally. Given that such large firms US chains leave plenty of money on the table by making suboptimal pricing choices, it seems worth scrutinizing firms' pricing choices in developing countries. To the best of our knowledge, no such studies exist.

Inventory management. A recent literature has begun to point to examples of small-business owners in developing countries leaving profitable investments unexploited. Kremer et al. (2013) show that many shopkeepers in rural Kenya fail to make small inventory investments with high expected returns. First, shopkeepers often fail to take advantage of bulk-purchase discounts from distributors. A considerable mass of inventory purchase orders is for quantities which fall just below thresholds at which additional discounts kick in. In addition, shops frequently experience stock-outs due to not maintaining enough inventory, even for relatively low-price goods which can be purchased in small increments, such as phone cards. The correlation of returns to inventory across goods is also low, suggesting that shopkeepers may not be equalizing marginal returns to inventory across goods. Inventory levels are predicted by small-stakes risk aversion displayed by the owners in a lab game, as well as by their math skills, but not by their self-reported credit constraints.

[34] This example provides another illustration of the inefficiencies caused by the norms against female labor-force participation.

Beaman et al. (2014) provide another example of small firms failing to maximize profits. They show that a representative sample of micro-enterprises in two Kenyan cities lose 5–8% of total profits for a surprisingly simple reason: they fail to keep enough change on hand to break larger bills, and thus lose potential sales to customers. The authors study 508 typically small firms, with 60% having just one worker, the owner. The firms include a variety of businesses, from vegetable vendors to furniture shops, and service providers such as small restaurants, repair shops, and barbers.

Simply drawing firms' attention to the frequency of "change-outs" and lost sales—through a randomized information intervention, or simply by asking them questions about it—led to a reduction in change-outs and an increase in sales and profits. This result parallels Hanna et al.'s (2014) results on inattention and technology adoption: firms may not think that change-outs are important, and they thus fail to attend to them. But once their attention is drawn to the neglected factor, or if they are directly provided with the summary information, they make the high-return investment. If the change-outs were instead due to other (rational) factors such as an aversion to keeping cash on hand due to the risk of theft, providing information on the frequency and cost of change-outs would not be expected to change behavior.

Labor and capital choices. Firms might also deviate from profit-maximization in their labor and capital-investment decisions, although we have few direct tests of this. Adhvaryu et al. (2018b) show that even large firms may under-invest in worker skills: an experimentally introduced low-cost soft-skills training for workers in a large textile firm increased worker productivity by 20% without raising turnover, resulting in a large internal rate of return (over 250% over eight months). How could such large returns remain unexploited by a large firm? One possibility is that the owners and managers simply under-estimate the returns to soft skills among workers.

Firms might also manage their staff inadequately, e.g. by providing suboptimal incentives to workers, by making inefficient hiring choices, or by discriminating certain types of workers or by hiring their friends and family members. One suggestive example is from Abebe et al. (2017), who document that firms in Ethiopia do not understand how skills among workers are correlated with barriers to applying to jobs. Specifically, they show that a firm that provides a small monetary subsidy for people to apply to its open jobs attracts a more talented applicant pool than it can achieve by even doubling the offered wage. The crucial finding from the behavioral perspective is that firms systematically under-estimate the effect of providing such a subsidy. In fact, managers on average expect applicant quality to *decrease* due to the subsidy.

Finally, firms may fail to adopt the highest-return technologies, as discussed with numerous examples in Section 6, although these focus on agricultural technology adoption by small-scale farmers. Even larger firms may not adopt appropriate technologies. For instance, Adhvaryu et al. (2018a) describe how managers of the 28 textile factories in their study largely neglected the effect of heat on worker productivity, and thus undervalued LED-lighting technology. When LED lighting was adopted to satisfy environmentally-motivated international buyers, the side-effect of reducing temperatures led to substantial unanticipated increases in productivity. Similarly,

Atkin et al. (2017) document organizational barriers to the adoption of a profitable technology among soccer-ball manufacturers in Pakistan. They argue that employees resist adoption of a new, more efficient technique due to fears that adoption will reduce their effective wages.

Management practices. Bloom et al. (2013) investigate firms' management practices by running a management field experiment with large, multi-plant textile firms in India. Firms in this study receive free consulting on management practices to a treatment group of firms and find that this intervention increases productivity by 17% in the first year. Annual profitability increased by over $300,000, and treatment firms grew faster and opened more production plants within three years.

Given these large positive impacts, why had firms not already adopted these practices? While in some cases firms were simply not aware of practices such as daily factory meetings, owners appeared to systematically underestimate the profitability of simple and known practices such measuring quality defects, machine downtime, and inventory. Importantly, despite these failures to adopt high-return management practices, control-group firms were not weeded out of the market. Competitive pressures, the authors argue, were restricted by high tariffs, credit constraints, and particularly by limited managerial time. As in DellaVigna and Gentzkow (2017), this paper provides evidence that failures of profit-maximization are not restricted to small firms.

A related paper by Bruhn et al. (2018) examines the impact of access to one year of management consulting services on the outcomes of small and medium enterprises in Mexico. The authors randomly assigned enterprises that applied to receive subsidized consulting services to either receive the subsidized services or not. The authors find that the consulting intervention increased owners' "entrepreneurial spirit" (an index that measures entrepreneurial confidence and goal setting) and had positive short-run impacts on productivity and profits.

While many of the studies described above mostly do not take a behavioral perspective, the evidence they provide for failures of profit-maximization is compelling. Given this evidence, and given the arguments we presented for why behavioral firms are more likely to exist in developing countries, we believe that studying firm decisions in developing countries could be a promising new agenda for behavioral economics. In addition to studying standard behavioral-economic topics such as loss aversion, biased beliefs, and inattention in a new high-stakes economic setting, such an agenda might uncover new and previously understudied biases in human decision-making.

Indeed, one could argue that development economics has led the way in pointing out the importance of behavioral firms, an area that may find an increasing number of applications also to firms in rich countries.

9 Social preferences, culture, and development

So far in this chapter, we have considered the implications of behavioral models while treating the models and even parameter values as universal. In the remaining two sec-

tions, however, we describe arguments and recent evidence for systematic differences in psychology across rich and poor countries, and across rich and poor individuals. Section 9 describes a literature studying differences in social preferences (such as trust and reciprocity) and culture across societies and then discusses its possible implications for development. Section 10 describes the new literature on the psychology of poverty.

These sections are more speculative, in part because the modern economics literature on these topics is newer. However, some of the ideas in Section 9 echo an older tradition of thought on economic development, which viewed development as a process involving important changes in social structure and in ways of thinking. We begin by briefly sketching a history of the views of human behavior implicit in thinking about development and growth.

9.1 History of views of human behavior in economic development

Historically, many social scientists, including classical economists, did not see humans as rational and purely self-interested actors. As behavioral economists enjoy pointing out, Adam Smith anticipated much of behavioral economics (Ashraf et al., 2005).[35]

Prior to the emergence of modern economics, a long history of thought argued that what we now see as the process of economic development involves fundamental changes in economic psychology. Modern economists assume that firms maximize profits and individuals maximize utility across history and across societies, but for many Marxist writers, the "icy water of egotistical calculation" is a feature of capitalism, not of pre-capitalist societies or of the human condition more broadly (Marx and Engels, 1848). Famously, Weber (1905) argued that modern capitalism and the pervasive role of rationality emerged historically in response to changes in ways of thinking induced by Protestantism.

Modernization theory, prominent in the 1950s, influenced by Weber and Durkheim, drew a distinction between "traditional" and "modern" societies, including differences between societies based on achievement versus societies based on birth; orientation towards the nuclear family versus extended kinship ties; individualism versus communal orientation; relations based on tradition and loyalty versus those based on rational exchange. Proponents of modernization theory thought that people in traditional societies are not necessarily motivated by the rational calculation of self-interest of their modern counterparts. The process of modernization was thought of as a process of dramatic change in social structures, but also in ways of thinking. For instance, McClelland (1961) emphasized the "need for achievement"

[35] In his *Theory of Moral Sentiments*, Smith argued that behavior was determined by the struggle between what Smith termed the "passions" and the "impartial spectator." The passions included drives, emotions, and motivational feeling. Smith viewed behavior as under the direct control of the passions but believed that people could override passion-driven behavior by viewing their own behavior from the perspective of an outsider—the impartial spectator (Ashraf et al., 2005).

as a psychological characteristic that was key to entrepreneurial activity and modernization, and Inkeles and Smith (1974) defined uniquely "modern" personality traits.

After the 1950s and 1960s, modernization theory fell out of favor. In economics, Schultz (1964) argued that those in developing countries are "poor but efficient".[36] In this view, *homo economicus* did not need to be created; he or she was there all along. Whereas development experts influenced by modernization theory may have seen farmers as irrationally clinging to outdated farming techniques because of an attachment to tradition and may have favored coercion or heavy subsidies to encourage adoption of new techniques, modern development economists began with the assumption that farmers knew what they were doing.

Economists studying growth and development also reacted against cultural explanations for differences in economic development across societies that seemed unfalsifiable and therefore unscientific in the cross section, and that later turned out to be false once a longer panel data emerged: India was thought to be stuck with a low "Hindu rate of growth" while China's development was said to be held back by Confucian traditions (as described in Acemoglu and Robinson, 2013).

In part as a reaction to this sort of claim, development economists perhaps went to the opposite extreme of presuming that people in developing countries (and elsewhere) are fully rational *homo economicus*. If Weber argued that farmers in traditional societies were irrational and stuck with traditional techniques even when this was not profitable, modern development economists responded by demonstrating that farmers changed their behavior in response to prices. Yet, such evidence is far from showing that farmers are fully rational or are quantitatively (and sometimes even qualitatively) well-described by standard neoclassical theory.

In the past two decades, with the rise of behavioral economics, the pendulum has begun to swing back towards a more psychologically-realistic view of human behavior in development economics. Development economists have increasingly incorporated systematic departures from pure rationality and self-interest while approaching substantive questions in development. Crucially, this approach has involved rigorous empirical tests of the underlying behavioral ideas. Perhaps the clearest sign of the new openness of development economics to ideas from behavioral economics was the publication in 2015 of the World Bank's flagship annual World Development Report, "*Mind, Society, and Behavior*", with the theme of behavioral development economics.

A key difference between behavioral development economics and the older modernization-theory literature, however, is that the behavioral economics literature has mostly focused on universal features of human behavior, rather than on variation across individuals or societies. Recent work in cultural economics and behavioral economics, however, has begun to explore variation across societies. The rest of this section describes this new literature.

[36] Modernization theory also fell out of favor in sociology, but for somewhat different reasons: it was criticized as conflating features of Western society with necessary requirements for development, and was subject to criticism with the rise of dependency theory.

9.2 Differences in social preferences across societies

Behavioral economists and psychologists have argued that in addition to being motivated by private consumption, people have numerous social and moral motives. For instance, they often care about others' outcomes, by being altruistic (placing a positive weight on others' utility) or envious (placing a negative weight on others' utility). Individuals care about the fairness of outcomes and processes, such as by preferring to split unearned money in a dictator game equally with a recipient. They care what others think of them, for both instrumental and hedonic reasons, and thus have social image motives. They care that others act fairly and mean well, and may incur a cost to punish others who misbehave or hurt them, an example of negative reciprocity. People also care about conforming to social norms regarding appropriate behavior and may internalize these norms such that they are influenced by them even in private.

The above broad set of frequently powerful motives have been termed *social preferences* in the behavioral economics literature. While these preferences may have evolved for functional reasons—for example, negative reciprocity may have evolved because it helps sustain cooperation in repeated interactions—the experimental economics literature suggests that these motives are now "hard-wired" and partly unconscious rather than being simply deliberate strategic behavior. For example, individuals share money with anonymous recipients in a dictator game, even in the absence of repeated interactions or any role for reputation effects.

We next discuss certain aspects of social preferences which may differ systematically across societies, and which have been argued to matter for economic development.

Trust and reciprocity. Trust can be broadly defined as willingness to cooperate with others. Conceptually, trust is a somewhat complex concept, involving both beliefs (particularly beliefs about whether the other party is trustworthy) as well as preferences (such as "warm glow" from the act of cooperating, and altruism towards the other party), and potentially norms towards appropriate behavior. Reciprocity is the tendency to reward someone who cooperated or was generous (positive reciprocity), and to punish someone who defected or behaved poorly (negative reciprocity). Both trust and reciprocity are considered key ingredients for generating cooperative behavior, especially in situations requiring cooperation with those outside one's immediate family or kin group (Henrich et al., 2010a).

Multiple pieces of evidence suggest that developing countries have lower levels of trust and reciprocity than rich countries.

First, cross-country survey evidence from sources such as the World Values Survey shows substantial variation across countries in levels of self-reported generalized trust in others. Generalized trust is trust towards other members of society (rather than trust towards close family or friends), including trust towards one's neighbors, co-ethnics, fellow citizens, and even trust in strangers and foreigners.[37] An influential

[37] In surveys, generalized trust is measured with questions such as "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?"

body of work shows that such measures of trust (and trustworthiness) are correlated with per-capita income and institutional features of countries: poorer countries and regions have lower levels of trust (e.g. LaPorta et al., 1997; Knack and Keefer, 1997; Tabellini, 2010).

Some economists view survey measures as unreliable and prefer incentivized or revealed-preference outcomes. An innovative early paper by a team of anthropologists and behavioral economists ran incentivized social-preference lab experiments in 15 small-scale societies across the world (Henrich et al., 2001). The authors report considerable variation across these societies in play in dictator games, ultimatum games, and public-goods games, although in each case outcomes deviate from self-interested choices without social preferences or fairness concerns. The author point to a correlation in their results between the degree of market integration (at the society level) and greater cooperation in experimental games.

More recently, using the Global Preference Survey (GPS), a dataset covering 80,000 respondents who constitute nationally-representative samples from 76 countries, Falk et al. (2018) find systematic differences across countries in measures of social preferences. Specifically, the authors find that developing countries have lower levels of both trust and reciprocity. However, variation within countries substantially exceeds variation between countries. Moreover, the measure of patience is more predictive of per-capita GDP than measures of trust and social preferences, and controlling for patience makes the coefficient on trust non-significant in a regression on per-capita GDP.[38]

It is worth noting that there need be nothing irrational about low levels of trust. To establish some failure of rationality, one would need to show, for example, systematically biased beliefs about how trustworthy others are, and separate this from differences in preferences. Differences in societies across trust could, for example, be driven by differences in history or institutions or could simply reflect multiple equilibria (e.g. Aghion et al., 2010, 2011; Alesina and Giuliano, 2015). We are not aware of systematic evidence on this question.

Moral attitudes. In addition to the standard notions of social preferences in behavioral economics such as altruism, fairness, reciprocity, and social image concerns, psychologists have in recent years expanded our understanding of *moral* preferences. Such authors point out that psychology has focused excessively on WEIRD—Western, Educated, Industrialized, Rich, Democratic—populations (Henrich et al., 2010b). In such populations, morality is conceptualized as being primarily about harm and fairness. Outside of these populations, for example, in developing countries, and in less-educated and lower-income populations in rich countries, moral attitudes are broader than these two principles (Haidt, 2012). These conceptions of morality include not only harm and fairness, but also deeply-held beliefs in moral ideals of loyalty to one's group, respect for authority, and purity or sanctity. Haidt

[38] As discussed in Section 2, some of the correlation between GDP and measured patience could be due to liquidity constraints affecting the measures of patience, even for hypothetical choices.

(2012) argues that these beliefs are extremely important to people and correlate with important political and social behaviors. The implications of these different moral frameworks for economic and political behavior are ripe for exploration.

Culture. A recent literature in economics takes an even broader view of cross-society variation in values, beliefs and social preferences. Guiso et al. (2006) define culture as "those customary beliefs and values that ethnic, religious, and social groups transmit fairly unchanged from generation to generation". Nunn (2012) instead defines culture as heuristics and rules of thumb that aid in decision making, with a role not just for values and beliefs, but also for emotions and "gut feelings".

Nunn (2012) summarizes the evidence on differences in culture across societies. One empirical strategy has been to compare individuals from different cultures brought into the same environment. For instance, Fernandez and Fogli (2009) show that the fertility and labor-force participation of second-generation US women is positively correlated with historical fertility and labor-force participation in their parents' country-of-origin. Fisman and Miguel (2007) study national variation in a culture of corruption by documenting differences in rates of unpaid parking tickets accumulated by diplomats from different countries who are all stationed in New York City.

Another strategy has been to conduct similar economic lab experiments across different societies, such as the work of Henrich et al. (2001) or Gneezy et al. (2009). More commonly, survey evidence has been used to document differences across countries in the stated importance to the respondent of family, the importance of children showing obedience and respect, the role of hard work versus luck in success, or the degree to which people prefer to be self-reliant versus integrating closely with a group (Alesina and Giuliano, 2015).

9.3 Do social preferences and culture matter for development?

Since at least the work of Banfield (1958), Coleman (1990), and Putnam (2000), social scientists have argued that trust plays a crucial role in generating desirable economic outcomes. More generally, achieving cooperation—including with strangers and in one-shot interactions—is often argued to be central to the process of development (Algan and Cahuc, 2014). In economics, an understanding of incomplete contracts and imperfect enforcement has led some scholars to agree. For instance, Arrow (1972) emphasized the importance of trust as follows: "virtually every commercial transaction has within itself an element of trust, certainly any transaction conducted over a period of time. It can be plausibly argued that much of the economic backwardness in the world can be explained by the lack of mutual confidence."

This idea is consistent with the cross-country correlations described above: trust and reciprocity are positively correlated with economic outcomes. However, one might worry that trust is simply a consequence of development. Poor countries tend to have worse contract enforcement and legal institutions, and thus it may simply be rational to distrust others more in poor countries. The process of development and growth might in turn strengthen state capacity and improve contract enforcement, thus increasing trust.

In recent years, some scholars of long-run growth and of cultural economics have argued that trust and related social attitudes are not only an outcome of development, but are instead (at least in part) deeper drivers of development themselves.[39]

One body of work provides evidence that modern-day trust and related concepts such as trustworthiness have deep historical roots. Nunn and Wantchekon (2011) show that current differences in trust levels within Africa can be traced back to the transatlantic and Indian Ocean slave trades, and that individuals who have ancestors from areas that were heavily raided through the slave trade show lower levels of trust in survey data. This evidence provides a potential mechanism to explain the large differences in modern-day development across the same regions of Africa (Nunn, 2008).

Other scholars have pointed to the importance of historical kindship structure in generating variation in modern-day culture. Enke (2018) shows that historical tightness of kinship structure predicts modern-day moral attitudes and social behaviors. Enke classifies societies by whether they historically had tighter kinship structures, in which people were deeply embedded in extended family networks, or conversely looser kinship structures, in which such extended family networks were less important. Groups which historically had tighter kinship have lower levels of trust, more in-group favoritism, higher willingness to cheat on and distrust outsiders, and more local rather than broader institutions today.

Schulz et al. (2018) argue that this psychological variation arose as a response to different institutions governing kinship, descent and marriage. They propose that the Catholic Church's policies led to the dissolution of traditional kinship institutions in Europe, creating the specific modern-day psychology specific to Western countries, including the increased importance of impartiality, universal moral principles, generalized trust, cooperation, and fairness.

The above evidence suggests that present-day levels of trust, social preferences and culture more broadly are not entirely determined by present-day outcomes, making a causal role for trust on development more plausible. Other work more directly attempts to link trust causally to economic outcomes. Algan and Cahuc (2010) use an ingenious approach to determine historical levels of trust in various countries. They examine trust levels in present-day individuals in the United States and, using variation in when the ancestors of those individuals first immigrated to the US, infer the levels of trust in the sending country at the time of immigration.

Algan and Cahuc (2010) make a key assumption, well-accepted in cultural economics, that present-day trust among individuals is correlated with the trust levels of their ancestors. Moreover, they assume that the nature of selection into migration by trust does not change substantially over time. The authors then relate the inferred level of trust in each sender country in a given year to income-per-capita in that country in that year and estimate substantial causal effects of trust on per-capita income.

[39] Recent reviews of this literature include Algan and Cahuc (2014), Spolaore and Wacziarg (2013) and Nunn (2012).

In subsequent work, Algan and Cahuc (2014) calculate that Africa would have a 5.5 times higher per-capita income if it had the same trust levels as Sweden (Algan and Cahuc, 2014).

Discussing the determinants and impact of ethnic diversity on economic, political and social outcomes is beyond the scope of this chapter, but it is worth noting that some studies using micro data suggest that, at least in some circumstances, there may be costs to diversity. Moreover, these costs may be context dependent and subject to policy influence.

Hjort (2014) examines how inter-group preferences can affect output. He collects data from a large flower farm in Kenya and shows that workers have strong social preferences featuring an in-group bias: they act to increase the payoffs of their co-ethnics relative to members of a rival ethnic group. Workers work in small teams of three, with one upstream worker and two downstream workers in each team. Hjort (2014) shows that upstream workers distort their effort and direct more of the intermediate goods they produce towards their co-ethnics downstream, resulting in both productivity losses of 4 to 8 percent and lower earnings even for themselves. These distortions worsen when ethnic divisions become more salient after electoral violence, until the firm finally reacts by adoption a team-pay scheme which eliminates incentives to discriminate. The paper thus also provides an illustration of how institutions (in this case, within-firm rules and incentives) can be adapted to reduce the distortions arising from ethnic preferences.

Ethnic diversity is also associated with worse local public goods. For instance, higher ethnic diversity is correlated with lower primary school funding and worse school facilities in Kenya (Miguel and Gugerty, 2005). The authors argue that diversity makes it more difficult to impose social sanctions, creating collective action failures. However, as discussed in Section 9.4 below, such effects are not found in Tanzania, a country with a history of policies designed to reduce ethnic conflict.

Not all the evidence suggests substantial individual-level ethnic prejudice. For instance, Berge et al. (2015) run lab experiments in a large sample of participants in Nairobi, Kenya, and find no evidence of ethnic favoritism in dictator games, public-goods games, and choose-your-dictator games, in which the participant can choose which other individual must decide how to share some money with them. Intriguingly, Berge et al. do find evidence of bias among recent movers to Nairobi, suggesting that living in a more cosmopolitan urban setting, with frequent interaction across ethnic groups, may have played some role in reducing ethnic preferences. In contrast to the overall null effects on behaviors, the authors detect a small amount of ethnic "bias" in Implicit Association Tests.[40] The incongruence in the findings on behaviors and implicit associations echoes with an ongoing debate in social psychology over whether IATs meaningfully predict real-world behaviors (Greenwald et al., 2009; Oswald et al., 2013).

[40] The Implicit Associate Test (IAT) is a test developed by social psychologists to measure the extent to which certain categories (such as race or gender) are associated with stereotypes, or with generally positive or negative valence (Greenwald et al., 1998).

Low levels of trust and the structure of in-group versus out-group preferences may also be related to several other important economic and political outcomes. For instance, some evidence suggests that levels of trust predict the structure of firms: higher trust in Italian regions predicts larger firm size and more decentralized decision-making (Cingano and Pinotti, 2012). Firms in Asia are substantially more centralized in terms of decision-making than firms in the United States or Europe and the extent of centralization is correlated with regional trust. (Bloom et al., 2012). Similarly, a sense of duty towards family and kin, and a lack of trust towards strangers may contribute to a culture of corruption and patronage in politics.

9.4 The impact of contact and policies on social preferences and norms

The previous discussion suggested that differences in social preferences and culture are driven at least in part by long-run historical factors. Should cultural differences and social trust or conversely social divisions therefore be thought of as fixed and immune to policy? Recent research suggests that at least some of these factors are malleable. Policy-relevant factors such as social contact, media exposure, and education can all affect social preferences.

Inter-group contact. A recent body of work in economics and psychology has provided rigorous tests of Allport's (1954) prediction that inter-group contact will (at least under certain favorable conditions) reduce social prejudice and improve social behavior.

Rao (2018) shows that the integration of rich and poor children in schools reduces social discrimination and increases willingness to socialize. Additionally, contact with poor children increases rich children's generosity towards others in both the lab (measuring using dictator games) and the field (volunteering for charities in school). Finally, it increases the strength of fairness preferences: rich students integrated with poor classmates become more inequity-averse in lab games. Corno et al. (2018) find similar reductions in racial prejudice using randomized roommate assignments of university students in South Africa, as do Boisjoly et al. (2006) in a university in the United States.

Lowe (2018) pushes this literature forward by investigating how the precise conditions under which contact occurs improve or instead worsen prejudice and mutually-beneficial economic transactions. He runs a field experiment involving a cricket league in villages in India and shows that cooperative contact (playing on the same team with members of a different caste) reduces caste prejudice in young men, while competitive contact (playing against others of a different caste) somewhat worsens attitudes. Cooperative contact also makes individuals more likely to engage in trade across caste lines and thus earn greater surplus in an innovative field task created by the author.

Okunogbe (2018) studies the consequences of mandatory national service in Nigeria, where college graduates are required to temporarily serve in other provinces in the country. She finds that inter-ethnic exposure causes individuals to have greater

national pride and more positive attitudes towards Nigeria, but simultaneously increases the salience of one's own ethnic identity, resulting in more positive attitudes towards one's own group (but not others). These results point to the need for a nuanced understanding of national identity and ethnic diversity: it is possible to build national identity without weakening ethnic identity, even in a diverse developing country.

Media. Exposure to media has been shown to be a powerful driver of change in social preferences and attitudes in developing countries. For instance, exposure to Rwandan government radio propaganda, which focused on post-genocide nation-building, decreased the salience of ethnicity and increased inter-ethnic trust (Blouin and Mukand, 2017). Most intriguingly, the authors show that individuals from treated locations become less likely to use ethnicity (Hutu versus Tutsi) to categorize individuals, suggesting that even the salience of ethnic categories is malleable and could be influenced by governments or private media. Of course, such effects cut both ways: the same media tools can effectively be used to worsen social attitudes, stoke distrust, and even incite violence (Yanagizawa-Drott, 2014).

Exposure to television has also been shown to change attitudes and behaviors. La Ferrara et al. (2012) find that telenovelas in Brazil reduce fertility for the exposed cohorts in regions with access to telenovelas. Similarly, Jensen and Oster (2009) show evidence that the arrival of cable television in villages in India changed stated gender attitudes and some measures of behavior.

In contrast to the evidence on the effects of radio and television, little rigorous evidence exists on the effect of the print media on social and economic attitudes. Similarly, the rapid adoption of social media using internet-enabled cellphones in developing countries offer another important topic for future research.

Education. Education is generally shown to be positively correlated with trust and measures of prosocial preferences (e.g. Falk et al., 2018). However, we have relatively little causal evidence on this topic. Miguel (2004) argues that Tanzanian "nation-building" policies, partly implemented through school curriculum, allowed ethnically diverse communities in rural Tanzania to achieve considerably better local public goods outcomes than diverse communities in the nearby Kenyan region without similar policies.

School curriculum changes in China have been shown to have substantially affected students' political attitudes, making them more skeptical of free markets and more supportive of Chinese governance (Cantoni et al., 2017). Algan et al. (2013) argued that horizontal teaching practices in school—wherein students work together in groups—builds social capital. Rao (2018) similarly showed that direct personal interactions between students, caused by quasi-random assignment of students to study groups, reduced discriminatory behavior towards outgroup-members even outside the classroom. Further evidence on how education affects in-group preference and moral and social preferences is a promising area for future research.

This section has described the evidence on cross-society differences in social preferences and other aspect of culture. It has pointed to both evidence that variation in culture has deep historical roots, but also that social preferences, beliefs and values

are at least somewhat malleable at the individual level and respond to a variety of interventions.

10 The psychology of poverty

A recent body of work suggests that living in poverty may *directly* affect cognitive function and economic behaviors, thus potentially exacerbating behavioral biases and deepening poverty (Haushofer and Fehr, 2014; Schilbach et al., 2016). In this section, we discuss the emerging literature on the psychology of poverty and point to both its promises and its present shortcomings.

10.1 Scarcity

In an influential book, Mullainathan and Shafir (2013) argue that poverty impedes cognitive function by capturing people's minds with thoughts of scarcity. At any point in time, a poor person may worry about paying their rent, their children's school fees, cellphone bills, or an adverse health shock with the potential to cause financial ruin. Everyday events such as seeing the doctor or buying groceries are also more likely to trigger thoughts about money or cost among the poor (Shah et al., 2018).

One might expect this increased focus to result in better decision-making. Models of rational inattention would predict that when the stakes are higher, which they often are for the poor, individuals will pay more attention and thus make better choices. There is some evidence in support of this theory. The poor have higher awareness of certain prices (Mullainathan and Shafir, 2013), and they pay more attention than the rich to sales taxes (Goldin and Homonoff, 2013). They also display more consistent valuations of goods across contexts, making them less likely to display biases such as proportional thinking in money (Shah et al., 2015).[41]

However, according to Mullainathan and Shafir (2013), while some of this attention is intentional and productive, much of it is not. Since cognitive capacity is limited and money-related thoughts take up some of this valuable capacity, mental "bandwidth" available for other tasks is reduced. As a result, they argue, poverty itself impedes cognitive function among the poor, degrading also the quality of decision-making and lowering productivity.

[41] Shah et al. (2015) provide examples in which lower-income individuals hew more closely to a rational model than the rich do. For instance, the poor appear to engage less in proportional thinking (Tversky and Kahneman, 1981): they report being equally willing to travel 30 minutes to save $50 off a purchase, regardless of whether the item they are purchasing costs $300, $500, or $1000. In contrast, high-income consumers are more willing to spend 30 minutes to save $50 on a $300 purchase than on a $1000 purchase, a classic finding in behavioral economics (Thaler, 1985). The poor also express the same willingness to pay for an item across contexts, unlike the rich. Specifically, their WTP for a beer to be consumed on a beach is the same whether the beer was purchased from a hotel or a store, while higher-income consumers report being willing to pay more for the same beer from a hotel.

Mani et al. (2013) provide empirical evidence in support of this hypothesis. Their study features two complementary designs: a "lab study" in a mall in Trenton, NJ, and a field study with farmers in India. The lab study induces thoughts about finances by making individuals consider a financial scenario and then measures cognitive function using tasks developed by psychologists to measure fluid intelligence (IQ) and cognitive control. Results from four different trials show a subtle but highly intriguing picture. Performance by rich individuals, defined as those higher than median income in the sample, is unaffected by whether the financial scenario concerns involve large or small amounts of money. In contrast, when asked about the high-amount scenario, the poor perform significantly worse compared to being asked about the low-amount scenario, suggesting that induced thoughts about money lowered their cognitive function.

The complementary field study in Mani et al. (2013) cleverly exploits within-person variation in financial status before and after harvest among sugarcane farmers rural India. The harvest cycle for sugarcane, a cash crop, is about 18 months and farmers have trouble evenly spreading the resources received at harvest over the entire cycle, possibly due to present bias. Consequently, farmers are significantly poorer in the months before harvest compared to the months after harvest, as reflected in belongings pawned, outstanding loans, and reported ability to cope with ordinary bills. Farmers' cognitive performance right before harvest is significantly worse compared to their performance right after harvest. The authors provide evidence against competing channels such as nutrition or uncertainty and conclude that poverty itself impedes cognitive function.

The results in Mani et al. are striking and important for several reasons. First, the estimated effects are enormous. While the effect sizes in the lab study are difficult to interpret, the authors argue that the differences in the field study correspond to differences of about 10 IQ points, comparable to the impacts of losing a night of sleep or being moderately inebriated. Lower cognitive performance is known to be correlated with lower levels of patience and willingness to accept risk (Dohmen et al., 2010), worse job performance (Kuncel and Hezlett, 2010) and even higher mortality (Batty et al., 2009). If these effects translate causally into worse real-world decisions and behaviors, they could help explain puzzling behaviors among the poor, such as evidence of lower parenting effort, lower medication adherence, and food-consumption patterns. If such effects indeed exist, they may make an additional case for the effectiveness of unconditional cash transfers, reducing hassles among the poor, or subsidizing insurance to facilitate peace of mind.

There is also some, albeit disputed, inconsistently measured and hard-to-interpret evidence of differences in cognitive ability across the rich and poor, and even across rich and poor countries (Ervik, 2003; Palairet, 2004). Previous explanations of such differences include differences in childhood nutrition (such as iodine supplements in diet), education, and other omitted variables.

In contrast, Mullainathan and Shafir (2013) offer a new perspective: poverty itself may lower cognitive function. In fact, in the mall study of Mani et al. (2013), described above, the cognitive performance of the rich and the poor was indistin-

guishable from each other in the absence of the financially-stressful question. The argument is thus not one of fixed differences across individuals, but of the importance of the situation of poverty. This echoes the long-running debate in psychology between social psychology, which argues that variation in human behavior is overwhelmingly driven by variation in the situation or context (Ross and Nisbett, 1991; Bertrand et al., 2004), and personality psychology, which argues that stable individual differences in personality traits explain a great deal of variation in behavior (e.g. Borghans et al., 2008).

However, important gaps and shortcomings in this promising research agenda remain. First, the existing studies have understandable methodological limitations. For instance, the field study of Mani et al. is a simple pre-post comparison without a control group, which raises the question of potential learning effects or time trends explaining the results. Second, to the best of our knowledge, neither of the two studies appears to have been replicated. In a related setting, Carvalho et al. (2016) find no differences in cognitive function and decision-making around paydays in the US, though this finding may be in explained by the smaller differences in financial hardship before and after payday in their sample relative to those among farmers in India.

Third, to date, little evidence exists of impacts on economic outcomes such as productivity, preferences, or decision-making. Ong et al. (2018) analyze the impacts of a debt-relief program among low-income individuals in Singapore. While the authors find intriguing impacts on a range of cognitive and economic outcomes, the study does not feature a control group, causing identification concerns similar to the ones regarding Mani et al.'s (2013) field evidence. Bartos et al. (2018) measure the impact of poverty on time preferences. Experimentally-induced thoughts about poverty increased Ugandan farmers' impatience, as measured by their preference to consume entertainment early and instead to delay work effort.

Kaur et al. (2018) consider the impact of poverty on productivity in a field experiment with low-income piece rate workers in rural India. The authors randomly vary the timing of wage payments to workers—generating variation in the timing of cash receipt while holding overall income fixed—with the payment amount corresponding to about 2 to 3 weeks' worth of baseline earnings. Since workers are severely cash-constrained at baseline, receiving early payments significantly alters workers' expenditure patterns following the days of the payment. Workers reduce debt overhang and increase food purchases.

The authors interpret the early-pay intervention as changing the experienced financial constraints among study participants. Upon receiving their early pay, workers significantly increase their hourly output compared to the control group, with effects concentrated among poorer workers. Kaur et al. (2018) find evidence of decreased attentional errors in production, suggesting improved cognition as a contributing channel for the productivity effects. The authors argue that the impacts are not driven by gift exchange, trust in the employer, affect, or nutrition. The results provide evidence that the alleviation of experienced financial constraints may have a direct link with productivity and offer suggestive support for cognition as a channel.

The effects of scarcity are most likely to translate into important real-world outcomes if people are not self-aware of such effects. Individuals in both of Mani et al.'s (2013) studies were not given a choice as to when to perform the cognitive tasks. Individuals who understand the impacts of scarcity on their decision-making might choose to make important decisions at times when they are cash-rich and thus to mitigate the impacts of scarcity. To date, there is no evidence of people's (lack of) awareness of the impacts of scarcity on their cognitive function. In an experimental study on the impact of noise on cognitive function and productivity, Dean (2018) finds near-complete naïveté regarding impairments of cognitive function and worker productivity due to noise.

10.2 Deprivations beyond lack of money

Poverty entails many other deprivations and potentially detrimental situations beyond lack of money (Schilbach et al., 2016). Perhaps most well-known among these and well-studied in the development literature, the poor are often affected by malnutrition (FAO, 2018). Another recent literature has documented that poverty and negative income shocks are associated with higher levels of stress (Haushofer and Fehr, 2014), although evidence on the effects of stress on economic decision-making is mixed at best (Haushofer et al., 2018).

However, the urban poor are also disproportionately exposed to poor sleeping conditions (Grandner et al., 2010; Patel et al., 2010) as well as environmental and noise pollution and heat (Harlan et al., 2006; Dean et al., 2018). Physical labor, lack of education and limited access to medical care also lead to higher prevalence of physical pain among the poor (Krueger and Stone, 2008; Poleshuck and Green, 2008; Case and Deaton, 2015). While rigorous evidence on the underlying causal relationships is scarce, poverty has also been associated with hazardous alcohol consumption patterns and other forms of substance abuse (Neufeld et al., 2005; Subramanian et al., 2005; Patel, 2007). Moreover, poverty often entails stigma, shame, and social exclusion, which could all affect cognition and decision-making (Hall et al., 2014; Ghosal et al., 2017; Chandrasekhar et al., 2018).

For each of these factors, a rich literature in psychology, medicine, and other fields has studied and often established impacts on cognitive function, decision-making, and health, mostly via experimental lab studies and observational data, as summarized in Dean et al. (2018). A key open question is whether the known impacts on cognition and health translate into economically meaningful effects on productivity, labor supply, and decision-making. A second line of research is whether these factors can *cause* behavioral biases. Behavioral economics to date has primarily shown the existence and relevance of behavioral biases, mostly focusing on average parameter estimates, for instance, the fraction of present-biased individuals and the average degree of present bias among those individuals. Uncovering some of the underlying sources of behavioral biases could help to identify some of the determinants of variation across individuals and over time. Since the poor are disproportionately exposed by these factors, they could lead to more pronounced behavioral biases among the poor.

Recently completed and ongoing work has attempted to make inroads into each of these two lines of research. Studies have found significant impacts of noise, environmental pollution, nutrition on worker learning, productivity, and earnings (Schofield, 2014; Chang et al., 2018; Dean, 2018; Jagnani, 2018). Many of the poor are exposed to several of these factors, such that impacts on productivity and earning might well add up to economically large magnitudes. There could also be important interaction effects between these factors that are yet to be explored.

There is less evidence on the impacts of factors surrounding poverty on preferences and decision-making. Schofield (2014) finds evidence of increased nutrition on effort discounting among low-income workers in India. Sleep deprivation appears to make individuals less altruistic, trusting and trustworthy (Dickinson and McElroy, 2017). Similarly, Koppel et al. (2017) find that acute pain makes individuals less patient and more risk-seeking. Finally, Schilbach (2019) finds that incentives for sobriety significantly increased savings among low-income drivers in India, particularly among individuals without access to commitment savings. Additional evidence linking the above factors to preferences and decision-making would be valuable.

In an ongoing study, Bessone et al. (2018) study the impacts of improving sleeping conditions among the urban poor in Chennai, India. They find that study participants sleep on average under 5.5 hours per night, implying severe chronic sleep deprivation, in part due to environmental irritants such as heat, noise, mosquitoes, and physical discomfort. The authors evaluate different randomized interventions (such as improving individuals' home sleep environment and offering them a place to nap at the workplace) to investigate the impacts of improved sleep on labor market outcomes as well as behavioral biases and preferences (time, risk, and social preferences, susceptibility to defaults, and inattention).

10.3 Mental health

There is mixed evidence on the relationship between poverty and mental ill-health. On the one hand, income and consumption measures do not appear to strongly correlate with mental health, even when mental health is itself measured in representative surveys, such that differential rates of diagnosis are not a factor (Das et al., 2007). However, other measures and aspects of poverty, such as food insecurity, lack of education, poor housing, and self-reported financial stress are associated with mental ill-health in numerous epidemiological studies (Patel and Kleinman, 2003; Lund et al., 2010).

Regardless of the income gradients of mental health, the prevalence of mental health conditions in developing countries is high and is paired with extremely low levels of diagnosis and treatment options, especially for the poor. For instance, India has only about 0.3 psychiatrists per 100,000 individuals (3,600 psychiatrists to serve a population of 1.2 billion), compared to 12.4 per 100,000 individuals in the United States. In addition to inadequate care, mental ill-health is often associated with stigma, exclusion, and shame, further reducing the propensity to seek mental health care in times of need.

Major Depressive Disorder ("depression") is the single leading cause of disability worldwide (Friedrich, 2017). At a global level, over 300 million people are estimated to suffer from depression, equivalent to 4.4% of the world's population. Scholars in global mental health have shown that simple psychotherapy interventions can be effective in treating depression in low-income contexts (Bolton et al., 2003). These methods usually involve trained laypeople delivering psychotherapy as volunteers. Patel et al. (2017) use a community health approach to psychotherapy in Goa, India. A short-run evaluation of a behavioral-activation treatment delivered by lay counselors showed high effectiveness in reducing depression incidence and symptom severity three months after the end of the intervention.

Baranov et al. (2017) show impacts of a similar intervention, delivered by community health workers, on depression and female empowerment seven years after the end of the treatment. While these results are encouraging, it is too early to tell whether low-cost psychotherapy is a scalable and effective way to improve mental health in developing countries. Numerous other trials are in the field, including evaluations of therapy provided over cellphones and using text-messaging (Fairburn and Patel, 2017).

Psychotherapies have been employed to support individuals in other ways than alleviating depression. Two trials have recently been completed in developing countries. Blattman et al. (2017) evaluate the impact of a cognitive-behavioral therapy (CBT) intervention and the distribution of unconditional cash transfers on the behavior of high-risk young men in Liberia. The authors find reduced criminal behavior and improved self-control and self-image among participants. McKelway (2018) evaluates a four-week psycho-social intervention to improve generalized self-efficacy and found large impacts on female labor supply (as discussed in more detail in Section 7.5).

Suicide is a particularly severe consequence of mental ill-health and one of the leading causes of death for individuals suffering from severe mental ill-health (Hawton et al., 2013). Suicides cause 800,000 deaths annually, with about three-quarters of these deaths occurring in developing countries. Stress, mental illness, and depression have been identified as major causes of suicides (Mann et al., 1999; Boldrini and Mann, 2015). While economic conditions have been linked to each of these factors, few studies have been able to provide a direct link between economic wellbeing and suicides. Using a difference-in-differences approach in Indonesia, Christian et al. (2018) find that cash transfers reduced yearly suicides by 0.36 per 100,000 people, corresponding to an 18 percent decrease.

While we have learned much about mental health and the impact of psychotherapies, many open questions remain. A high priority for future research is to better understand the underlying mechanisms. How does depression affect preferences, beliefs, and decision-making? More generally, how should economists model de-

pression?[42] As a first step toward better understanding these questions, a follow-up evaluation of Patel et al. (2017) is underway, which will investigate the medium-run effects of this intervention on depression, earnings and consumption (de Quidt et al., 2018). Specifically, the study seeks to shed light on the underlying channels of potential treatment effects, by measuring individuals' risk, social, and time preferences as well as beliefs in one's own ability and information processing.

Numerous questions remain for future investigation. How does the effectiveness of mental health treatments interact with cash payments or available economic opportunities (e.g. job offers)? Existing evidence shows cash transfers can improve wellbeing and mental health (Haushofer and Shapiro, 2016). But do such effects persist over a longer time horizon? Can we better understand determinants of entry into and exit from depression? Do cash transfers and/or mental health interventions have intergenerational effects on children's mental health? What is the relationship between physical pain, mental health and substance abuse? These and many questions remain to be explored in future research on this topic.

10.4 Aspirations, hope, and religiosity

We now turn to positive psychological factors, particularly hope and aspirations, which may be helpful in generating better economic outcomes and psychological well-being among the poor. We also discuss suggestive evidence on how religious beliefs and practices may, at least in some cases, provide similar benefits.

Aspirations and hope. Development economists have investigated the role of aspirations and hope in the lives of the poor at least since Sen (1985, 1999). Appadurai (2004) proposed that 'aspirations to the good life' are not evenly distributed in society, with lower capacity to aspire among the poor—not because of any fundamental cognitive differences, but simply due to a lack of opportunity to practice the 'exploration, conjecture and refutation' of possible futures. Low levels of aspirations and hope in turn can limit social mobility and even create a poverty trap (Ray, 2006; Dalton et al., 2015; Genicot and Ray, 2017).

An important challenge in this literature is the definition and modeling of aspirations. Aspirations are broadly a hope or ambition of achieving something.[43] While such broad definitions are useful and intuitive, it has proven difficult to map aspirations into existing economic frameworks. Aspirations are conceptually distinct from both beliefs about the future and preferences for outcomes. Endogenous reference points might come closest to existing theories in behavioral economics. In recent years, models of aspirations and hope as reference points have made progress in this direction (Dalton et al., 2015; Genicot and Ray, 2017; Lybbert and Wydick, 2018). They are also closely related to existing models of goals

[42] One approach is provided by de Quidt and Haushofer (2016), who model depression essentially as having low beliefs about returns to effort. They show how this simple assumption can rationalize several behaviors associated with depression.

[43] For excellent discussions of the recent literature, see La Ferrara (2018) and Duflo (2012a).

as endogenously set references point, useful to motivate one's effort when facing self-control problems (Hsiaw, 2013).

Dalton et al. (2015) propose a model of aspirations as reference points, wherein aspirations influence effort choices, and effort produces future wealth. Future wealth in turn causes aspirations to adjust, potentially producing a virtuous cycle. A key assumption is that individuals do not realize how their future aspirations will be affected by their current effort levels. That is, they do not internalize the future motivating or demotivating effects of their present effort choice. Since the authors additionally (reasonably) assume that poor individuals need to exert greater effort to reach the same final wealth level, the model can generate poverty traps: even if they start with the same aspirations, poor individuals will exert less effort, which will cause their future aspirations to become lower, further reducing effort, and so on.

Genicot and Ray (2017) provide another model of aspirations as reference points. In their model, parents have aspirations for children's future wealth levels. Parents receive a utility boost proportional to the extent to which their children exceed their parents' aspirations, creating a kink in the utility function akin to models of reference dependence. Aspirations in their model are not (necessarily) rational expectations or status-quo levels, but instead may depend upon the distribution of outcomes in society. Aspirations moderately above the individual's present level provide incentives to invest, while avoiding frustration.

A key empirical question in this literature is whether aspirations are malleable and how different policies might be able to affect them. Bernard et al. (2014) consider the impact of exposing individuals to documentaries showing similar individuals from their community who managed to escape poverty through their own efforts in agriculture or business. The authors find remarkably large five-year impacts on aspirations as well as investments in education, livestock, and agricultural inputs. More research in this area is underway, with the goal to confirm and expand upon these striking and surprising impacts from such a light-touch intervention.

Aspirations for one's children could be particularly important for economic development and poverty alleviation. Beaman et al. (2012) show that role models are an important aspect in shaping individuals' aspirations. The authors find that Indian parents are less ambitious for the education and careers of their daughters than their sons. However, random exposure to female politicians at the local level (due to a reservation policy in India) sharply reduced this gender gap in aspirations as well as actual educational achievement among teenage girls.

An open question is whether improving economic outcomes via cash transfers or broader programs such as the ultra-poor program fosters higher aspirations. While Banerjee et al. (2015b) do not report findings regarding aspirations in their six-country evaluation of the multi-faceted "graduation program", Sulaiman and Barua (2013) report that changing aspirations is often cited by the implementers as the

most important challenge in the ultra-poor graduation program in the context of Afghanistan. [44]

Religiosity. The poor often spend considerable time and money on festivals, funeral, pilgrimages, and other religious activities (Banerjee and Duflo, 2007). Such activities may foster social cohesion and trust in societies (Clingingsmith et al., 2009). Moreover, work going back to Adam Smith and Max Weber argues that religiosity (specifically, the Protestant faith) causes economic wellbeing by fostering diligence, thriftiness, and norms prescribing virtuous behavior (Iannaccone, 1998; Iyer, 2016). Religiosity has been linked to many aspects of lives that are favorable for individuals' economic wellbeing including human capital formation, income, savings, and health (Freeman, 1986; Gruber, 2005; Ellison, 1991; Gruber and Hungerman, 2008).[45]

Despite these prominent arguments for the importance of religion and specific religious traditions for economic activity, rigorously establishing causal relationships between contemporaneous religious practices and beliefs, income, and wealth has been difficult due to obvious identification challenges, particularly at the individual level. Moreover, research on the economic and psychological consequences of religiosity we described above mostly focuses on various denominations of Christianity. Given the diversity of religious traditions in the developing world, a potentially important research agenda in behavioral development economics is to consider a wider range of religions and contexts and their implications for the lives of the poor.

Bryan et al. (2018) make progress toward improving our understanding of the causal impacts of religiosity by randomizing exposure to religion in the Philippines. They randomly assign over 6,000 poor households in 160 communities in the Philippines to receive invitations to attend an evangelical Protestant Christian values-and-theology education program consisting of 15 weekly half-hour sessions. This treatment significantly increases both religiosity and income. Puzzlingly, the authors detect no effect on either total labor supply, assets, or consumption, begging the question of where the increase in income comes from and how they are spent. A partial answer could be a shift from agricultural to non-agricultural self-employment, which may involve a higher implicit wage.

Beyond impacts on human capital, earnings, and wealth, religion could influence individuals' hope and aspirations, as well as their expectations about the future. As discussed in Section 5 on insurance, beliefs in higher, interventionist powers could crowd out demand for formal or informal insurance (Auriol et al., 2018). Such beliefs

[44] Related evidence is provided by Laajaj (2017), who shows that an intervention providing input subsidies and a savings match to farmers in Mozambique increases their self-reported planning horizons. The author provides a model in which the agent's planning horizon is endogeneously determined by how bright their future prospects appear. The idea is that a gloomy future causes distress due to anticipatory utility, and the agent responds by avoiding thinking about the future, worsening planning and reducing long-term investments.

[45] Bryan et al. (2018) provide a more thorough review of this literature.

could also foster individuals' hopes and aspirations, and even boost mental health, as argued in a contentious literature going back as far as Freud (Levin, 2010).

Cooley Fruehwirth et al. (2019) consider the possibility that religiosity directly impacts depression. To address endogeneity concerns, the authors exploit across-cohort variation in the religiosity of students' peers at school. They report that increased exposure to religious peers among US adolescents increased own religiosity and lowered depression. The authors provide evidence that the mechanism through which religiosity protects against depression is not by strengthening friendships or increasing social activities. Instead, they argue, religiosity increases psychological resilience and ability to deal with stressors. While this evidence is intriguing and important, identification concerns remain, and more work along these lines would be valuable.

11 Conclusion

In this chapter, we discussed canonical topics in development economics through the lens of behavioral economics. We argued that models and ideas from behavioral economics can help explain important puzzles in development, and have applications to understanding preventive health behavior, savings, demand for insurance, technology adoption, labor markets and firms. We also discussed evidence of variation in social preferences and culture across societies, and of the relationship between poverty and psychology.

We have not discussed several important topics in development, due to limited existing work on these topics in behavioral development. One such topic is education. As an investment good, education may be particularly subject to behavioral biases if children and youth themselves have substantial agency over educational investments (Bursztyn and Coffman, 2012). Existing evidence suggests that the time preferences of students may be malleable and important (Alan and Ertac, 2018; Alan et al., 2018) and that students may have systematically biased beliefs about the returns to education (Jensen, 2010). Another under-explored topic for behavioral development could be the economics of the family. Social preferences and norms within the household could matter for consumption and investment decisions, as could biased beliefs. For instance, Dizon-Ross (2018) shows that parents do not fully understand their children's (relative) ability and returns to education. Another topic we have only touched on in passing is the political economy of development, where social preferences, biased beliefs and norms may all be important (e.g. Finan and Schechter, 2012; Chen and Yang, 2018). We believe that these are equally important areas for future work in behavioral development economics as those we have covered in this chapter.

While policy design is not the focus of our paper, we have discussed some cases of success of behaviorally-informed solutions, for instance, the use of small incentives to encourage desirable health behaviors, and the use of mental accounts to direct savings. In other cases, the solutions proposed by behavioral economics are yet to show reliable impacts on outcomes, for instance, in the case of commitment devices to ad-

dress self-control problems. Yet other interventions show promising initial evidence, but with much more investigation warranted, as in the case of psychotherapies to improve mental health and economic outcomes.

We close by encouraging researchers in behavioral development economics to take behavioral theory seriously and ideally quantitatively, providing calibrations or estimations where possible (DellaVigna, 2018). This approach entails designing experiments to more precisely identify specific behavioral mechanisms and to test for them (Ludwig et al., 2011).

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