CENEX-FALE UFMG – EXAME DE PROFICIÊNCIA EM INGLÊS PARA PROCESSOS SELETIVOS DE PROGRAMAS DE PÓS-GRADUAÇÃO

ÁREA 2 – CIÊNCIAS EXATAS E DA TERRA, ENGENHARIAS

NBER WORKING PAPER SERIES NUDGING FARMERS TO USE FERTILIZER: THEORY AND EXPERIMENTAL EVIDENCE FROM KENYA

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"The rest of the world is fed because of the use of good seed and inorganic fertilizer, full stop. This technology has not been used in most of Africa. The only way you can help farmers get access to it is give it away free or subsidize it heavily."
Stephen Carr, former World Bank specialist on Sub-Saharan African agriculture, quoted in Dugger, 2007.

Many agricultural experts see the use of modern inputs, in particular fertilizer, as the key to agricultural productivity. Pointing to the strong relationship between fertilizer use and yields in test plots, they argue that fertilizer generates high returns and that dramatic growth in agricultural yields in Asia and the stagnation of yields in Africa can largely be explained by increased fertilizer use in Asia and continued low use in Africa (Morris, Kelly, Kopicki, and Byerlee, 2007). Based on this logic, Ellis (1992) and Sachs (2004) argue for fertilizer subsidies. Many governments have heavily subsidized fertilizer. In India, for example, fertilizer subsidies amounted to 0.75 percent of GDP in 1999–2000 (Gulati and Narayanan, 2003). In Zambia, fertilizer subsidies consume almost 2 percent of the government's budget (World Development Report, 2008).

In contrast, the Chicago tradition associated with Schultz (1964) starts with the presumption that farmers are rational profit maximizers, so subsidies will distort fertilizer use away from optimal levels. Others have argued that fertilizer subsidies create large costs beyond these Harberger triangles. They are typically regressive as wealthier farmers and those with more land often benefit most from subsidies (Donovan, 2004), and loans for fertilizer often go to the politically connected and have low repayment rates. Moreover, while moderate fertilizer use is environmentally appropriate, overuse of fertilizer induced by subsidies can cause environmental damage (World Bank, 2007). Furthermore, fertilizer subsidies may lead to government involvement in fertilizer distribution, politicization, and very costly failures to supply the right kind of fertilizer at the right time.

Partly due to the dominance of the anti-subsidy view among economists and international financial institutions, fertilizer subsidies have been rolled back in recent decades. Recently, however, they have seen a resurgence. For example, after Malawi's removal of fertilizer subsidies was followed by a famine, the country reinstated a two-thirds subsidy on

fertilizer. This was followed by an agricultural boom which many, including Jeffrey Sachs, attribute to the restoration of the fertilizer subsidies (Dugger, 2007).

A key assumption in the Chicago tradition case against fertilizer subsidies is that farmers would use the privately optimal quantity of fertilizer without subsidies. To reconcile low fertilizer use with the large increases in yield from fertilizer use found in agricultural research stations, economists often note that conditions on these stations differ from those on real-world farms, and returns may be much lower in real conditions, where farmers cannot use other inputs optimally. There is evidence that fertilizer is complementary with improved seed, irrigation, greater attention to weeding, and other changes in agricultural practice that farmers may have difficulty in implementing. However, in previous work we implemented a series of trials with farmers on their own farms in a region of Western Kenya where fertilizer use is low. Those trials showed that when fertilizer is used in limited quantities, it generates returns of 36 percent over a season on average, which translates to 70 percent on an annualized basis (Duflo, Kremer, and Robinson, 2008), even without other changes in agricultural practices. Low investment rates in the face of such high returns are particularly puzzling since fertilizer is well-known and long-used in the area. Moreover, since fertilizer is divisible, standard theory would not predict credit constraints would lead to low investment traps in this context.[1] There could of course be fixed costs in buying or learning to use fertilizer (for example, making a trip to the store). Indeed, small fixed costs of this type will play an important role in our model. However, such costs would have to be implausibly large to justify the lack of fertilizer investment in the standard model.[2]

In this paper we argue that just as behavioral biases limit investment in attractive financial investments in pension plans by workers in the United States (e.g., Choi, Laibson and Madrian, 2008), they may limit profitable investments in fertilizer by farmers in developing countries. We set out a simple model of biases in farmer decision-making inspired by models of procrastination from the psychology and economics literature (see O'Donoghue and Rabin, 1999). In the model some farmers are (stochastically) present-biased and at least partially naïve, systematically underestimating the odds that they will be impatient in the future, at least in the case when they are patient today. Going to the store, buying fertilizer, and perhaps deciding what type of fertilizer to use and how much to buy, involves a utility cost. Even if this cost is small, so long as farmers discount future utility, even farmers who plan to use fertilizer will choose to defer incurring the cost until the last moment possible, if they expect to still be willing to purchase the fertilizer later. However, farmers who end up being impatient in the last period in which buying is possible will then fail to invest in fertilizer altogether.

Under the model, heavy subsidies could induce fertilizer use by stochastically hyperbolic farmers, but they also could lead to overuse by farmers without time consistency problems. The model implies that if offered just after harvest (when farmers have money) small, time-limited discounts on fertilizer could induce sizeable changes in fertilizer use. In particular, early discounts of the same order of magnitude as the psychic costs associated with fertilizer purchase can induce the same increase in fertilizer use as much larger discounts of the order of magnitude of the out-of-pocket costs of fertilizer later in the season. Moreover, ex ante (before the harvest) some farmers would choose to be eligible for the discount early on, so as to have an option to commit to fertilizer use.

In collaboration with International Child Support (Kenya) a non-government organization (NGO), we designed and tested a program based on these predictions. Using a randomized design, we compared the program to alternative interventions, such as standard fertilizer subsidies or reminders to use fertilizer. The results are consistent with the model. Specifically, offering free delivery to farmers early in the season increases fertilizer use by 46 to 60 percent. This effect is greater than that of offering free delivery, even with a 50 percent subsidy on fertilizer, later in the season.

Following an approach similar to O'Donoghue and Rabin (2006), we use the model to analyze the impact of different policies depending on the distribution of patient, impatient, and stochastically present-biased farmers. Calibrations based on our empirical results suggest that 71 percent of farmers are stochastically present-biased, 16 percent are always patient, and 13 percent are always impatient. This yields a prediction that roughly 55 percent of farmers should

never use fertilizer in the three seasons we follow them. Empirically, 52 percent of comparison farmers do not use fertilizer in any of the three seasons for which we have data. The calibrated model matches other moments in the data, in particular the proportion of farmers who take up fertilizer when given the choice of which date they would like to be offered free fertilizer delivery.

The calibration suggests that a “paternalistic libertarian” (Thaler and Sunstein, 2008) approach of small, time-limited discounts could yield higher welfare than either laissez faire policies or heavy subsidies, by helping stochastically hyperbolic farmers commit themselves to invest in fertilizer while avoiding large distortions in fertilizer use among time-consistent farmers, and the fiscal costs of heavy subsidies.

The rest of the paper is structured as follows: Section 2 presents background information on agriculture and fertilizer in Western Kenya. Section 3 presents the model and derives testable predictions. Sections 4 lays out the program used to test the model; Section 5 reports results, and Section 6 calibrates the model and then uses the calibrated model to compare welfare under laissez faire, heavy subsidies, and small time-limited subsidies. Section 7 examines alternative hypotheses, and Section 8 concludes with a discussion of the potential for realistically scaling up small, time-limited subsidies in a way that would not involve excessive administrative costs.

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Questões

1. O que dizem muitos peritos em agricultura ao apontar a forte relação entre o uso de fertilizante e rendimentos em parcelas de teste? (sugestão: 4 linhas)

2. O que aconteceu com os subsídios a fertilizante nas últimas décadas e o que a experiência de Malávi exemplifica? (sugestão: 5 linhas)

3. O que mostraram os autores em trabalho anterior com fazendeiros na região do Quênia Ocidental? (sugestão: 5 linhas)

4. Como foi desenhado o teste aplicado pelos autores em colaboração com a *International Child Support* e quais foram os resultados? (sugestão: 5 linhas)

5. O que sugere a calibração no modelo? (sugestão: 5 linhas)